GEOSPATIAL
HALL of FAME

THE LEGENDS OF GEOSPATIAL INDUSTRY

A GEOSPATIAL MEDIA & COMMUNICATIONS INITIATIVE

These are the legends of our industry. The pioneers whose passion, vision, knowledge, leadership, and business acumen have brought our community closer to the core of human lives and endeavors. Each of these individuals represent the uniqueness, the innovativeness and the diversity of the geospatial industry, which have become vital to every business and individual today. In a world where location is becoming fundamental to all decision making, these individuals have not only taken our industry to new heights, but in the process have also touched the common man who doesn't even know what 'geospatial' means!

We are inspired by their infinite urge for innovation, their endless resilience, their unshakeable faith in their abilities, and that single-minded goal of making the world a better place. We salute these extraordinary leaders who broke all barriers and did the impossible— taking geospatial technologies out of the research lab and bringing them to all spheres of life.

Geospatial Media & Communications has curated the 'Geospatial Hall of Fame' to pay our gratitude to the pioneers and founding fathers of our industry.

INSIDE

Sanjay Kumar
CEO, Geospatial Media & Communications

sanjaykumar1970

INCREDIBLE LEADERS, INSPIRING JOURNEYS

Having been associated with geospatial community for two decades, I feel highly blessed and fortunate to have pursued my professional journey with an ever-exciting group of people who have made difference to our society through their knowledge, passion, quest, leadership, acumen, humility and endeavors.

Understanding Mother Earth and its relationship with the universe has been a quest of human beings since time immemorial. However, using geography as language of communication and engagement has been a phenomenon of probably the past one century and today it has evolved to be an integral part of almost every human activity. This has been weathered through social, intellectual and economic processes, led by consistent and undeterred pursuant, developing fundamental pillars, structures and axis around which geospatial industry revolves today.

Tracing pursuits of those who got triggered by something unusual and believed in inner sense, it is quite obvious to get influenced by each one of them in different yet connected manner. They have followed different paths, beliefs and practises, yet combined value of their journey has very much culminated in limitless value and opportunities for geospatial professionals and industry.

Owing our existence and relevance to geospatial phenomenon and its leadership, Geospatial Media team takes pride in being instrumental to bring forward the exciting journeys of these leaders whose dreams, wisdom, agility, and leadership shaped our future. Thought of Geospatial Hall of Fame is being driven with rationale and gratitude to recognize and cherish stories of these personalities whom we feel indebted to. I am confident these stories would offer inspiration and encouragement to next generations in pursuing their quest.

I would like to express my gratitude and complements to the Geospatial Hall of Fame leaders for having been very kind in sharing their wonderful journey with our team. It has been an inspiring experience and personal privilege to be part of this historical effort.

I take this opportunity to thank the International Advisory Board of Geospatial Media and Communications for their continued guidance and supervision. I would also like to put on records my appreciation for the Media and Public Relations Division of Geospatial Media, who have displayed great team efforts in putting together a wonderful journey of founders of geospatial industry.

INNOVATION GOT THEM AHEAD OF THE CURVE

Prof. Arup Dasgupta
Managing Editor,
Geospatial World

aruprdg

What drives innovation? It could be a desire to do something better or more efficiently than what was being done before. But real innovation is when the solution is one that meets new requirements and even unarticulated needs, by bringing together various novel ideas in a way that they affect the society positively. Innovators are also lateral thinkers because they work out of the box by implementing existing technology in novel ways. In doing so they bring about disruption in the way we look at our world and in the way we deal with the processes that impact our environment, our work and even our view of the world.

A fire in the polluted Cuyahoga River in US brought the issue of environmental protection to the forefront. Jack Dangermond, a young landscape architect working in the Harvard Laboratory for Computer Graphics on Sysmap, an early implementation of a GIS, realized the importance of mapping and the power of digital computation in understanding, ameliorating and avoidance of such disasters and thus was born the Environmental Systems Research Institute, now better known as Esri. While Dangermond seized an emerging need, Walter Scott of DigitalGlobe was a first responder to a government initiative.

Scott, then working in the Lawrence Livermore National Laboratory mulled over the possibility of extending many of the technologies he had worked on like remote sensing, GIS and the Internet during the Cold War, to a much bigger market. Anticipating the Land Remote Sensing Policy Act, he set up WorldView Imaging Corporation in January 1992 — seven months before the act came into force and was its first licensee. What makes him an innovator is his understanding that after the successful launch of a satellite, the real 'heavy lifting comes from building a business around it'. His view that the future of satellite imagery lies in analytics supported by the Cloud, machine learning and crowdsourcing illustrates his innovative approach to building business using emerging technologies and processes.

Alain De Taeye's journey from Informatics & Management Consultants to Tele Atlas to TomTom illustrates a single-minded thrust to bring routing technology using digital maps and GPS to provide consumers navigation solutions. On the technology commercialization aspect, we see a Kanwar Chadha commoditizing the complex technology of GPS receivers such that now every mobile has a GPS capability using a SiRF chip. Another person who saw civilian opportunities in the GPS system is Charlie Trimble.

FROM THE EDITOR'S DESK

Having honed his skills in one garage operation (Hewlett Packard), Charlie Trimble ventured on his own by developing GPS receivers and using them for land and hydrographic surveys and marine navigation. By integrating cellular communications system with GPS, Trimble created the Kinematic GPS, the core of many mobile and airborne survey systems. "The hard way that even though you have a better mousetrap, the world is not going to beat a path to your door", was apt lesson.

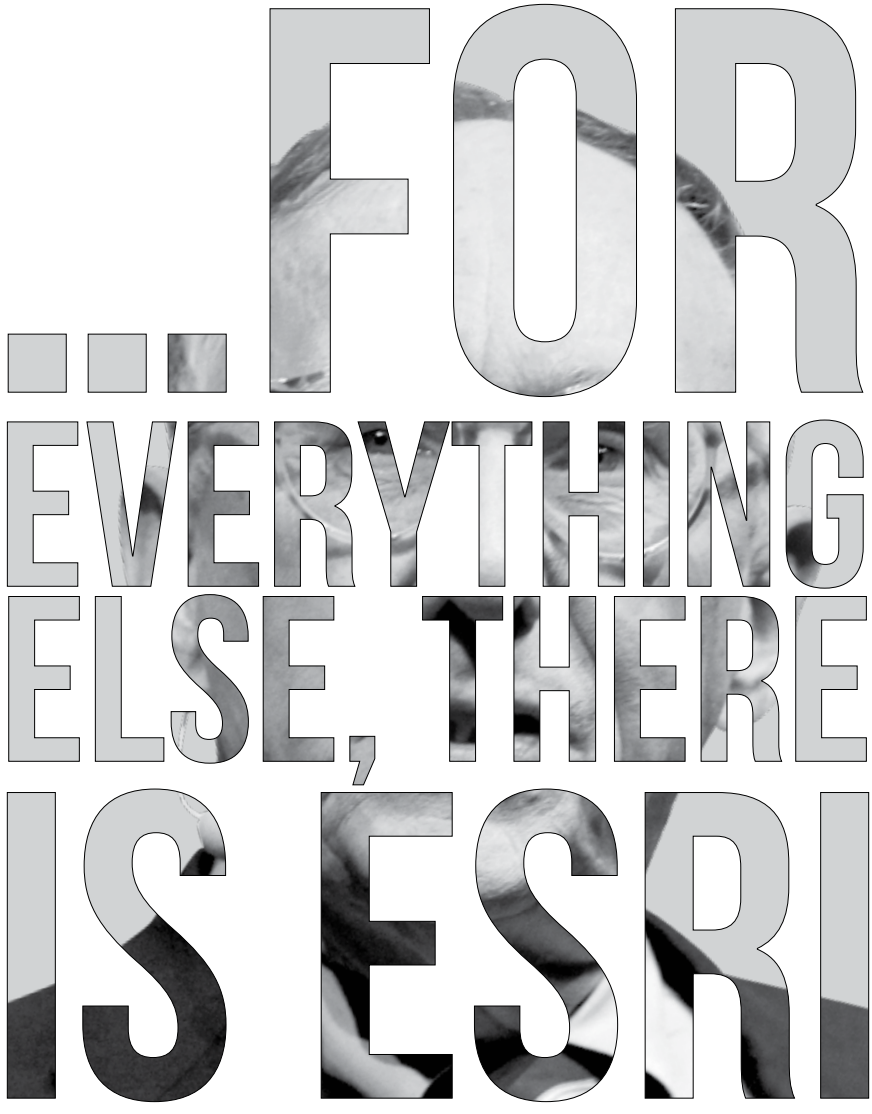
An innovator who built up his business in an environment which had unarticulated needs is Kamal K. Singh, the founder of Rolta India. A mechanical engineer who started a steel rolling mill, Singh branched out to data processing which turned out to be an uncertain field. Today, Rolta is focused on geospatial technologies to develop IP-led solutions in the areas of photogrammetry, base mapping and intelligent 3D city models. Now, Singh wants Rolta to play a substantial part in what he calls the third industrial revolution.

Different types of innovators are people who enabled the progress of geospatial technologies, systems and applications through a fresh look at technologies and processes. Barbara Ryan led the move for free data access in the United States Geological Survey when she noticed that the Federal government was the biggest consumer of Landsat data. Rather than transferring funds from one pocket to another, it made sense to make the data free. She had the satisfaction of seeing a 60% jump in data usage as a consequence of this move. Today she evangelizes for Open and Free data through GEO. David Schell founded OGC with the vision of socializing geospatial capabilities. He realized that unhindered flow of digital spatial information had the power to address global issues like environment and geo-political decision-making and this could only be achieved through "a wonderful marriage of technology and idealism, technology and values". Today, 'Certified OGC Compliant' is a sought after label — indicating the product is standardized and interoperable.

Like KK Singh, who saw a great scope of GIS in India, Shunji Murai realized that remote sensing was a technology that would be of great benefit to Asian countries. A fortuitous remark led him to establish the Asian Conference of Remote Sensing (ACRS), enabling the introduction of remote sensing in Asian countries. The Asian Association of Remote Sensing was also formed under his tutelage. ACRS became a regular feature and was steered by Murai from 1980 to 2009. In these four decades, the Asian community of remote scientists was given a voice and with Murai chairing ISPRS in 1992, Asian scientists found voice in the international arena.

Is GIS a technology, a subset of IT? In 1992 Michael Goodchild, a faculty in the National Centre for Geographic Information and Analysis took on this question "as it raised important intellectual questions that were fundamental to science". He developed these ideas in a paper in 1992 titled Geographic Information Science, and in a number of further papers that explored GIScience as a theoretical and empirical discipline of critical importance to geospatial technology. This concept has played a large part in unifying the geospatial community, encouraging research and establishing Geographical Information Science as an important component of an information society.

Our special edition celebrates these innovators, the unsurpassable legends of the geospatial industry by recounting their stories. So that they continue to stimulate other budding innovators to keep the geospatial pot boiling.



Jack Dangermond

Founder, Esri

Hall of Fame.

THE GODFATHER OF GIS

IT ALL BEGAN AT A plant nursery. A nursery owned by a family of Dutch immigrants in the United States. Money was tight, but life-lessons were plenty. Dinner table conversations usually revolved around cash flows, customer service and bill payments. What a young Jack Dangermond did not know at the time was that the wisdom imparted by people who loved nurturing business would trump the education of any management school.

At the age of 16, Dangermond was managing landscape crews at the nursery owned by his parents. Working in a team taught Dangermond that if you take care of your employees, they would do the same for you. Watering wilting plants made him understand that if you don't take care of problems the moment you see them, your profits will go down pretty quickly. Taking care of patrons prepared him for making products that a customer would need and want.

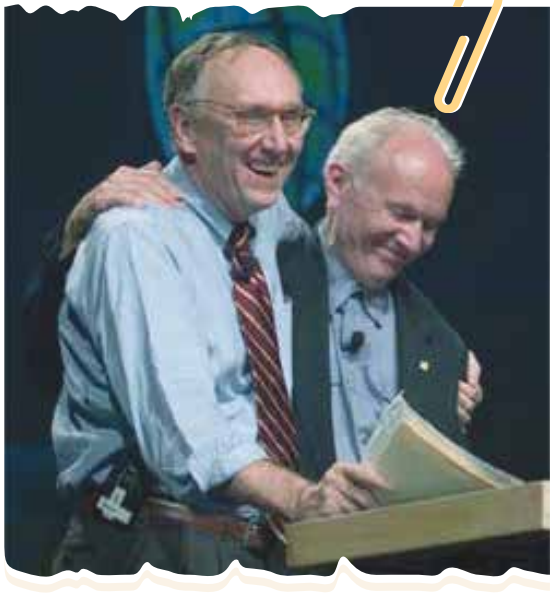
Today, Dangermond is a billionaire, and his company, Esri, America's best-kept software secret. Esri's mapping tools are used by more than 350,000 organizations across the globe, generating over $1.5 billion in revenue — even

Top: Jack & Laura Dangermond were named in Business Insider's Top 100 Visionaries in 2016

Left: Photo taken at Esri headquarters in Redlands, California in March 1977, during the visit to the start of the 'Environmental Impact Assessment of the Gusare Socuy Carboniferous Project.' (Sitting left to right) Laura Dangermond, Jack Dangermond, Flor H Méndez and Rosario Giusti; (Standing) Jesus Garrillo and Ramon A. Perez

Courtesy: National Audubon Society

The Redlands nursery once operated by Jack Dangermond's parents



With the winner of 'Making a Difference' award Allan Schmidt (Right), former director of Harvard Computer Graphics Lab

Courtesy: National Audubon Society

Jack and Laura Dangermond were both working in a lab for computer graphics in spatial analysis in Harvard University when they started Esri

though it is not a household name like Google or Microsoft. Esri has 41 offices across the planet, run by more than 9,500 employees from 67 countries. And in the 47 years of its existence, Esri has never missed a quarter, never had any layoffs and never had any downsizing.

How Esri came into being 47 years ago is almost as incredible as the company's rise to become the world leader in GIS technology. In 1969, the Cuyahoga River in Cleveland got so fouled with industrial waste that it caught fire. The next few months saw a rise in environment awareness in the United States, followed by a flurry of environmental laws. For the first time, environment was at the forefront of government ethics.

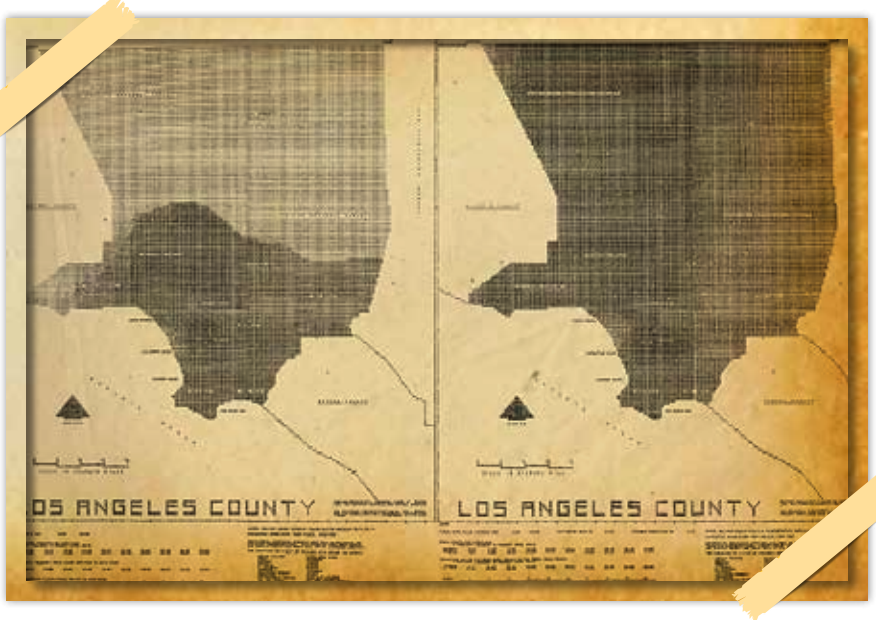
DID YOU KNOW?

ESRI WAS BORN OUT OF THE ENVIRONMENT MOVEMENT IN THE US IN 1960S

These were the happenings that spurred Dangermond, then a young landscape architect at Harvard at the time, into action. Working at the Harvard Laboratory for Computer Graphics and Spatial Analysis — an experimental lab dedicated to automating geography, cartography, and doing spatial analysis — for $4.40/hour had instilled a deep passion for maps into Dangermond anyway.

Esri in 1969. (Left to right)Jack Dangermond, Logan Hardison, Scott Morehouse and SJ Camarata

> We are in this evolving geospatial industry because of the smart people here who are interested in crafting and creating tools that actually work.



Two maps created by Jack Dangermond when he was a graduate student at Harvard. These maps were made using SYMAP, and they demonstrate the effects of barriers when used in modeling the distribution of air pollution

But, making maps was no mean feat, even for Dangermond. "My first attempt to make a computer map took 30 submissions. And this happened over a month or so. I was like why the hell can't I make a map! I was desperate to get a map out of that machine," he recalls.

But, Dangermond and his wife Laura recognized the need to bring rational thinking to the field of geography. So, the couple moved to Redlands, California, and created a platform to ground the discussions around environmental conservation. Thus was born Environmental Systems Research Institute, known by us all today as Esri.

Talking about Laura makes him smile. "Laura and I met when we were 16, at high school," he says. "From the very beginning we were partners. We would work together at university, help each other and when we started

the company we already had a strong philosophy of staying together and trying to look after the business together. So, it's a great partnership."

Esri's foundation was based on the belief that geography could be the base for integrating different kinds of sciences. In the end, it could be used for all sorts of decision making. Starting off as a consulting company that made maps and ran analytics, Esri kept improving its software and methods for a decade before it released its first commercial GIS product known as Arc/Info in 1982, marking the company's evolution into a software solution provider.

"Early in our work, only people with money were able to afford this technology. They ranged from big cities to big federal agencies to oil companies and forest companies and so on," Dangermond remembers.

Receiving the Royal Geographical Societies Patron's Medal from Society President Michael Palin

DID YOU KNOW?

JACK DANGERMOND'S FIRST ATTEMPT TO MAKE A COMPUTER MAP TOOK 30 SUBMISSIONS AND ONE MONTH

Top: Esri Startup Program class of 2015

Right: 2016 Esri User Conference

Then came the 1990s. Faster and cheaper computers arrived, the commercial earth observation industry opened up, and new data capture techniques like the GPS spurred rapid growth of the GIS industry. And Esri was quick to take full advantage of it.

Esri re-engineered Arc/Info to develop a modular and scalable GIS platform that would work both on the

desktop and across the enterprise. The result was ArcGIS. In short, five successive rounds of re-development of the core platform through the years, this horizontal technology, which largely focused on project work in the beginning, is today adopted by individuals, departments and by large enterprises alike.

With a strong focus on research and innovation, driven by a bunch of passionate and committed professionals, Esri grew from strength to strength, mostly organically. "We are in this evolving geospatial industry because of the smart people here who are interested in crafting and creating tools that actually work. In that respect, our motivations are different from a typical public company that is into this business," Dangermond says.

Receiving the Jane Goodall Global Leadership Award in 2011

Courtesy: Business Wire

After more than 40 years of its founding, Esri continues to be a privately owned company, with majority shares held by the Dangermonds. It's rooted in the philosophy that private ownership means no stockholders forcing short-term decisions at the expense of long-term objectives. Customer relationship forms the core of Esri. "We do not try to make money or be a great company from financial point of view. Wall Street doesn't matter to us. Quarterly revenues do not matter to us. What matters to us is seeing neat stuff done by our users," Dangermond stresses.

DID YOU KNOW?

IN THE 47 YEARS OF ITS EXISTENCE, ESRI HAS NEVER MISSED A QUARTER, NEVER HAD ANY LAYOFFS AND NEVER HAD ANY DOWNSIZING

Committed to the technology it believes has the potential to transform the world, Esri spends about a quarter of its revenue on research and development. This is at least double of what most technology companies spend on R&D. "We are wired as an organization that serves its customers and by serving them, we get paid and get the opportunity to use the funds to innovate and drive the technology which in turn is provided to them," underlines Dangermond.

> "Wall Street doesn't matter to us. Quarterly revenues do not matter to us. What matters to us is seeing neat stuff done by our users"

Courtesy: Claremont Graduate University, Flikr

Left to right: Telle Whitney, Deborah Freund, Laura and Jack Dangermond. Whitney and the Dangermonds received honorary degrees at Claremont Graduate University's 85th annual commencement ceremony. May 2012

Jack Dangermond with Sam Pitroda, the Father of the Indian Telecom Revolution, at 2013 Esri International User Conference

Esri supports many global communities that are using GIS to increase spatial literacy, protect the environment, assist with disaster response, and support humanitarian affairs, with the aim of making the world a better place. The company has long supported the widespread use of GIS in classroom and research labs around the world.

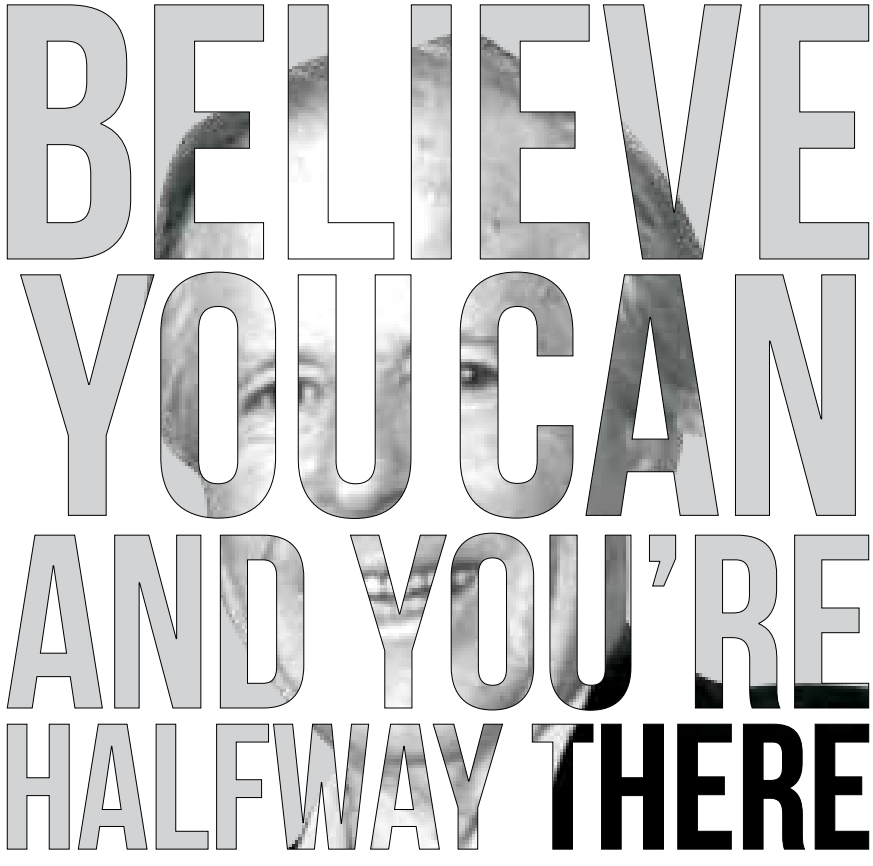
> We are wired as an organization that serves its customers and by serving them, we get paid and get the opportunity to use the funds to innovate and drive the technology

Jack and Laura Dangermond received the Audubon Medal, in 2015. Others (left to right) Honoree Spender Beebe, actress Kate Flannery, President and CEO of Audubon Society David Yarnold

"We have a program where we donate our software to all kinds of NGOs. There are about 11,000 NGOs that are in conversation and humanitarian work all over the world. We support them with software and also training to help them basically be equal participants in the society along with the business sector and government sector."

An ardent technologist and an innovator, at 70, Dangermond still nurtures the passion of his young Harvard years. He and Laura have numerous prestigious awards under their cap. They were recently named in the Business Insider's top 100 business visionaries.

Constantly creating value for the world, Esri is counted amongst the elite list of companies like Google, Apple, Facebook and General Motors. "With this next generation change of technology, there are hundreds of millions and ultimately billions of people who will be affected with this notion that they can apply geographics science to make the world a better place," says Dangermond. And with his life and mission, Jack Dangermond has proved it.



Charlie Trimble

Founder, Trimble

CHANGING THE WORLD FROM A GARAGE SHOP

CURIOSITY IS THE MOST POWERFUL thing one can own. Lucky for Charles R. Trimble, he was always passionately curious. "I was always diving into things headfirst," remarks the founder of Trimble Inc. "As a way of keeping me quiet, I was taught to play chess at a very early age. I didn't recognize it at the time, but I always wanted to be on the steep portion of the learning curve."

His hunger for knowledge got Charlie — as he is known in the industry — into one of the toughest schools of his time, the California Institute of Technology, better known as Caltech. It also made him the pioneer of the GPS industry when he launched his company in 1978 that would ultimately go on to transition what was till then science fiction into an everyday, indispensable reality.

It all started back when Charlie was growing up on an avocado ranch in rural California. Space was the new frontier. "Sputnik went up early in my sophomore year in high school. It had a major effect on me, as it did a generation of people," he recalls.

Charlie signing the gift agreement for Trimble's first production GPS receiver at the Smithsonian Museum, Washington. Photo was taken in late 1985 or 1986

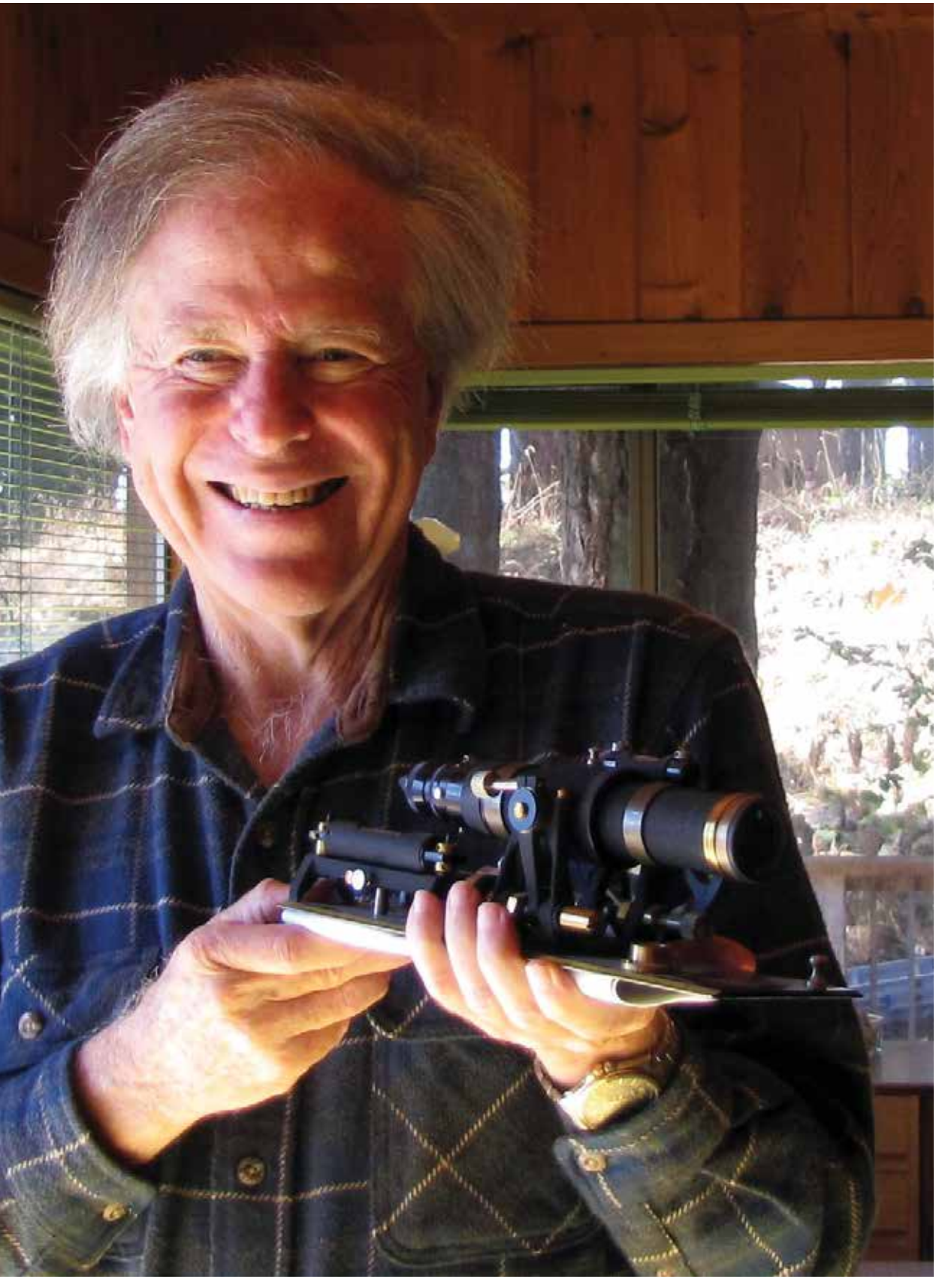


Photo credit: Mai Schrock and xyHt Magazine

An American daily newspaper carried a cover story 'Trimble CEO sets sights on Fortune 500' on Charlie Trimble in July 1991

And then Chrysler showcased a concept car that had a navigation unit in it. Science fiction was already in place, in a James Bond car! "Turns out science fiction is one of the best predictors of where technology is going to go. I truly believed that if the satellite system really was there, the ability to know your relative position was going to be very important."

Caltech did its part to challenge his hungry mind. "We would have to solve three out of five problems. And the first time you read each one of them, you wanted to go to the next one because they seemed impossible," Charlie laughs. But the training in terms of focusing on figuring out what's important about a problem helped him develop simplistic, predictive models of problem-solving — a skill he would use later to develop GPS-enabled solutions.

> I always knew I wanted to play in the interface between business and technology


The New York Times

Business Day

Business Technology

FEBRUARY 6, 1991

Charlie got featured in The New York Times, February 1991

The problem-solving abilities Charlie acquired at Caltech also instilled in him a thirst for entrepreneurialism. "I knew I wanted to play in the interface between business and technology." The break came in the way of a job with Hewlett-Packard. "Actually they were running employment ads at the time: 'Want to start your own business? Come work for us for a few years and learn how to do it.' I absolutely thrived in that environment," he recollects.

HP went from being engineering-driven to marketing-driven to resource allocation-driven — all of which Wall Street was quite happy with. But, the opportunities for being entrepreneurial had gone from a 5-year time horizon to a 10-year time frame. "I was very restless," Charlie says. "And they cancelled the LORAN-C project — the second generation navigation and positioning system used to guide fighter planes across the North Atlantic during World War II. They had spent $1.3 million on it and they were going to shelve it."

So, Charlie bid $50,000 to buy two racks full of equipment, a couple of working prototypes, and a lot of reading material. He set up shop above a remodeled theatre in Los Altos, California. This was 1978 — the year US launched the world's first GPS satellite, NavStar. By 1982, Trimble had begun developing engineering products that were based on GPS technology for precision measurements needed for land and hydrographic survey industries. Marine navigation was another focus area. "But, I had to learn the hard way that even though you have a better mousetrap, the world is not going to beat a path to your door. What we did know is that there was going to be this navigational capability. But just knowing that didn't tell you where GPS

DID YOU KNOW?

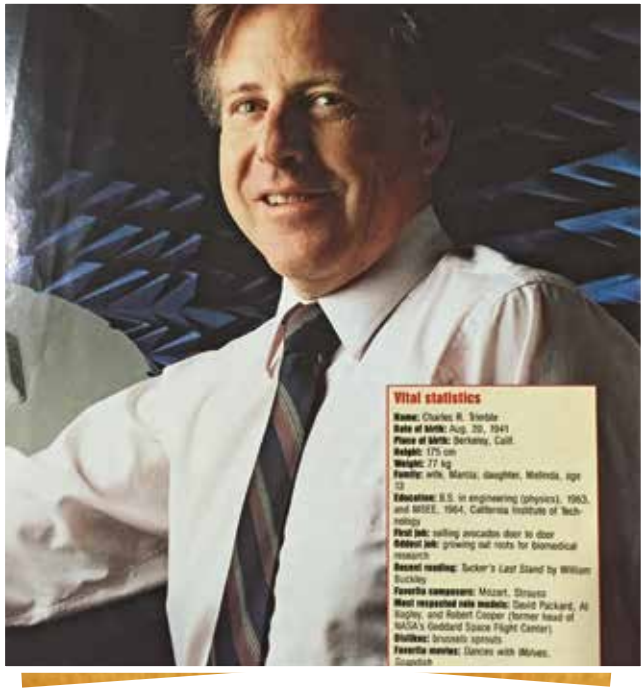
CHARLIE TRIMBLE WAS INSPIRED BY THE LAUNCH OF SPUTNIK AND A JAMES BOND CAR

Top: HP engineering group responsible for the first civil GPS receiver

Right: Charlie at a business agreement signing in 1989

Courtesy: xyHt

> You never want to carry the milestone of perfection around your neck. I know I am wrong almost as much as I am right.



IEEE Spectrum perspective article telling the Trimble story, February 1992

The article 'Visualizing Interface Bus Activity' got published in Hewlett-Packard Journal in January 1975 while Charlie was working with HP

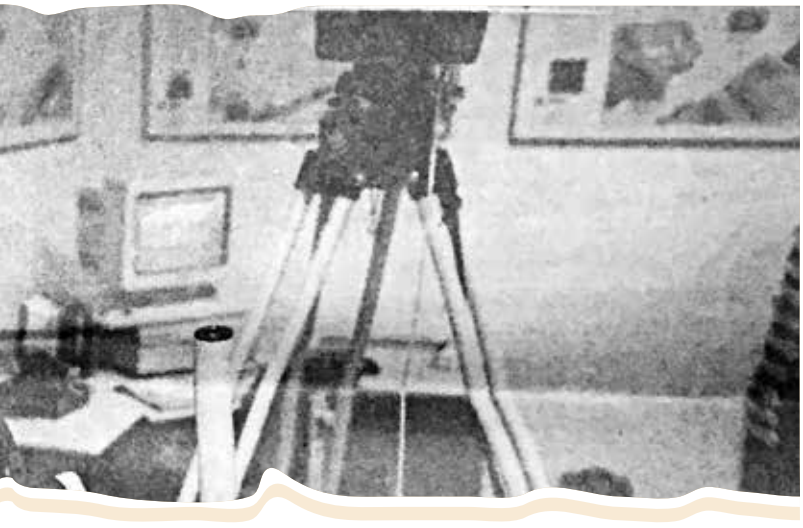
was going to go. The part of it came from just looking at the early markets."

After two years of R&D, Charlie took his first prototype to a technology show in Boston. "There was great disbelief that a garage shop could have put together a GPS receiver. One of the people that were there was a division manager from Northrop. He bought the first two channel receivers from me for a hundred thousand dollars," he recalls.

By 1988, the company had deployed GPS products for land and hydrographic surveys and scientific research. Acquisition of TAU Corporation's Navigation Systems Division in 1989 helped improve products using differential GPS. Soon it was time to go public.

"We ended up going public the Friday that Saddam Hussein invaded Kuwait in 1990. And one of the proudest things that I have is that I managed to get the public window with total investment of $9.5 million and employees owned over 50% of the stock," he smiles.

Through the early 1990s, Trimble continued innovation efforts — integrating GPS with communications



'GPS ready to take off', another newspaper article on Charlie showcasing GPS device from Trimble Navigation

Charlie Trimble with his wife Liying (Lily)

Courtesy: xyHt

Charlie in the mid-'80s and his receiver in a precision time exhibit at the Smithsonian

technology. The revolutionary real-time kinematic technology allowed moment-by-moment GPS updates. With the US government opening up GPS in 1996 for consumer markets, Trimble's GPS became part of PCs and handhelds, like the Seiko Epson Location. But focus of the company remained on the commercial market.

In 1998, Trimble became the first to put GPS and cellular communications on a single board. That same year, Charlie ended his two-decade long stint as CEO and handed over the baton to Steve Berglund. Under Berglund, Trimble has grown exponentially acquiring a multitude of companies and expanding to diverse markets like construction and agriculture.

DID YOU KNOW?

TRIMBLE WENT PUBLIC THE DAY SADDAM HUSSEIN INVADED KUWAIT IN 1990

"I drove the technology and then moved into some of the markets and by and large my growth was organic. Now, Steve is a capital alligator and his push was to flush out the various markets that Trimble was in. He did this through acquisition. He has certainly grown the company by over an order magnitude from where he took it over," smiles Charlie, satisfaction written large on his face.

Today, Trimble engineers worldwide are working on cutting-edge positioning applications that no one could even imagine just a few years ago. With more than 500 products, Trimble continues to lead the way in developing position-centric solutions to address some of the world's most complex challenges.

Charlie, meanwhile, has gone back to what he loves the best — collecting experiences. Like shooting pictures

Charles R. Trimble

Shortly after joining the HP Frequency and Time Division in June of 1964 Charlie Trimble was asked to look into signal averaging techniques. After proving the feasibility of many of the ideas embodied in the HP Signal Analyzer system, he was appointed group leader and given the responsibility for developing the HP 5480A and associated digital signal-processing equipment.

Charlie graduated with honors from the California

GPS At Work : An Interview With Charles Trimble

Innovator Charles Trimble:

Bringing Specialized Navigation Systems To Mass Market

Paparazzi has always followed the true pioneer of the GPS industry

Trimble's target: Fortu

Charles Trimble

'Trimble's target: Fortune 500', an article appeared in Mercury News just a year after Trimble went public

of bears fishing in Alaska. And helping other pioneers like himself. "For a while I was poking around Caltech figuring out what I wanted to do with the rest of my life. I ran into a fellow that was about 18 months into a biotech startup and decided that what he was doing looked important enough that a real purpose that I could provide was to keep him alive long enough for him to do something useful," he says.

DID YOU KNOW?

IN 1998, TRIMBLE WAS THE FIRST TO PUT GPS AND CELLULAR COMMUNICATIONS ON A SINGLE BOARD

Charlie remains a pioneer at heart and a seer of things to come in the GPS industry. "The two things that come to mind are machine learning and virtual reality. Well, augmented reality is more important than virtual reality," he says.

And even though he may have turned the GPS world upside down, Mr Trimble remains a humble man. "I don't hesitate in asking for help. When I was 17, my uncle gave me Dale Carnegie's How to Win Friends and Influence People. My take away from that was you never want to carry the milestone of perfection around your neck. So, I don't have it and I know I am wrong almost as much as I am right. The trick is to know it's much easier to tell whether the decision was right or wrong by the consequences after the decision."

Shunji Murai

Founder, Asian Association of Remote Sensing

Hall of Fame.

THE REMOTE SENSING PHILANTHROPIST

A WORLD WAR II SURVIVOR WHO narrowly escaped American bombings. An Olympic-level rower who drew strength from his failures. A remote sensing pioneer who never studied the subject formally. An international-level academician and scientist whose sole focus was uplifting of the community around, than looking for personal glory. The life story of Prof Shunji Murai, often referred to as the father of remote sensing in Asia, is captivating.

To pioneer a technology when the technology itself is developing takes courage. And to pioneer such a still-developing technology in a region striving for basic necessities, next-to-zero awareness and negligible support takes perseverance. Murai had both. Maybe because the intense struggles in early life instilled these qualities in him.

World War-II is infamous as being the most destructive of all wars in human history — communities ripped apart, cities under siege, hunger stalking the civilian populations... a young Shunji was witness to the horrors that changed the lives of many. “Every day Tokyo was attacked by American bombers. It was a very difficult time and we were always hungry. My dream was to eat until I die,” Murai laughs today while recalling 74-year-old memories, sadness etched on his face.

But when the going gets tough, the tough gets going. Murai defeated all odds to complete secondary education. But if you thought thus began the life of this great academician, you are

Left: Murai with his wife Taeko (Suzuoka)

Right: In traditional Japanese Kimono, 1998

wrong. He was talked into joining an orchestra club first and then took up rowing. He was part of the rowing club of the University of Tokyo, which was selected to represent Japan at the 1960 Rome Olympics. Sadly, the Japanese team came last. Another disappointing performance followed at the 1962 World Championships.

Twenty-one-year-old Murai realized that he was not good enough to reach the top in rowing. But the competitions did help in broadening his horizons and finding new ways of looking at the world at that tender age. "It was a physically exhausting sport. But back then I decided I had to win a gold in some area, if not sports."

Life went on beyond the palisades. Murai finished his graduation in civil engineering and started his professional career. He joined a private company and was posted in Ghana. But he was yet to find his calling. Due to some trouble with the company he had to quit. "I was completely jobless and had no money. I was so ashamed of myself."

Then one day he was visiting a former professor of his. "I don't know why I asked him if I could take up further studies. And he amazingly said yes," Murai remembers fondly. He started studying photogrammetry, but life continued to be tough. The money crunch even choked a day's meal. "I had no money for lunch, so I skipped lunch. I had no money for bus trips, so I walked," he recalls. However, after barely three months Murai got promoted as a research

DID YOU KNOW?

PROF SHUNJI MURAI WAS AN INTERNATIONAL LEVEL ROWER AND HE PARTICIPATED IN 1960 ROME OLYMPICS

> Friendship, trust, and brotherhood with my fellow Asian people are priceless. These are the jewels of my life

assistant. It was during this time he met Taeko (Suzuoka) — a geography teacher by profession. The young couple got married and thus began a lifetime partnership.

Life was good and Murai was learning fast. Some years later, he got a chance to visit the American Army Laboratory Topographic Command in the US. "I was very surprised that they had the original idea of the GPS. And also ideas about remote sensing from satellite. At that time nobody in Japan studied remote sensing."

DID YOU KNOW?

SHUNJI MURAI NEVER HAD ANY FORMAL DEGREE OR EDUCATION IN REMOTE SENSING

Murai (Center) addressing the third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), Vienna 1999

By this time, Murai had gained a doctorate in engineering, but his passion became remote sensing. In 1970, good two years before the launch of the first civilian earth observation satellite ERTS-1, he was already studying the aspects of meaningful use of satellite data. "I had no one to teach me. Remote science as a subject was yet to evolve in Japan and I was sure I didn't want to go to US to study." As he attended conferences and symposiums, international recognition started pouring in.

The year of 1980 was pivotal as that was when Murai began to focus on the Asian remote sensing community, something that would go on to become his life's mission. And it all happened by chance. "While I was in Costa Rica for the ERIM Symposium in April, I organized a small party. We were all talking and enjoying drinks, when one of my Asian friends said 'We Asians are a

With Maha Chakri Sirindhorn, Princess of Thailand, at the inauguration ceremony of Asian Center for Research on Remote Sensing (ACRoRS), 1999

minority in this symposium. Why?' Then they suddenly declared 'Shunji Murai you must organize a congress by December." When he agreed amid all the party spirit and revelry, he didn't quiet realize that it was a huge responsibility and there were only eight months to prepare.

But true to his words, Murai organized the first Asian Conference of Remote Sensing (ACRS) in Bangkok in December, 1980. Thailand of course had no budget. So, Murai took the onus of raising funds from his contacts in Japan. He went to China and India to advertise about the conference and solicited their participation. A total of 144 people attended.

This one conference was all it took to break the barriers. Asian countries took to ACRS as ducks to water. China proposed to host the second ACRS, which also saw the formation of an official body — the Asian Association on Remote Sensing (AARS). Murai was elected the first general secretary in 1981. The mission was very clear — for Asians, by Asians and with Asians.

DID YOU KNOW?

SHUNJI MURAI OFTEN FUNDS YOUNG RESEARCHERS AND PARTICIPANTS AT ACRS FROM HIS OWN POCKET EVEN NOW

In 1984 under Murai's leadership, Japan won the bid to host the 1988 ISPRS in Kyoto, Japan. Hosting the ISPRS congress was his first large involvement within an international activity. "At that time, I never thought that I would be serving ISPRS for the next 16 years. I was

With his wife Taeko (Suzuoka), sons, daughters-in-law and grandchildren

Murai became the first Asian to be elected as the president of ISPRS. Murai addressing the ISPRS congress in 1992

> Our mission was very clear from the beginning – for Asians, by Asians and with Asians

Prof Shunji Murai was awarded the 2016 Chen Shupeng Award at the 37th ACRS held in Sri Lanka

too occupied with the fear of how I would ever manage the huge budget necessary for the ISPRS Congress."

However, all his hard work paid off and the ISPRS congress was a huge success with 2,300 participants from 73 countries.

The real change came when he was elected the president of ISPRS in 1992. Before that all the presidents were from the West; Murai changed the tradition and became the first Asian to hold this post. "Till that time the West never paid attention to the remote sensing community in Asia. After I became president, I actively promoted our work, and lobbied for the ACRS."

Murai's four decades of inspirational leadership and single minded dedication has built the Asian community of remote sensing professionals and has paved the way for setting up of remote sensing research in several countries. Today, AARS has over 29 member countries. His leadership and untiring efforts to motivate professionals at grassroots levels has brought consistency in overall evolution of remote sensing capacity and all levels, including government, civil societies, multilateral agencies and academic institutions in Asia.

In 2009, at the age of 70, Murai decided to step down and hand over the ACRS leadership baton to the next generation. Prof Murai has published over 50 books and at 77, still likes to keep himself busy. He has recently formed a company and is working an earthquake prediction tool. A dedicated family man, he cooks for his wife every day. "Cooking is my hobby so I like it. I like to listen to music too."

Murai being presented Map Asia Lifetime Achievement Award by Murli Manohar Joshi, Former Indian Minister of Science and Technology, 2002

WEC Group, Melbourne, 2012. Shunji Murai is sitting on extreme right

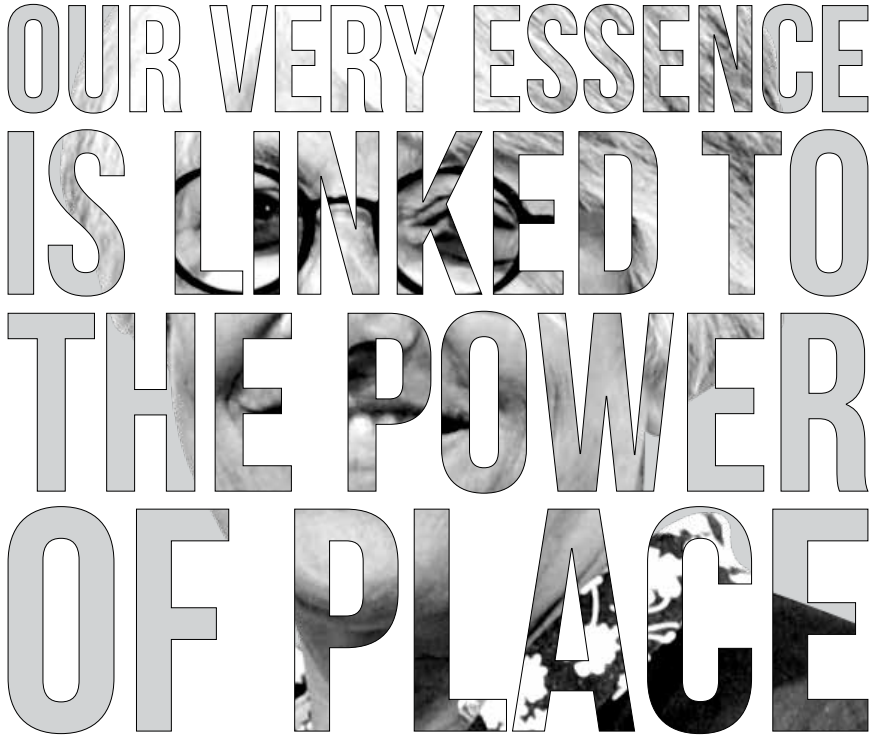
Addressing the 24th ACRS, Korea 2003

And of course his affair with remote sensing continues. He is now working on an earthquake prediction tool. "It is completely new and unique as compared to existent seismic science. It is a very good method and precision is 70-80%, which is not at all bad."

Over the last more than three decades with ACRS and AARS, Murai has sacrificed his energy and time for the promotion of remote sensing within Asia. "Reflecting over the years, I see what I gained — the relationships, the learning, the research — is surely much larger than whatever little I may have lost. Friendship, trust, and brotherhood with my fellow Asians are jewels of my life. If I were to sum up my life in one phrase, I would say, my life is for the Asian people," he sighs, like a father proud of his child's achievements.

DID YOU KNOW?

THE FIRST ACRS IN 1980 HAD ONLY 144 PARTICIPANTS. BY THE TIME THE SECOND WAS ORGANIZED NEXT YEAR IT HAD BECOME HUGELY POPULAR



Barbara Ryan

Director, GEO Secretariat

Hall of Fame.

Ryan with her husband and son at USGS Open House

Top: Happily married for 38 years, Ryan with her husband at the Great Wall of China

Left: Ryan with her 1-week-old grandchild on the Big Island of Hawaii

A SALT-OF-THE-EARTH WOMAN

SHE GREW UP IN THE small town of Dalton in western New York, population 300, quite close to Letchworth State Park or the 'Grand Canyon of the East'. Much of her childhood time was spent outdoors. Playing in woods and fields surrounding her home, spending countless hours building sailboats out of twigs and sending them down the creek that ran past the field, putting rocks and stones in the stream to create dams...

"I think that is where my love for geography began," Barbara J Ryan muses. "You could really see how interconnected things are... I actually did a double major — in geology and in earth science education — from the State University of New York at Cortland."

Ryan joined the United States Geological Survey (USGS) — the nation's largest civilian mapping agency — in 1974. Every January, Ryan and a few others would descend upon the Great Plains to measure ground water withdrawals from the Ogallala Aquifer — the vast underground reservoir fueling the

> Scientists are wonderful people, but we are often not very good at communicating key messages. And politicians are going to make their decisions, with or without earth observation information.

Courtesy: U.S. Mission Geneva

Ryan briefing the media at the UN on the GEO-X Plenary and Geneva Ministerial Summit, January 2014

A nature lover, South Africa

With ISPRS Congress Director Lena Halounova at the XXIII ISPRS Congress 2016

breadbasket of America. "The kind of connection people share with the land is so amazing; it instilled in my psyche the importance of "place" in people's lives."

It also made Ryan an unrelenting environmental activist. An avid believer that every action we take has a profound impact on the world, Ryan can often be spotted returning from her walks with both hands filled with other people's trash. It wasn't long before she became an expert in groundwater contamination, studying the effects that low-level radioactive waste burial had on water quality.

Climbing the ladder steadily at the USGS, Ryan earned master's degrees in geography from the University of Denver and in civil engineering from Stanford University along the way. Soon,

Ryan with family friend, Jerry Spurr, Denver, Colorado, 2016

Ryan with delegates from the African Association of Remote Sensing of the Environment (AARSE) at the 1st AfriGEOSS Symposium, Zimbabwe May 2016

she found herself serving as a staff assistant to the Department of the Interior's top official for water and science. Her main job was to communicate information clearly, coherently, and convincingly — an experience that has come in quite handy in her later years as the Secretariat Director of the intergovernmental Group on Earth Observations (GEO).

"It was the first time in my career that I saw how politicians look at science issues," Ryan recalls. "Scientists are wonderful people, but we are often not very good at communicating key messages. And politicians are going to make their decisions, with or without earth observation information. So, why not feed them good scientific information in a timely fashion?" This also included creating the position of a geographic information officer, or GIO, at the USGS for the very first time. Advancing comfortably at the mapping agency, Ryan became an associate director, responsible for the USGS' remote

Ryan at the Earth Observation Center, in Oberpfaffenhofen, Germany

Mount Ryan, Antarctica
78°25' S, 85°56' W

Mount Ryan is a mostly ice-free mountain rising to 3200 meters between Mount Shear and Mount Gardner in the central ridge of the Sentinel Range, Ellsworth Mountains. At the recommendation of its Advisory Committee on Antarctic Names, this mountain was named by the United States Board on Geographic Names in 2006. It honors Barbara J. Ryan, Associate Director for Geography, United States Geological Survey (USGS), who has program and policy responsibilities for the nation's Landsat satellites, and the agency's remote sensing, geography, and science impact programs. During her 30-year career with the USGS, she worked in seven states and Washington, D.C. Much of her early career was spent as a field hydrologist studying ground-water contamination and participating in the nation's first systematic study of water quality conditions. From 1989 to 1991 she served as Staff Assistant to the Assistant Secretary for Water and Science at the Department of Interior where she coordinated the Government's first compilation of Federal ground-water programs. Before becoming Chief Geographer, she served as the agency's Chief Information Officer as well as Chief Financial Officer. Most recently she championed the development of *The National Map*, a consistent framework for geographic knowledge that provides public access to high-quality, geospatial data and information from multiple partners to help support decision-making by resource managers and the public. Barbara Ryan served on a number of committees related to photogrammetry and remote sensing and additionally, from 2001 to 2005, was Department of Interior representative on the United States Board on Geographic Names. In the 2001-02 field season she was a team member of the USGS Geodesy, Remote Sensing and Mapping Program in the McMurdo Dry Valleys of Victoria Land, Antarctica.

Mount Ryan, Antarctica, was named by the United States Board on Geographic Names in 2008. It honors Ryan's contribution towards geospatial community

Ryan during her expedition to the South Pole, Antarctica in 2001

sensing, geography and civilian mapping programs. And also, the Landsat satellites. "The first Landsat satellite was launched in 1972. And for the next 35 years, people were fighting to have the data from the Landsat program made freely and openly available. It just so happened that I was in a senior career position from 2000 to 2008. I could reignite the issue," she recalls.

DID YOU KNOW?

BARBARA RYAN WANTED TO PURSUE A CAREER IN PHYSICAL EDUCATION BEFORE SHE GOT HOOKED TO THE EARTH SCIENCES

An analysis soon revealed that the federal government was the biggest buyer of Landsat data. This meant that the government was simply taking the money from one pocket and putting it into another. Ryan was leading the effort to change the decades-old Landsat data policy to full and open.

> We show governments across the world that it makes financial sense to release broadly and openly the data that the taxpayer has already paid for

In 2008, the USGS adopted an open access policy for the free distribution of all data in the US Landsat archive via the Internet. "The then - Secretary of the Interior Dirk Kempthorne made this announcement at the GEO Ministerial in Cape Town, South Africa, instead of in the US, and that got us so much more political and international attention," Ryan smiles. The policy change resulted in an annual $1.7 billion of economic benefit in just three years. "We referenced this economic analysis in the many letters we wrote to the European Commission, encouraging them to adopt a broad open data policy for the Sentinel missions as well."

With this decisive feather secured in her hat, Ryan decided to end her 34-year career with the USGS and moved to Geneva to serve as the director of the World Meteorological Organization's space program. Though she was no stranger to the ways of the bureaucratic world, Ryan chuckles as she talks about the cultural transition she had to witness. "As a native English speaker, and one who uses a fair number of idioms in her

Left to right: Razan Khalifa Al Mubarak, Secretary-General, EAD; Jacqueline McGlade, UNEP; Barbara Ryan, Secretariat Director, GEO; Janet Ranganathan, WRI; and Thomas Brooks, IUCN

With Petteri Taalas, Secretary-General, WMO, Geneva, Switzerland, 2016

Left to right: Bert Jarreau, Chief, Technology Officer, National Association of Counties; Barbara Ryan, Associate Director for Geography, USGS; William F. Johnson, President, National States Geographic Information Council

Ryan in her office in Geneva, Switzerland, 2016

Left to right: Stephan Bojinksi,WMO Space Programme; James Muldoon, husband; Ryan; Jerome and Delphine Lafeuille, WMO Space Programme; Jean Louis Fellous, COSPAR Executive Director, Mariinsky Theatre, St. Petersburg, Russian Federation

> The kind of connection people share with the land is so amazing; it instilled in my psyche the importance of "place" in people's lives

speech, I have to speak a lot more slowly, more clearly and not use as many idioms because they do not translate very well. I often say, 'Oh my goodness, we can wait until the cow comes home!' And I remember someone from another country asking me what do cows have to do with this?"

In 2012, Ryan joined GEO to integrate earth observation systems from around the world into a federated, comprehensive system that uses coordinated data to understand how environmental factors impact both the landscape and human life. She tells, "We show governments across the world that it makes financial sense to release broadly and openly the data that the taxpayer has already paid for. It will build your economy, it is certainly good for transparent government and, it is a boon for capacity building and education."

Even as Ryan serves as a mentor and a role model for colleagues across the world, she counts her family as her biggest asset. Happily married for 38 years, and grandmother to a now 9-month-old, Ryan says, "We moved eight different times for the USGS, and then we moved to Europe. My family certainly got the short end of the stick in all this. But, they were always there for me."

DID YOU KNOW?

RYAN HAS SERVED AS CHAIR OF THE INTERNATIONAL COMMITTEE ON EARTH OBSERVATION SATELLITES, WHICH COORDINATES INFORMATION FROM MORE THAN 100 CIVILIAN SATELLITES

"I remember when I retired from the USGS in 2008, my son — a sophomore at the time — made a David-Letterman-like list of his Top 10 memories with me and my work." It had several less-than-favorable items like Ryan dragging Thomas to USGS Open Houses and numerous science camps. "But, the one that really choked me up was him saying: 'No matter how tired my mom was when she got home from work, we would always find time to read a book together before going to bed," she smiles. Because for Ryan, people are just as important as "place" is.

HAD THE GUTS, GOT THE GLORY

Alain De Taeye

Founder, Tele Atlas

Hall of Fame.

HE ROCKED THE MAPPING WORLD

HE HARDER THE STRUGGLE, THE more glorious the triumph. But not many people have the courage to persevere in the face of failures. Nor do they have the fortitude to not give up on their dreams despite setbacks. And there would only be a handful who have the wits to make their business sustain for 20 long years in startup-like conditions. A handful, like Belgium-born Alain De Taeye — the co-founder of Tele Atlas, the digital mapping company which was acquired by TomTom in 2008.

People take digital maps for granted now. They were not there to witness the time when map-making was considered an art, and map-reading needed skills. For long in history, many from Ptolemy to Piri Reis and Jodocus Hondius mapped the known world. De Taeye was one of the first to carry that tradition forward in the cyber world.

Alain De Taeye's vision towards creating and nurturing commercial geospatial content has empowered commoditization and consumerization of mapping capabilities

In an interview Alain De Taeye and his son Niek De Taeye share their views on the future of start-ups, June, 2016

Courtesy: WebTomorrow

"For me, it was logical that maps would also become digital and the reason for that is that actually routing the algorithm already existed since the '60s. We had the tools to calculate all kinds of things, but we did not have the digital maps. So, it was a kind of logical thing to do to fill in the gap," De Taeye recalls.

After graduating as an engineer-architect from the University of Ghent in Belgium. De Taeye launched Informatics & Management Consultants as an IT consultancy firm in the late 1980s. But, he continued work on digital map databases and routing fundamentals to today's satellite-based navigation devices.

Remembering those days brings a smile on De Taeye's lips. "It sounded like a bit of science fiction in those days. Remember, I was in the '80s and we talked about the cars that will actually tell you to drive from point A to B and then people compared me once to the knight rider."

In 1989, I&M merged with the Dutch Tele Atlas group, and a year later, De Taeye became its head. Here his vision toward creating and nurturing Tele Atlas focused on commercial geospatial content, which added immense value by empowering commoditization and consumerization of geospatial capabilities. "I never gave up on the idea that navigation will be used by everyone today and I am very happy to say that's the case," De Taeye quips.

> "I was absolutely convinced that people all over the world will use digital maps. I had no doubts"

DID YOU KNOW?

ALAIN DE TAEYE'S FIRST ENTREPRENEURIAL VENTURE WAS NOT IN THE FIELD OF DIGITAL MAPPING. IT WAS AN IT CONSULTANCY FIRM CALLED INFORMATICS & MANAGEMENT CONSULTANTS

> The Holy Grail of mapping is to build a real-time map. A real-time map means any change in reality finds its way immediately

In the early days, there were immense challenges to overcome. "The traditional map-making companies were oriented toward creating paper maps. And the people who were trying to digitize these maps had difficulties in managing the transfer from their original paper map production processes to digital maps. A new company that can start from scratch was the need of the hour, and that made it easier for us to take that step," he recalls.

The good thing about doing something new is that it's new. But, the bad thing is that you always end up encountering things you were not expecting. De Taeye was determined to go on when the lesser mortals would give up.

DID YOU KNOW?

IN 1993, ALAIN DE TAEYE CREATED THE EUROPEAN DIGITAL ROADMAP ASSOCIATION, CONSISTING OF ETAK, TELE ATLAS AND ROBERT BOSCH (AMONG OTHERS)

As the world's largest digital map maker, it was only natural that Tele Atlas and TomTom would eventually come together

"Of course you are disappointed when you have your first failure, when you are not that lucky and things postpone. But, that's when you stubbornly go on and never give up," he insists.

In the early '90s, success started to show with some top carmakers, like Mercedes and BMW, becoming early adopters. And even though they introduced digital maps in a very small volume of cars, it was a clear proof that what De Taeye was trying to do made sense.

In 1993, De Taeye helped create the European Digital Roadmap Association with Robert Bosch. Meanwhile, Dutch firm TomTom had in parallel begun a revolutionary transition from PDAs to navigation applications, such as, EnRoute. De Taeye found out that it shared the same vision as him. "I was absolutely convinced that people all over the world will use digital maps. I had no doubts. I had doubts about when and how fast it would go and how much money it would cost, whether I could afford it and so on."

DID YOU KNOW?

TELE ATLAS, WHICH WAS CO-FOUNDED BY ALAIN DE TAEYE, WAS ACQUIRED BY TOMTOM IN 2008

As the world's largest digital map maker, it was only natural that Tele Atlas

De Taeye continues to inspire the younger generation. Speaking at the TEDx Brussels conference, 2011

and TomTom would eventually come together. This happened in 2008 — four years after TomTom had launched its first affordable portable navigation device, TomTom Go. De Taeye calls the move as democratization of the navigation industry. "They took an existing technology that was available to only few people, and they made a fantastic product out of."

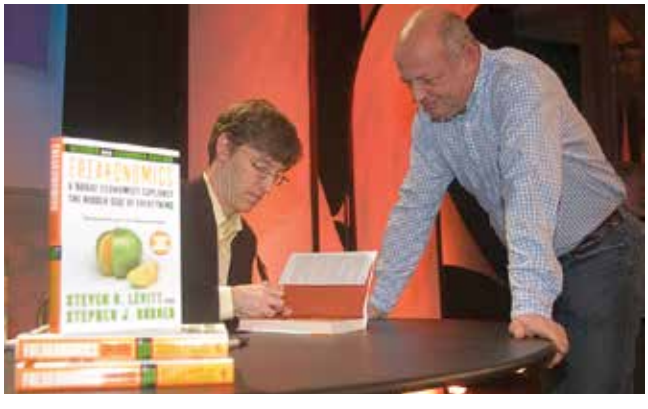
The merger of TomTom and Tele Atlas saw De Taeye don a new hat, on the executive management board of TomTom. His continued leadership brought consistency in overall evolution of geospatial content strategy offering newer dimensions and utilities across different disciplines driving future course of business direction, including e-commerce, autonomous vehicles, indoor mapping, etc.

But De Taeye is convinced that digital maps still have a long way to go, even as we talk about 3D maps, fleet management or autonomous vehicles that need highly-accurate maps to navigate. "The Holy Grail of mapping is to build a real-time map. A real-time map means any change in reality finds its way immediately through the whole production process of the map back to the user, the moment there is a change," he explains.

Over the years, De Taeye has drawn inspiration and strength from his family and friends. It may seem normal now, but in those days, creating digital maps for future navigation system was kind of a crazy idea. "I am very happy that my family supported that idea. My dad inspired me. He worked very hard. And at the end of the day, he was very good with people. He taught me how to work with people. You can say he was my role model. One of my teachers at the university — Professor Miller — also conditioned my mind to develop problem-solving skills."

De Taeye (second from right) with (left to right) Harold Goddijn, CEO of TomTom; President Zdanowska, Mayor of Łódź; Management Board Member of TomTom; Krzysztof Miksa, TomTom and Engineering Director in Łódź cut the ribbon to open TomTom's new office in Łódź, Poland

The Tele Atlas mapper van had cameras on the top and the hard drives cabinet in the customized rear seat. Since July 30, 2008, the company has been a wholly owned subsidiary of automotive navigation system manufacturer TomTom



De Taeye with Steven Levitt, the bestselling author of Freakonomics (2005)

Just like his role models, De Taeye continues to inspire the younger generation. He often lectures at the Antwerp Business School, and has been featured on platforms like TED. "My advice to the young people is that don't make the mistake of building something on technology where you don't know where it will end up. You don't know what problem it would solve. Start the other way around. Look around. There are tons of problems, big problems, that still need to be solved, that aren't solved yet."

For De Taeye, the best thing about maps is that they are a never-ending story. "Maps have existed for thousands of years. And they will exist for a thousand more years. What will change is that they will get more accurate, they will get more up-to-date." And we suspect De Taeye will play a major part in that!

KEEP EYES ON THE STARS AND FEET ON THE GROUND

Michael Goodchild

Founder, UCSB Center for Spatial Studies

FROM CAVES TO MAPPING: THE MAKING OF GISCIENCE

AN INGENIOUS 5-YEAR-OLD who could put together an electric plug. A rebellious boarding school product who wired his dormitory to communicate through Morse code. An unusually fractious teenager with a passion for exploring caves. An aspiring physicist at Cambridge fascinated by the theories of astronomer Fred Hoyle. A chance geographer who found a wonderful excuse to indulge his love of travel. A reluctant teacher who fantasized about an emergency rescue system for professors running out of material. A devoted family guy with a lifetime obsession for canned peaches. And also perhaps the best known GIScientist in the world.

Michael Frank Goodchild is all about intrigue... And just *so much* of it. Born during the Second World War in the English county of Somerset, Goodchild's tryst with science began at the age of five when he learned from his father the

This picture was taken in 1970s. Goodchild had an unusual passion for exploring caves

principles of electroplating and how to 'wire a plug'. "I grew used to the feel of the 240 volts of the British 'mains', twice as powerful as the US standard," he laughs.

The love affair with science continued even as Goodchild hated the boarding school he was sent away to at age 7. "Many railed against the system in one form or another and the school had its fair share of rebels," he recalls. "Much of my rebellion was technical, such as, wiring the dormitory so that we could communicate by Morse code after hours."

As an undergraduate at Cambridge (1962-65) studying Physics, Goodchild joined the university's Caving Club. "We would rent a minivan, spend most of Friday night driving the contorted and congested British road network, explore wet, muddy, and cold caves, drink to ease the pain, and drive back to Cambridge in time for Monday classes," reminisces Goodchild. Little idea did he have at the time how caving would later define his career path.

Goodchild flew out of London the day after Cambridge graduation to join a new group doing cave research at McMaster University in Ontario, Canada — the place where he had his first encounters with academic geography. "I drew several principles from my early exposures to geography: that selected geographic phenomena can be subjected to the same kinds of rigorous scientific analysis and theorizing that are typical of phenomena in physics; that technical expertise will always be in short supply in geography, and the technically-able will always find plenty to occupy their minds; that geographers can study almost anything, provided it exists within the geographic domain; and that a first-hand experience with geographic phenomena is both essential to research and also a wonderful excuse to indulge a love of travel."

Goodchild with his wife Fiona in California, 1996

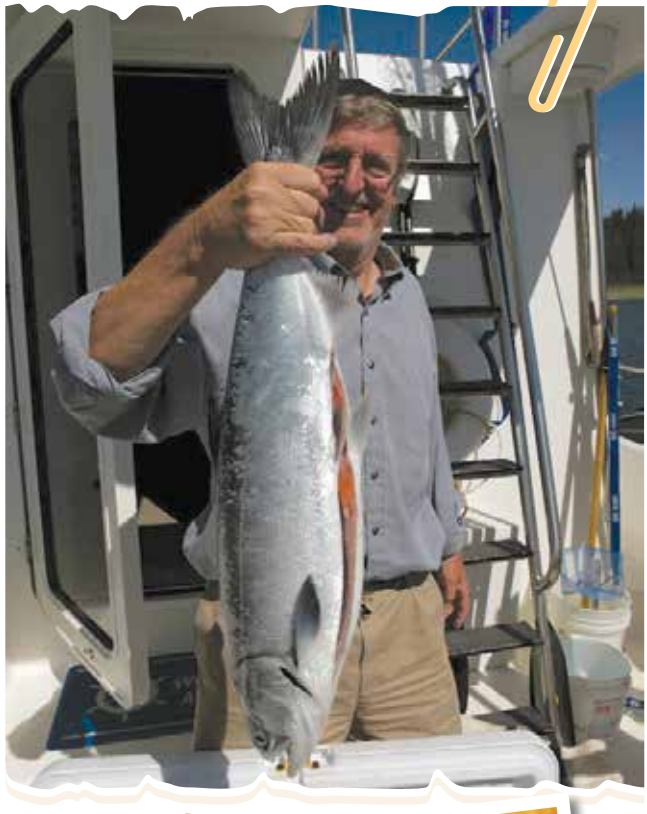
Being elected Foreign Member of the Royal Society UK, 2010

> My greatest victory was in convincing people that GIS was more than simply a computer application. It is a science

> Technical expertise will always be in short supply in geography, and the technically-able will always find plenty to occupy their minds

It was through his doctoral advisor Dr Derek Ford that Goodchild met his wife Fiona — a Scottish historian he married in 1968 and with whom he shares three daughters and seven grandchildren. Fiona went on to work in science education, running a series of programs for which she was funded by the National Science Foundation (NSF), and won a Presidential award from the White House for her success in mentoring students in science, engineering, and math.

In 1969, Goodchild joined the University of Western Ontario as an Assistant Professor. "I spent long hours thinking about every word of each lecture, and my biggest anxiety was to run out of material. I fantasized about an emergency system in the building to summon any available professor with a coded message that would signal 'Professor drying up in



Goodchild likes to enjoy life — growing vegetables, or hiking, or fishing for salmon in Alaska

With his NCGIA gang, 1990s

DID YOU KNOW?

MICHAEL GOODCHILD HEADED THE NATIONAL CENTER FOR GEOGRAPHIC INFORMATION AND ANALYSIS FOR TWO DECADES

Goodchild (right) with Jack Dangermond (center) and David Rhind (left) at the Natural History Museum, London, in 1996

Room 2050'. I still believe that if teaching ever feels easy, that is likely an indicator that I am not giving it enough thought or effort."

Meanwhile, the Canada Geographic Information System was in deep political trouble, having failed to deliver in its promised outputs. Goodchild was brought in as a consultant on the project — an experience which triggered in him an eternal passion for GIS.

"In the 1970s, there were no commercially available GIS software products. By the end of the decade, I had programmed solutions to many of the major problems of GIS, including polygon overlay, and was subjecting my students to all of the hazards of software written by amateurs," he recalls. "I wrote a paper in 1975 subtitled *The Map as a Stochastic Process*, arguing that one could model the contents of maps as if they were the outcomes of random processes. In hindsight, this was the first in a series of transitions between GIS as a technology, and GIS as the source or motivator of fundamental scientific problems."

By 1985, Goodchild was aggressively advocating how GIS could address fundamental and long-standing issues in academic geography. In 1987, when the NSF sought faculty to run the National Center for Geographic Information and Analysis (NCGIA), Goodchild was the first to get a call.

It soon became evident that he would need to move to Santa Barbara, California. What was not

apparent at that time was the NCGIA would become the nucleus for transforming people's perception of GIS.

"In the late 1980s many geographers were able to dismiss GIS as 'mere technology', so I and a few others were motivated to show that it raised important intellectual questions that were fundamental to science," says Goodchild. "I developed these ideas in a paper in 1992 titled *Geographic Information Science*, and in a number of further papers that explored GIScience as a theoretical and empirical discipline of critical importance to geospatial technology."

His theory that *GI Science* is the storehouse of knowledge that makes *GI Systems* possible soon became a unifying force for the community. His thoughts urged researchers to think more scientifically and holistically, eventually leading to a parallel establishment of GIScience as a critical forum in the information society.

Goodchild headed NCGIA for nearly two decades. From 1988 to 1996, NCGIA was funded at just over $1 million per year by the NSF. It produced over 1,000 papers, as well as numerous books, reports, software products, datasets, and instructional materials. Several conference series owe their origins at least in part to NCGIA, including COSIT (*www.cosit.info*), SSTD, GIScience (*www.giscience.org*), Spatial Accuracy Assessment, and GIS and Environmental Modeling.

After NCGIA's core funding ended in 1996, Goodchild managed to get external funding amounting to over $40 million for his pet projects — the Varenius project, the Alexandria Digital Library, the National Center for Ecological Analysis and Synthesis, and the Center for Spatially Integrated Social Science.

DID YOU KNOW?

PROF MICHAEL GOODCHILD COINED THE TERM GISCIENCE IN HIS LANDMARK 1992 PAPER, IN WHICH HE ARGUED THAT GIS WAS MUCH MORE THAN SPATIAL DATA HANDLING

Installing a plaque to mark the 120th Meridian, just west of Santa Barbara, in celebration of the founding of UCSB's Center for Spatial Studies

With his wife Fiona, three daughters, sons-in-law, and grandchildren, Lake O'Hara, Canada, 2005

Giving keynote speech, It's About Time: The Temporal Dimension in VGI, at Esri workshop in 2011

Honorary Doctor of Science, McMaster University, 2004

Goodchild was elected member of the National Academy of Sciences, US in 2002

> "If teaching ever feels easy, that is likely an indicator that I am not giving it enough thought or effort"

So, it wasn't a surprise when Goodchild got elected to the US National Academy of Sciences, the Royal Society of Canada and the UK's Royal Society. In 2007, he received the Vautrin Lud Prize, colloquially known as the 'Nobel Prize for Geography'. But for Goodchild, these numerous awards and honors are not his greatest achievements.

"The greatest victory was in convincing people that GIS was more than simply a computer application. It is a science. It has some fundamental questions and some fundamental discoveries and principles and laws. It constitutes a very important branch of science; one that deserves a great deal of attention," stresses Goodchild, who retired in 2012 after publishing over 15 books and 500 articles, and serving on the editorial boards of several journals and book series.

The last five years have seen life settle into a mellow, manageable rhythm for Goodchild. He can be spotted growing vegetables and flowers, or hiking and biking around Seattle and in the mountains. And with seven grandchildren, family activities often translate into a full-time job. Even then, he finds time to do consulting for Esri and serve as an expert witness in lawsuits over patents on geospatial technology.

Because even at the age of 72, Michael Goodchild is all about intrigue. And just *so much* of it.

KK Singh

Founder, Rolta Group

Hall of Fame.

ROLLING IN THE DEEP

WHEN IT COMES TO choosing a career path, India has a long tradition of following the family practise. It is pretty common to see a doctor's son taking up medicine or a chartered accountant's daughter joining her father's firm. So, when the son of the Dean of the city's medical college and the grandson of the state's most prominent physician decided to break the family tradition, quite a few eyebrows were raised.

No, it wasn't that Kamal K Singh was a rebel. He was just fortunate enough to have a mother who refused to push her child into taking the conventional route to success. "My mother said: I have seen your grandfather minting money. He made tremendous name for himself, but he had no time for himself or family. Your grandfather left everything he owned to your father and that money is helping us to support you. Otherwise in his own salary today, we can't afford to spend ₹1,000 a month for the education which you are getting. So my advise is, do something different," recalls Singh, who then went on to pursue mechanical engineering.

But, even as he was studying to be an engineer, Singh had decided to take the untrodden path. "I was probably 17 when I decided I will do my own business," he says. "I was a topper throughout my college days, but I never gave a single campus interview."

It wasn't long before Harvard University Business School beckoned Singh to earn a Master of Business Administration degree along with a hefty scholarship. With a few months to kill before the course was to begin, Singh set up a steel rolling mill on the behest of a family friend. When the time came for school to begin, Singh had to choose between the life of an executive in the United States and his dream of setting-up his own business.

The first-generation entrepreneur chose well when he decided to stay back in India. Because taking that humble

Chairman's Statement

We are at a pivotal point in history. Thanks to the force of the Internet, and the explosion of mobile communication, everything we know is undergoing dramatic change. Change, in fact, is no longer something to which we have to adapt, it's now the environment in which we live.

At Rolta too, we have undergone a transformation that will be regarded as our most significant ever. It was in 2008, we began a process of introspection and deliberated with leading consultants on our path forward so that we could continue to thrive and grow for decades to come. The outcome was a strategy to transform our business, from a model that was Services-centric to an IP-led one.

Today, we have transformed all our businesses by adding IP – Geospatial, Engineering, Enterprise IT, and Defence & Security, are all much stronger today due to this transformation. For example, the Geospatial business is much more healthier, as we are now able to capture requirements of both, the emerging markets that are built around services for data creation, as well as of developed markets, which require IP for data analysis, while in the Engineering domain, we have opened up much larger markets, due to our ability to now very well address the OPEX requirements of various plants, through our reliability and operational excellence solution, in addition to our traditional services offering for CAPEX projects.

But the largest transformation that has happened is in our Enterprise IT business, where we have built really robust capabilities at the front-end in North America for market access, credibility and differentiation in cutting edge technologies like, Real Time Business Analytics, Big Data, Cloud, Mobility, Business Intelligence, Enterprise Performance Management and Software Defined Infrastructure. We have done this by acquiring companies that give us a track record of over two decades, thousands of customers, offices at key locations, highly qualified personnel, key IP and access to newer markets – especially in the high growth verticals of Banking, Financial Services, Insurance, Retail, Healthcare and Manufacturing. These companies were already successful in the US using their onshore resources, which we have since supplemented with a solid offshore capability.

Today, when one looks at each of these businesses on a standalone basis – they are all very exceptional, especially due to this transformation. It is however, our ability to combine these businesses with each other, and cross utilize our IP and specific industry vertical know-how that gives us a very strong competitive edge.

This combination has allowed Rolta to build a solid Defence and Security business. Today, we are one of the very few select companies that have been qualified to bid for large

In the past one year alone, we have seen very significant multi-million dollar contract wins at industry-leading companies, against behemoths of the IT industry, when we have been able to combine our Geospatial, Engineering and IT capabilities.

For example, Memphis Light Gas & Water, USA chose Rolta for a US$ 31 Million project, due to our ability to provide end-to-end business transformation to MLGW, centered around integrating business & GIS Systems by leveraging the combination of Rolta Geospatial & IT expertise.

Similarly another utility, Northern Power Grid, UK, (a Berkshire Hathaway company) has awarded contracts of over US$ 15 million to Rolta, for delivering a solution that takes advantage of Rolta's Geospatial & IT capabilities for

and The Dow Chemical Company. We are executing a multi-million dollar contract from Sadara to implement a comprehensive Engineering System, by uniquely combining our Engineering and IT expertise.

As we have transformed our offerings stack to an IP led one, so have we transformed our ability to take these offerings to world markets. For example, we today have a game changing partnership with SAP, that allows us to take advantage of their sales organization and customer base. We are one of the very few selected strategic global partners of SAP, who can leverage SAP's worldwide sales engine to provide their customers with state-of-the-art Business Analytics and Big Data solutions by exploiting the power of SAP technology bundled with Rolta IP, through cost-effective and high value solutions. As a result, our access, as well as credibility viz.

Telecom, Power, Oil & Gas, Petrochemicals, Banking, Financial Services & Insurance, Retail, Manufacturing & Healthcare.

Our journey of transformation has been arduous. It has taken time, significant investments, and not been without its struggle. But its end result has been very rewarding – we today have a non-linear business model, which is built on revenues through sales of Rolta IP based solutions, rather than being dependent only on services. We have thus been able to increasingly monetize our investments for this transformation – through increased margins, higher customer stickiness and increased annuity revenues. We expect to continue rewarding our stakeholders and monetizing this transformation in the coming years.

Rolta today is a world leader in it's field, thanks to Singh's leadership and vision

One thing Singh had was unflinching support of his wife… who stood by him through thick and thin

A happy family life has been a core inner strength for Singh

steel works plant to the heights of high technology, Singh has led from the front the four-decade-long transformation of one of India's most iconic companies — Rolta India.

At that time, though, Singh's father wasn't too pleased with this decision. So, Singh took refuge in his mother's positive affirmations and his wife's unflinching support. "My wife always understood my decision; she has given me much-needed strength."

A few years down the line, Singh learnt that steel wasn't strong enough to build him a business empire. The cyclical nature of the business meant that whatever Singh earned in 2-3 years would go into sustaining the business for the next couple of years. Singh sold off the company, but not the firm's name. "Rolta borrows initials from my grandfather, mother and father's names. I always wanted a name which is very easy to pronounce; is not a tongue twister and can be accepted internationally."

> "Rolta borrows initials from my grandfather, mother and father's names. I always wanted a name which is very easy to pronounce; is not a tongue-twister and can be accepted internationally"

In 1982, Rolta started as data-processing company. "Technology is something I was very passionate about. In late '70s, to buy IBM 1401 and start putting into steel plant and using it for the various MIS and other things was unheard of, and I was doing that. And that is where I went. I started an IT company. Within a year

Singh being felicitated by Atal Bihari Vajpayee, Former Prime Minister of India, with the National Export Award

> I was probably 17 when I decided I will do my own business. I was a topper throughout my college days, but I never gave a single campus interview

Singh is a regular speaker at top conferences

we were doing software development, we were providing packages. And within two years we were doing all kinds of turnkey services," Singh recollects.

DID YOU KNOW?

KK SINGH GAVE UP STUDYING IN HARVARD UNIVERSITY BUSINESS SCHOOL TO BECOME AN ENTREPRENEUR

Not that this business came without a set of challenges. In those days, IT was a taboo. It was supposed to be taking jobs away. "Our competition in those days was also TCS. They were the big daddy of the business. I used to get jitters thinking if they decided to cut down their price, what will we do?"

So, to dispel the competition and add value to his business, Singh again started brainstorming. "Advanced countries like America and Europe were utilizing CAD/CAM/GIS, but

Singh being felicitated by Dr APJ Abdul Kalam, 11th President of India, with the Geospatial Entrepreneurship Award

Singh being honored with the Lifetime Achievement Award by Hamid Ansari, Vice President of India

these technologies were nowhere to be found in India." So, Rolta became the first company to introduce GIS solutions in India in 1985.

What followed was a huge contract. "Our first customer was the Survey of India. We gave them a customized Digital GIS system worth $10 million in those days, with complete support coming from us and our exclusive partners, like Intergraph."

At GeoSmart India 2016: Inaugurating the 'India Industry Report'

Even as orders flowed in, Rolta realized the government was not catching up in policy. The restrictive license raj regime was on the verge of spelling a death knell for the nascent industry. Something had to be done.

Since the whole process of importing hardware and software was taking 2-3 years, Rolta decided to build engineering workstations in India in 1989. The company set up assembly plants, imported components and tied-up with Intergraph technology and software at a huge cost of millions of dollars. That one decision transformed the company's success rate. One of the first customers for indigenous systems was the state-owned telecommunications service provider in the metro cities of Mumbai and New Delhi MTNL.

DID YOU KNOW?
ROLTA STARTED OFF AS A STEEL ROLLING MILL COMPANY

"Everywhere we went and our systems got welcomed with open arms. We captured 70-80% of the market in those 3-4 years. That's how we became kind of a market leader. The engineering workstations which we produced were also used for engineering plant design, and we captured 85% of that market," he explains.

However, the man soon realized he was missing the woods for the trees. "In my own passion for CAD/CAM/GIS, I neglected IT. We had just won our first large contract of

> Sometimes, I feel that I am a first-class labor. Working and slogging morning to night. I still work 70-80 hours a week. But, I feel fulfilled and satisfied, and that's all that matters.

With Bentley Systems CEO Greg Bentley

With Hexagon CEO Ola Rollen

With Trimble CEO Steve Berglund

$30 million for doing the complete digital mapping of Saudi Arabia. At that time, GE approached us, and I didn't give it the kind of attention that I should have," Singh sighs.

Rolta hastily entered IT setting up an internet service provider business in Mumbai, but it lagged behind the competition for years. "Even by 2005, my IT revenue was not even 10% of what our other revenues were. We were too late."

A major transformation came in early 2000 period when Rolta decided to change from a software service provider to an engineering and procurement or EPC firm. By 2005, Rolta was designing end-to-end large petrochemical plants in strategic joint venture with big names like Shaw. Singh also engineered the company's expansion in the defense sector, by providing state-of-the-art GIS based C4 ISR systems to the Indian Army. And then, between 2008 and 2015, Rolta decided to fully transform its business from a service-centric model to an IP-led model.

DID YOU KNOW?

ROLTA WAS THE FIRST COMPANY TO INTRODUCE CAD/CAM/GIS IN INDIA

But, this business transformations had come with a lot of pain points. "The only way was to acquire a lot of companies worldwide. For that I needed lot of investment. In the process, we spent over a billion dollars. Our market capitalization went down. From 'no debt', we became 'high debt'."

The sacrifice proved worthwhile as the company started getting well recognized for in-house developed IP-led Geospatial, Engineering and IT solutions worldwide. Rolta also leaped forward in the field of Digital IT Products including Big Data Analytics and Defence. And now, Rolta is playing a substantial part in what he calls the fourth industrial revolution

Over a span of 40 years, Singh has made Rolta a global name. And his secret is nothing but hard work. "In my mind, I would never retire," he says. "Sometimes, I feel that I am a first-class labor. Working and slogging morning to night. I still work 70-80 hours a week. But, I feel satisfied." And that's all that matters.

Walter Scott

Founder, DigitalGlobe

TRANSFORMING THE WORLD: ONE IMAGE AT A TIME

THEY SAY OPPORTUNITY DANCES WITH those who are already on the dance floor. But, if you are Dr. Walter S. Scott, you find a way to make opportunity dance with you even when your foot is broken! The year was 1991 — one day after Scott's bachelor party. His marriage was to take place in two weeks. And Scott was holed up in his room nursing a broken foot following an impassioned game of paintball with his best friend. This down time gave Scott time to work on a business plan he had been thinking about for a while.

The Cold War had ended. The world was set for a transformation. "I remember thinking at the time that any time there is change, there is opportunity," says Scott, who was then handling top defense projects at the Lawrence Livermore National Laboratory in the United States.

> We are fortunate that trends like cloud computing, machine learning and crowdsourcing are enabling analytics in a way that was never before possible

Satellite imagery proved to be a key factor during the Cold War, enabling the US to make decisions based on fact, not fear. "The GIS industry was emerging, computing costs were going down, Internet had been introduced, and the government was mulling letting the private sector enter the satellite imaging business. I remember thinking — why can't these technologies be applied to a broader group of users?"

Scott never went to business school and he didn't have any experience formulating business plans. "But, I knew this exercise wherein you prove how stupid your idea is. And

The QuickBird satellite was the first in a constellation of sub-meter spacecraft that DigitalGlobe developed to offer highly accurate, high-resolution commercial satellite imagery of Earth. It was launched in 2001 and decommissioned in 2015

DID YOU KNOW?

DIGITALGLOBE SAW TWO MONUMENTAL FAILURES AND NEARLY A DECADE OF HEARTACHE AND FRUSTRATION BEFORE IT SUCCESSFULLY PUT A SATELLITE UP IN SPACE

if by the end of the exercise, you can't prove it is stupid, it might actually be worth doing," he quips. WorldView Imaging Corporation was created in January 1992 — seven months before the Land Remote Sensing Policy Act was enacted.

WorldView Imaging went on to become the first private business to receive a high-resolution commercial remote sensing license under the landmark 1992 Act. Scott's vision in creating and nurturing WorldView Imaging brought a marked shift in overall drive towards scalability and utility in space industry. Nonetheless, getting the company off the ground was no easy task.

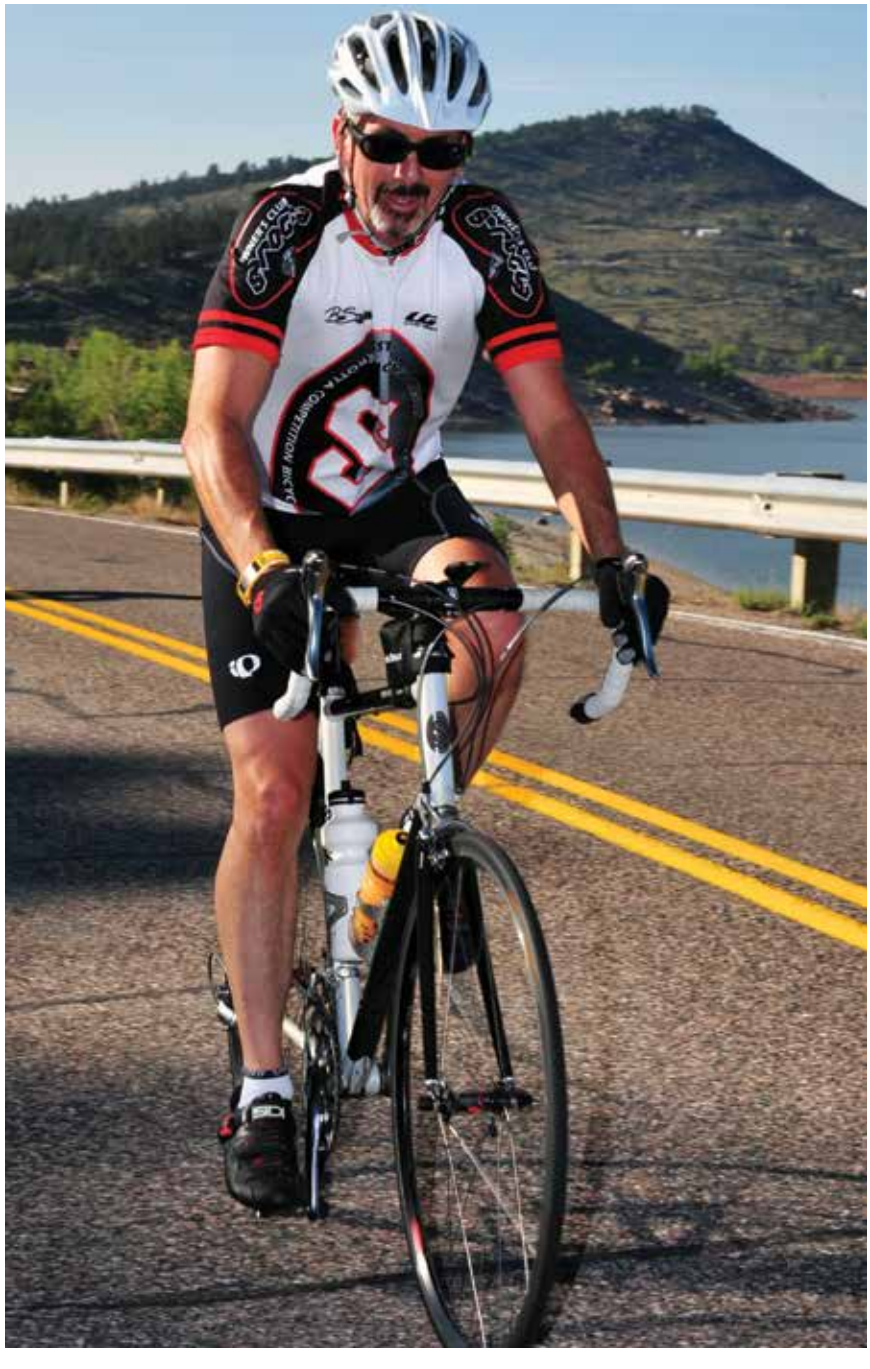
Rome imaged by WorldView-2 in December 2009: Caracalla archaeological area, with its impressive thermae, appears in the left part of the image; the FAO white building is toward the right

On November 11, 2016, DigitalGlobe's earth observation satellite WorldView-4 launched from Vandenberg Air Force Base in California. Lockheed Martin built the satellite. WorldView-4 offers 30cm satellite imagery – the highest resolution commercially available

In a span of seven years, WorldView Imaging saw two massive failures. "We blew up our first satellite, EarlyBird-1. The second, QuickBird-1, was a launch failure," Scott sighs. "For several years, I was living off my wife's income. We had become famous as the company known for blowing-up most remote sensing satellites. Luckily, I had a very supportive board of directors, and an equally supportive group of investors."

Then came October 2001, when QuickBird-2 went up successfully. The company, which had reorganized itself as DigitalGlobe by that time, started offering the world's highest-resolution commercial satellite imagery. It has never looked back since.

Ringing the bell: On December 15, 2009, executives and guests of DigitalGlobe visited the New York Stock Exchange to commemorate the company's initial public offering on the NYSE on May 14, 2009



Scott is an avid triathlete. After a couple surgeries, now he is only allowed to cycle

"I wouldn't say the dream came true overnight. I would say that some of the biggest barriers to the dream finally went away by having a satellite in the orbit. It was amazing to be able to sit at the satellite control centre and see on the screen pictures that were taken from the other side of the planet a few minutes ago," said Scott.

Now came the part where the team had to figure out how to make money. "It turned out putting the spacecraft into the orbit is actually the easy part. Building a business out of it is when the heavy-lifting happens. You couldn't go to governments and businesses and say: 'Hey, look there some really pretty pictures from space!' At best, it would mean these people would hang them on their walls as artwork. The need was to actually connect them with the value of these images, and show them how they can use the imagery to save lives, resources and time."

> Putting a spacecraft into the orbit is the easy part. Building a business out of it is where the heavy-lifting happens

Key partnerships with big customers, including Google and Microsoft, for location-based services and mapping applications poured in over the years but, not without intense competition from firms like Space Imaging, which operated the IKONOS satellite.

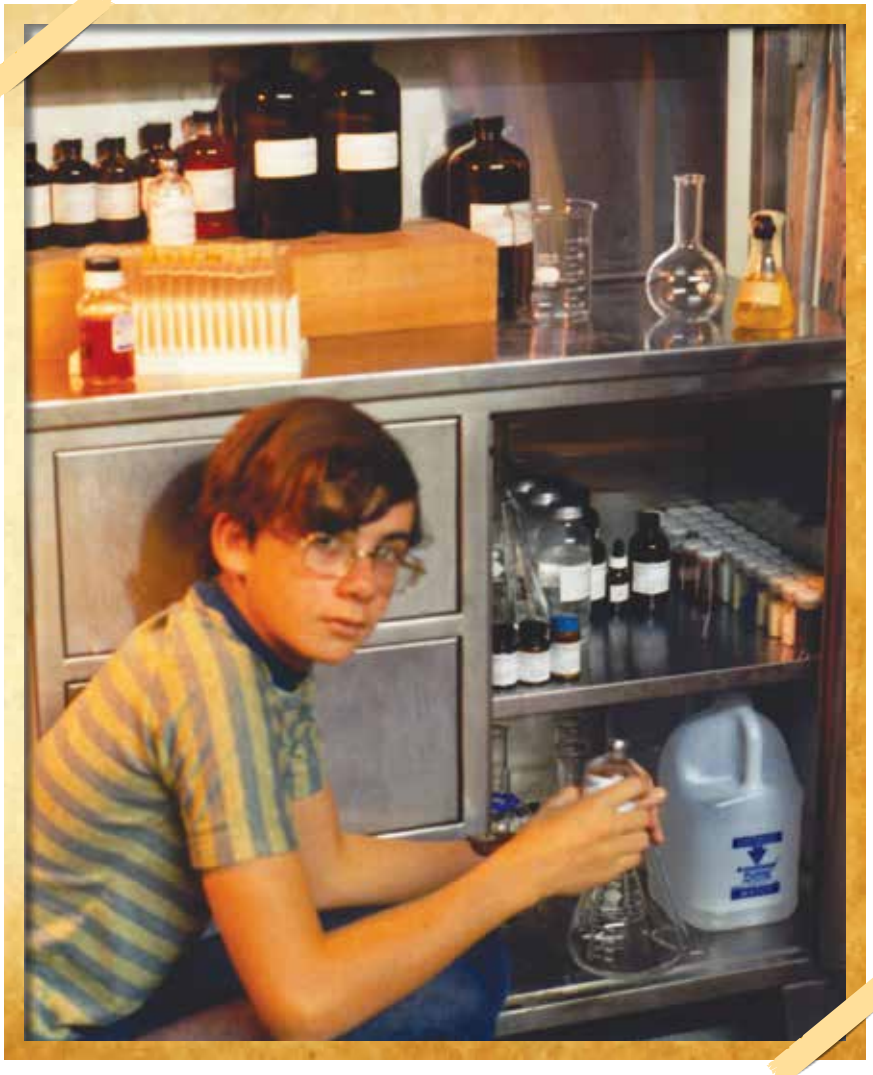
In 2003, the National Imagery and Mapping Agency was inviting bids for its prestigious NextView contract, intended to spur development of commercial imaging satellites. At the time, Space Imaging was Goliath, and DigitalGlobe was seen as David. To the surprise of the industry, DigitalGlobe won the first contract. David had beaten Goliath, and Space Imaging was soon up for sale and absorbed by rival firm GeoEye.

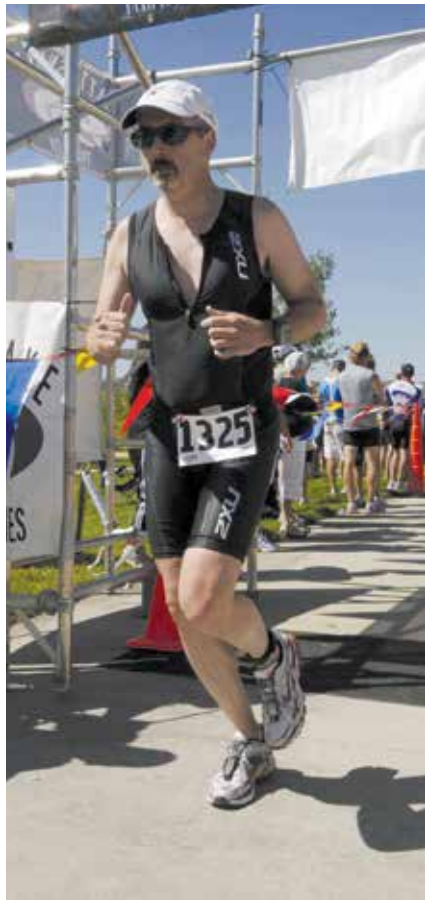
The NextView contract helped DigitalGlobe develop and deploy the revolutionary WorldView-1 satellite in 2007. Scott had put the company's trajectory well in advance of the competition. "WorldView-1 was a dramatic step-up in capability, and in retrospect, was really the first commercially viable remote sensing system. The investment we made in the WorldView constellations was delivering dramatically greater value per dollar than was being delivered by the GeoEye constellations."

Eventually, in 2013, the two companies merged making DigitalGlobe what it is today. What followed that merger was the launch of WorldView-3, providing the highest resolution satellite imagery commercially available. In 2016, DigitalGlobe followed it up with the launch of WorldView-4, thus increasing its capacity for 30cm resolution imagery. "WorldView-4 is not encumbered to provide imagery for the

The Jane Goodall Institute utilized DigitalGlobe's satellite imagery to make effective conservation decisions

Scott giving a special plenary session on 'Remote Sensing and the Impact on Sustainability' at American Geographical Society, November 2016





Left: Young Scott in a chemistry lab

Top: After satellites and imagery, sports is what excites Scott

> For several years, I was living off my wife's income. We had become famous as the company known for blowing-up most remote sensing satellites

Scott was chosen as Esprit's Entrepreneur of the Year 2003. In this news clipping, Scott is seen holding a model of the company's satellite that delivered high-resolution images of specific areas around the globe

Long, winding road to DigitalG

BY JOHN AGUILAR
Business Report Correspondent

LONGMONT — After nearly a decade of monumental frustration and heartache in trying to put a commercial satellite in space, Longmont-based DigitalGlobe succeeded in 2001.

This April, the Longmont-based company recorded its first profitable month ever. Then at the end of September, the company proudly announced a five-year contract with

Esprit

Esprit Entrepreneur 2003

Entrepreneur of the Year

Like trying to keep a marriage together ... the death of a baby."

DID YOU KNOW?

MORE THAN A BILLION PEOPLE AROUND THE WORLD USE NAVIGATION MAPS POWERED BY DIGITALGLOBE'S IMAGERY TO GET FROM POINT A TO POINT B

Top: WorldView-4's first public image, taken on November 26, 2016 features the Yoyogi National Gymnasium in Shibuya, Tokyo

Right: The Pearl Island in Qatar, as imaged by QuickBird

US government. That has enabled us to offer priority access to other customers. It's a purely commercially-driven satellite," Scott said.

Looking ahead, Scott, predicts radical changes to come in how imagery is processed. "I have seen a set of enablers that have emerged in the last few years that have made analytics on a very large scale suddenly possible. One of them is cloud computing. The second enabler is the emergence of machine learning algorithms that are now sophisticated enough to be trained to recognize objects. The third enabler is crowdsourcing. We are fortune that these kind of trends are enabling large-scale machine analytics in a way that was never before possible."

What also excites Scott is sports. An avid triathlete, Scott has kept his orthopaedic surgeon busy with a couple of shoulder surgeries, a knee surgery and a hip surgery. "Now, I'm only allowed to do cycling when I'm not taking meetings. I find it helps me keep my mind clear."

It has been over a quarter of century since the Cold War ended. In those 25 years, DigitalGlobe has been a leading innovator in the commercial satellite industry, monitoring how the world has changed and leading to greater global transparency. Today, more than a billion people around the world use navigation maps powered by DigitalGlobe's imagery to get from Point A to Point B. The company's customers range from urban planners, to conservation organizations like the Amazon Conservation Team, to US federal agencies like the National Geospatial-Intelligence Agency (NGA). Over the years, DigitalGlobe's imagery has helped prevent atrocities, war crimes and humanitarian crises. It has helped transform our world — based on facts, not fears.

HE TOOK THE ROAD LESS TRAVELED BY AND THAT MADE THE DIFFERENCE

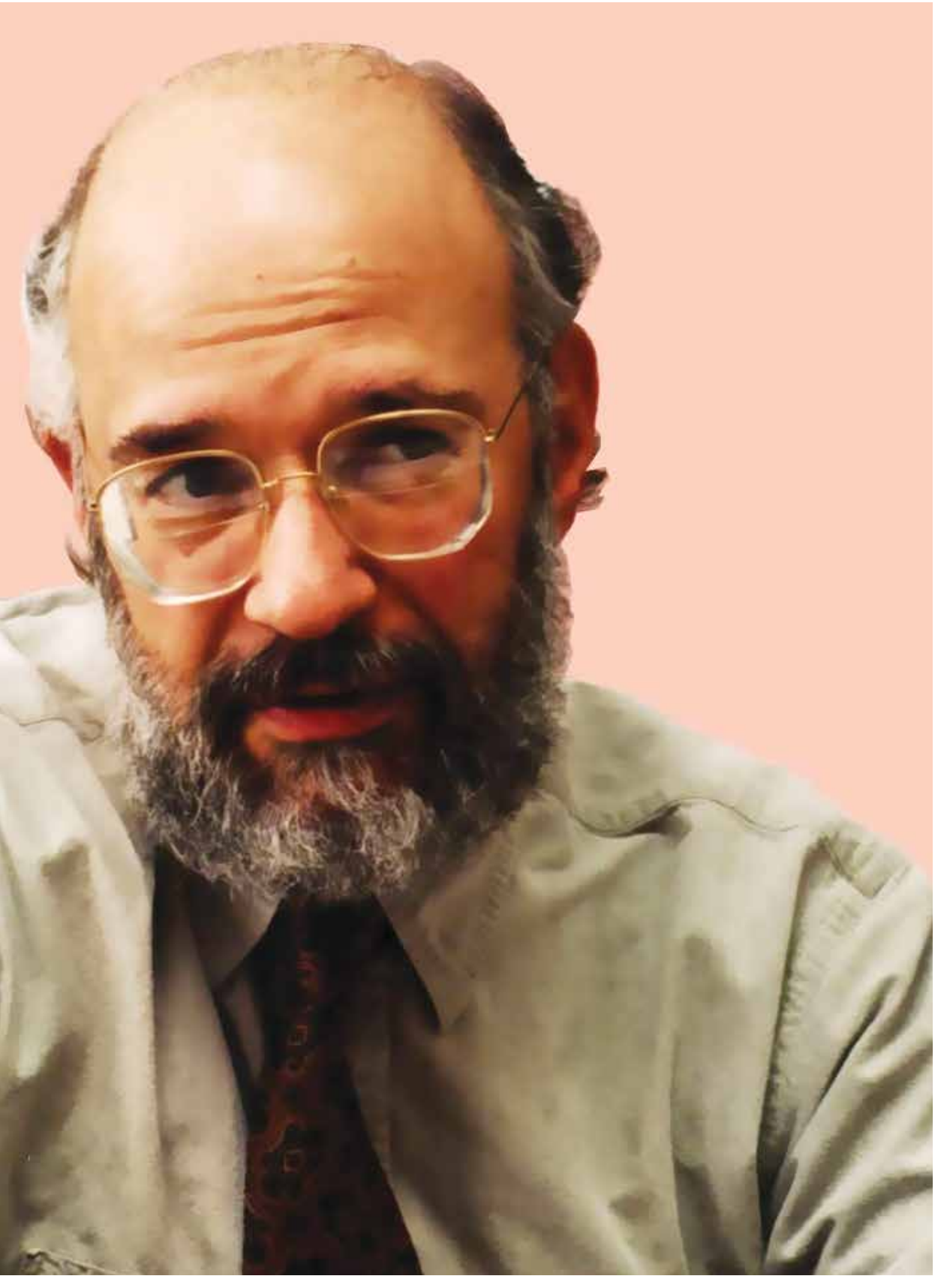
David Schell

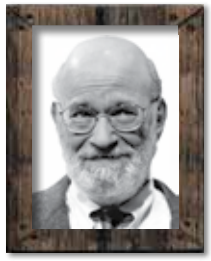
Founder, Open Geospatial Consortium

THE MAN WHO INVENTED THE BENCHMARK

THEY SAY, QUALITY ATTRACTS quality. And today, quality in geospatial industry is defined by one stamp — Certified OGC Compliant. Whoever carries it is genuine. They are the real deal. They are bona fide. But, in 1985, if you were told that a computer industry system programmer would start the revolution that would craft and shape the fabric of geospatial industry for the next 30 years, you might have laughed. Nevertheless, David Schell did exactly that.

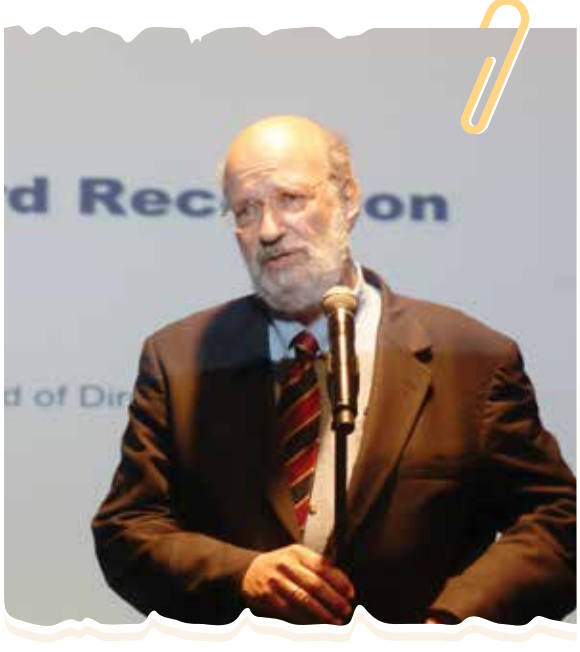
Schell presenting the Gardels Award to Dave Danko, Esri, June 2009





Schell receives an award from Kevin Bache of the US Army Corps of Engineers

> OGC is a remarkable organization. It involves a wonderful marriage of technology and idealism, technology and values



The Gardels Award is presented each year by OGC. Schell on the occasion of award ceremony, June 2009

Schell's interest in geospatial technologies began three decades ago, in 1986. Schell was working for a small Unix workstation company, MASSCOMP, where he got introduced to the world of GIS software. One of the customers was the US Army Corps of Engineers. When they needed support for a GIS product called the Geographical Resources and Analysis Support System (GRASS), Schell was the man on the job. GRASS was one of the first international open source development projects.

DID YOU KNOW?

OGC CURRENTLY HAS 521 ACTIVE MEMBERS. IT STARTED WITH 20 MEMBERS IN 1994

The Army Corps was not the only one using GRASS. Many other US government

agencies and the academic community were also using this internationally popular raster GIS for research. Schell realized that unhindered flow of digital spatial information was critical for addressing global issues like environment and geo-political decision-making. But, the existing GIS market was very limited. Data sharing problems needed to be solved by using a standard, open system.

At that time, one of the users of MASSCOMP systems and author of one of the first GIS textbooks, Prof Peter Burrough of the University of Utrecht, urged Schell to contact Carl Reed, president of a small, UNIX-based vector-GIS company called Delta Systems. It wasn't long before Schell had Delta Systems overlay vectors on GRASS images, beginning the evolution of Open GIS.

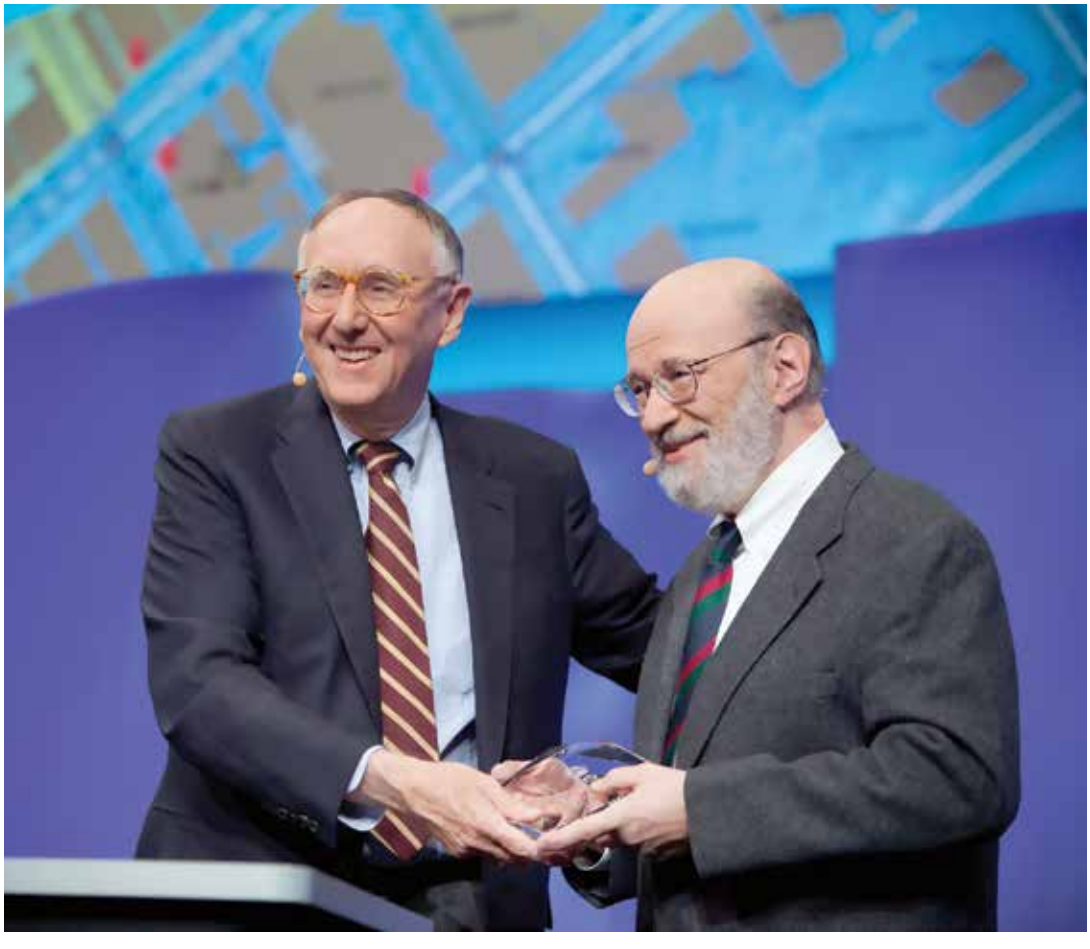
At this point MASSCOMP became the victim of a leveraged buyout and Schell found himself doing consulting work. A year later, the GRASS User Forum founded a non-profit corporation called the Open GRASS Foundation, or OGF, to support the development of geospatial interoperability. Schell was chosen to lead the foundation.

OGF became the incubator of Open GIS and geospatial interoperability. "The ability to interoperate between multiple modes and operations created a kind of a revolution equivalent to the 'Gutenberg' revolution where all of a sudden knowledge can spread through Web with tremendous speed and tremendous ability to do good," says Schell.

OGF gained a foothold when it received an educational grant from Sun Microsystems. The company's Academic Grants program awarded new SPARCstations worth $80,000 to support an OGF proposal that multiple product organizations work together to integrate for the first time

DID YOU KNOW?

OGC WAS FOUNDED WITH EIGHT CHARTER MEMBERS AT THE TIME OF ITS FIRST BOARD OF DIRECTORS MEETING ON SEPTEMBER 25, 1994. THESE MEMBERS WERE CAMBER CORPORATION, UNIVERSITY OF ARKANSAS - CAST, CENTER FOR ENVIRONMENTAL DESIGN RESEARCH AT THE UNIVERSITY OF CALIFORNIA - BERKELEY, INTERGRAPH CORPORATION, PCI REMOTE SENSING, QUBA, AND USDA SOIL CONSERVATION SERVICE



Schell was presented with a 'Making a Difference' Award by Jack Dangermond at the Esri Federal GIS Conference, February 2012

Schell (left) with noted climate scientists Dr Roberta Balstad of Columbia University and Dr Robert Corell, who have both served on OGC's board of directors

> We aspire to create an opportunity for scientists to model complex views of the reality of the world that enable them to have a much more accurate sense of our future

Top: GRASS Newsletter: GRASSCLIPPINGS; from 1985 to 1992, Schell worked extensively with the US Army Construction Engineering Research Laboratory (USACERL) on commercialization of its GIS product, the 'Geographical Resources and Analysis Support System' (GRASS)

Right: Receiving GeoTech Media's 2007 Visionary Achievement Award

a functionally interoperable geo-spatial development environment. This was followed by a coopera-tive agreement with NASA, which got OGF the time it needed to refine the concept of Open GIS.

Schell organized OGF with his strategic vision and recruited the commercial participation needed to develop a framework for geospatial interoperability. In 1993, OGF organized a user meet in Washington, D.C., which was attended by more than 400 people despite a record snowfall hampering air traffic throughout the Eastern US.

When the Corps made a decision to discontinue its support of GRASS, the OGF board of directors voted to reorganize OGF as an open consortium focused on developing open standard interfaces that would make it possible for different geospatial systems to interoperate.

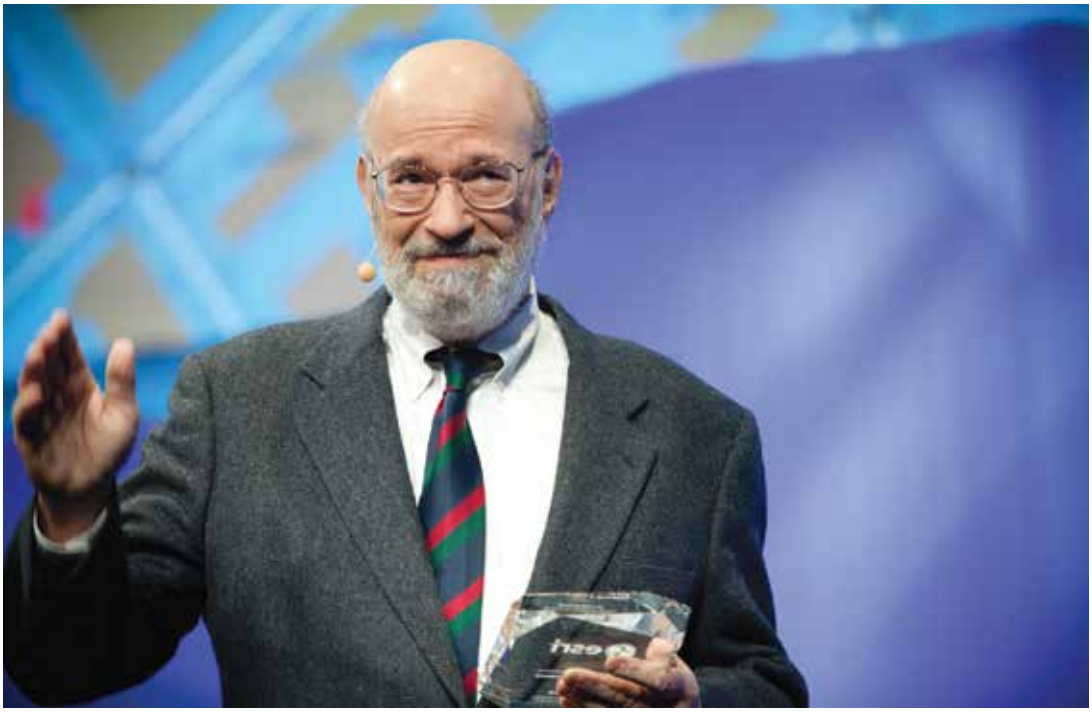
Thus was born the Open GIS Consortium, now known as Open Geospatial Consortium, or OGC. Schell served as both Chairman and CEO of OGC from its founding in 1994 until 2008. "OGC is a remarkable organiza-

DID YOU KNOW?

OGC IS THE ONLY INDUSTRY CONSORTIUM THAT COMPREHENSIVELY ADDRESSES THE ISSUES OF SPATIAL AND TEMPORAL COMPUTING TO ENABLE THE INTEGRATION OF ALL SPATIAL DATA TYPES AND REAL-TIME SPATIALLY RELATED TECHNOLOGIES INTO MAINSTREAM ICT

Top: Schell at a meeting that includes Bob Moses, one of the original founders of OGC

Left: Receiving the Lifetime Achievement Award from Dr APJ Abdul Kalam, 11th President of India, during Geospatial World Forum 2012



At Esri Federal GIS Conference, 2012

> I take great pride in what we have been able to build, and what you [OGC members] will be able to create

tion. It involves a wonderful marriage of technology, idealism and values," Schell stresses. "I am proud of the fact that what we have done has had a very helpful effect in people's communication and everyday life. Location services have enabled people to do things for themselves that were unheard of."

Schell is known for his ability to sense where the market is going and figuring out course correction to keep the organization relevant. He calls it the 'arc of IT'. It helped him steer the OGC through almost two decades in which information technology (IT) was evolving rapidly and forcing major changes in all types of organizations.

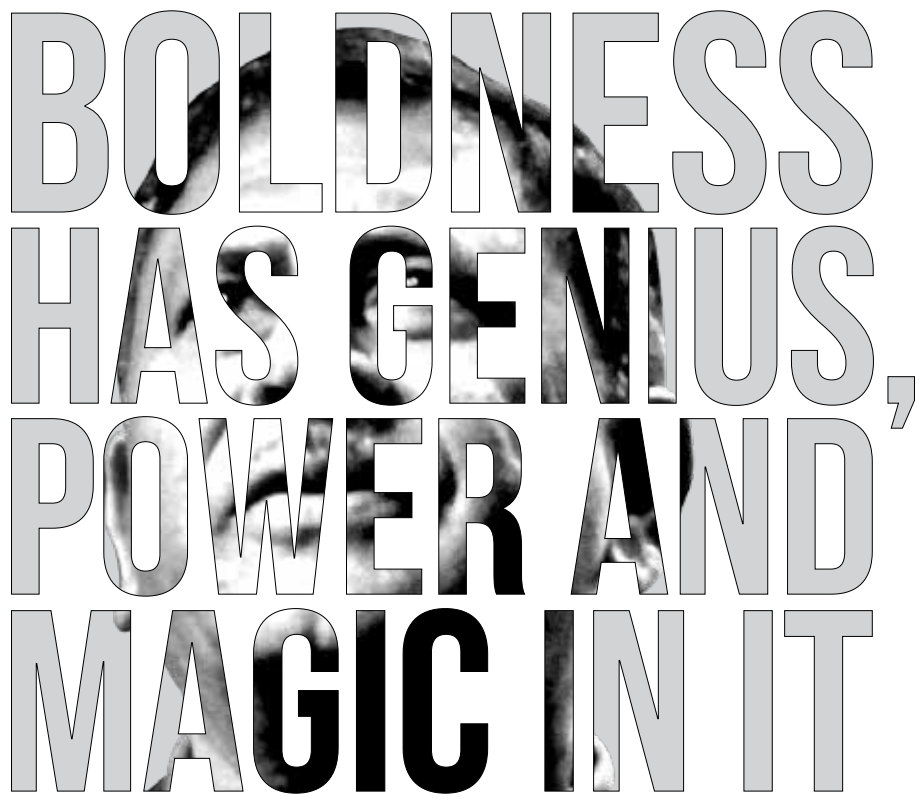
From the beginning, Schell knew that he wanted OGC to be truly international. And he made sure to involve Canadian companies during the organization's formative years, then expanding its footprint to European countries. Now, OGC has more European members than US and Canadian members combined, with Asian and Middle East countries swiftly joining the bandwagon.

Those who know Schell would vouch that purity of purpose and process hold higher value for him than individual outcome and benefits. "We aspire to create an opportunity for scientists to model complex views of the reality of the world that enable them to have a much more accurate sense of our future and where we are going to go as a human race."

Schell's strategic vision has laid the foundation for a vibrant, socially relevant, and solutions centric geospatial industry. His tremendous contribution to OGC has enabled collaboration, communication and co-existence in the geospatial community. Schell made sure that the OGC community is filled with creative people capable of innovative development. And his successful transition of power to the next generation is one of the main reasons that OGC has continued to lead in an evolving and expanding technology market.

OGC's membership has grown from 20 members in 1994 to 521 active members presently. While accepting the Lifetime Achievement award, courtesy of Geospatial Media and Communications at the Geospatial World Forum 2012, Schell famously told them, "All of you have wonderful things to do in the future. I take great pride in what we have been able to build, and what you will be able to create will be something to be more proud of."

Schell continues to serve as the Chairman Emeritus of the Board of Directors of the OGC and Chief Strategist for the corporation.



Kanwar Chadha

Founder, SiRF Technology

Hall of Fame.

HOW MR. GPS CHANGED THE WORLD

HE IS NOT A BUSINESSMAN. HE IS NOT A DREAMER. He is a visionary. And he knows the difference between the two. "A vision has a foundation of certain intuitive fundamentals to be successful... it has an understanding of if you have the right time. Can I make a right team to make the dream successful? Is the market opportunity right? Do I have enough funding? So there are a number of things which come into play for a company to be successful and most importantly there is luck," quips extraordinary technologist Kanwar Chadha, better known as Mr GPS.

Chadha founded SiRF Technology in 1995 in San Jose, California, with nothing more than a simple but daring vision: GPS for consumers. Today, he has over 20 patents in GPS-enabled applications, and has recently worked on a high bandwidth wireless technology that has been acquired by Facebook.

Born and raised along the borders of northern India, Chadha grew up to be a humble trailblazer striving to shape the world of technology and innovation. He graduated from India's premier engineering institute, IIT-Delhi, and went to the United States to further his education and witness the American dream.

Kanwar had commissioned an 'Idea Book', titled Navigations, in 1995 when SiRF was just getting started. It has many futuristic but artistic concept devices and scenarios highlighting potential use cases of GPS in our daily lives; things we may take for granted today but that seemed quite far-fetched in 1995

Giving the closing remarks at SiRF Ecosystem's Location 2.0 Summit 2006 held in San Francisco, 2008

Chadha (second from right) with his siblings and parents, early 1970s

Young Kanwar (fourth from right) with the 3rd Prime Minister of India, Indira Gandhi (center), Kanwar's father in uniform (second from right) and mother (extreme right), 1971

"I did my MBA and MS together from University of Pennsylvania and got my first job at Intel. My plan was to have some experience in the US and then go back to India. But that five-year-plan has remained such ever since."

After moving to the Silicon Valley — the hub for technologists, where innovation and entrepreneurship is a part of everyone's DNA — Chadha began to push the boundaries. "Intel gave me lots of freedom to do things the way I wanted to do." But, after a certain period of time, he started feeling the constraints of working in a big company. "I had ideas about some new processors which I was developing, but Intel wasn't committed to that project. That was the first motivation for me to go and do things the way I wanted to."

Chadha took the brave step of leaving Intel at a time when he was taking a significant step forward in his personal life. "I left Intel and started my own venture at the time when I got married. It was quite a shock for my wife. We didn't even tell

> There are opportunities all over... Do you see it? You may not see it. That is your bad luck. You see it, but don't take full advantage of it. That is your fault.

DID YOU KNOW?

AT ITS PEAK, SIRF WAS A $400 MILLION COMPANY THAT HAD CAPTURED ABOUT 95% OF THE MARKET SHARE

Baby Kanwar (center) with the First Prime Minister of India Jawaharlal Nehru

Enjoying a sunny day with younger brother Sanjeev (first left) and brother-in-law Rakesh Kapur (center)

her family for some time because they had married their daughter to someone who was working with Intel, and here was this man with a no-name startup," Chadha smiles.

Chadha's wife, Ashu, adds, "I had heard horror stories of females getting married to engineers who actually turn out to be just mechanics. So when I landed there, I thought my worst nightmare had come true. My trust was tested."

Chadha's first entrepreneurial venture — a company that

DID YOU KNOW?

THE INITIAL IDEA FOR SIRF WAS NOT GPS, BUT WIRELESS MULTIMEDIA

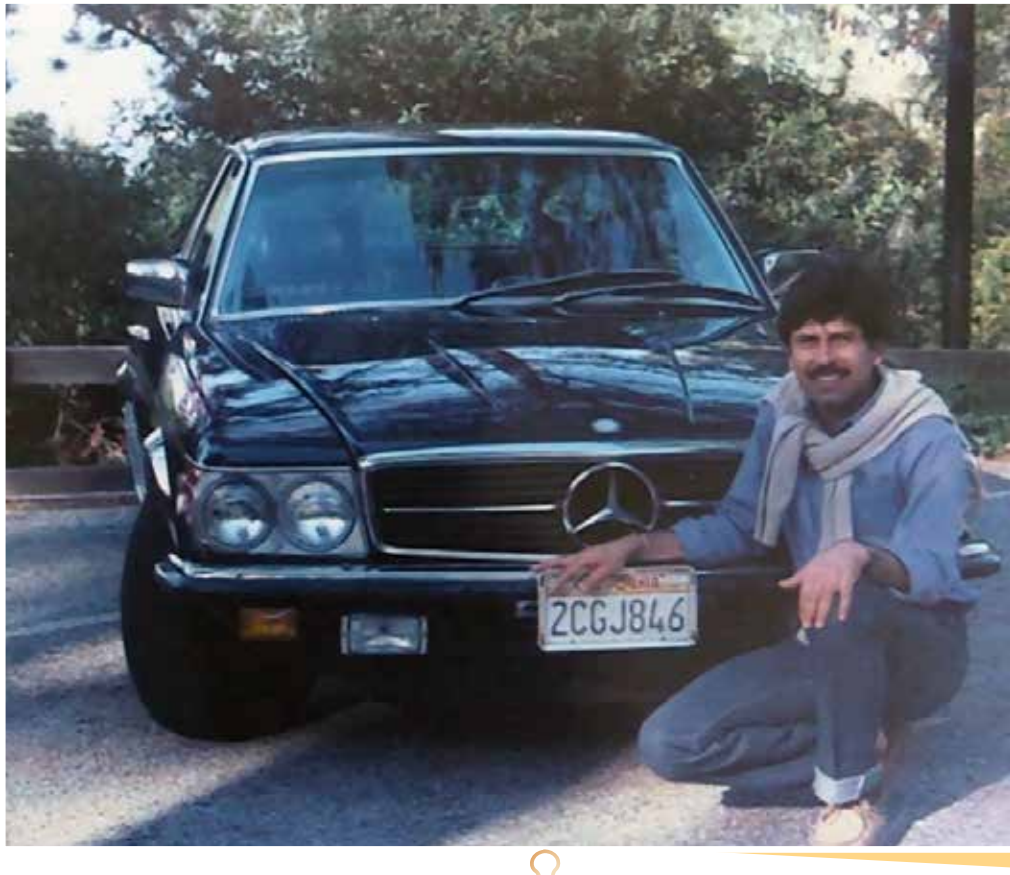
developed multimedia and 3D graphic acceleration products — was called AQuest. Unfortunately, it couldn't succeed because of lack of funds. Not that it deterred Chadha. "Failures are the best learning practices for a man."

But, then came SiRF — a company which aimed to bring GPS-enabled location technology to mainstream markets as a consumer commodity. "When I started SiRF I ensured that we always have more funding than what we need. Most important is to build the team that compliments you," Chadha insists.

The concept of consumerizing GPS emerged when Chadha was wondering how location can impact day-to-day life of a common man. "We created scenarios where people could relate to GPS. Like how can GPS help if somebody gets lost in a foreign country? We asked enterprises: Your trucks are everywhere, but do you really know where they are? It was like telling a story."

However, the initial idea of SiRF was not GPS. It was GPS or wireless multimedia. It was only on realizing that opportunities in GPS were much more immediate, Chadha made it his mission to explore the possibilities of consumer GPS. "We realized there were some fundamental issues with consumer GPS which nobody had addressed, like how do you make it work in urban environments? How do you make it work with very, very low power? How do you make it work in a small package?"

Times were difficult and challenges were many. Entering into a market that was already dominated by big companies, and taking an elite technology like



Mr GPS with his better half Ashu Sehgal Chadha

> Startups fail not because they don't have ideas, but because they lack vision

Chadha has a penchant for classy cars. This photo was taken around 1987-88

GPS directly to consumers was a huge concern. The team at SiRF, however, looked at it otherwise.

"We said that we are going to change the world," Chadha recalls. We had majority of GPS chipset market, but 95% seems too high. And the second thing was that how to integrate into devices that people already have. That's where smartphones with GPS component came in. It seemed like an impossible task, but we could see that if a technology can be brought down that can fit into a phone and at a price where everybody can afford it, then everyone will buy it."

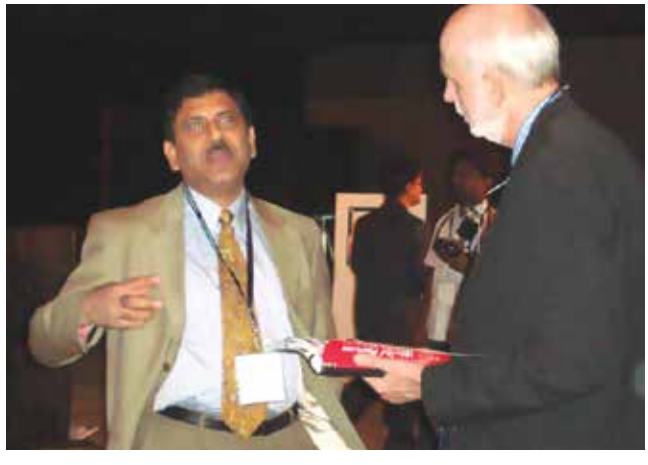
Then, as a startup, SiRF started advocating to the US government to let GPS move out of the military domain. "We were facing two major issues. One was that even for a chip, we needed an export license — which was a process in itself. We worked with the Department of Commerce to simplify that process for our kind of chip which will never be used for precise location. The second was the selective availability which was reducing the accuracy of GPS to a point where it was not very useful," Chadha recalls.

And then, the government decided to remove the selective availability. SiRF's growth shot up, and it went on to become a $400 million company capturing about 95% of the market share. As GPS moved toward being an integrated solution, a new challenge emerged — threatening the most viable business segment of SiRF, the PND market and a downward trend began. Even then, the team at SiRF refused to give up, and proved the naysayers wrong.

DID YOU KNOW?

KANWAR CHADHA HAS OVER 20 PATENTS IN GPS-ENABLED APPLICATIONS, AND HAS RECENTLY WORKED ON A HIGH BANDWIDTH WIRELESS THAT HAS BEEN ACQUIRED BY FACEBOOK

Networks Under Stress: The Future of Wireless International Conference, Cambridge Wireless



With Peter Holland, president, PCGIAP at Map World Forum, Hyderabad, 2007

> The thing about entrepreneurship is that you don't know what's next. I actually like to build companies; companies that I believe; companies that I feel can change the world

The Chadha couple flanked by daughters Ankita and Shivani and special family member Polar Chadha

Chadha says, "It was very clear that we needed more than GPS in a phone platform for us to be successful in this market. So, we merged with a company called CSR which had a Bluetooth platform and Wi-Fi technology."

Through a comprehensive understanding of what was happening in the industry and where he wanted to take the company, Chadha was able to achieve his dream of positioning GPS as a consumer commodity, without veering from the original vision of SiRF. "Our vision was so powerful that even in the worst phases of SiRF, we could not find a loophole in that vision. That's exactly what kept us going. You see dark patches, but there is light at the end of the tunnel. Lots of startups fail not because they don't have ideas, but because they lack the vision. At SiRF, we could see how it's going to change the world and we believed in it."

Leaving behind a glorious legacy at SiRF, Chadha has now moved forward with a new vision of bringing connected solutions for consumers through the Internet of Things. With another vision on the brink of a probable breakthrough, Chadha concludes his success to be in the building of ideas that he strongly believes can not only change an industry, but change the world.

"The thing about entrepreneurship is that you don't know what's next. I actually like to build companies; companies that I believe; companies that I feel can change the world. Seeing the vision become a reality is very satisfying, more than money, more than anything else."