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**\$2 Million Error** This is not surveying

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# Monumental Challenge

**NOVEMBER/DECEMBER 2014** 





**Left:** Ben doing construction surveying in 1962 at an industrial complex on the outskirts of Mosul, Iraq.

# MONUMENTAL CHALLENGE

Ithough there is still some dispute as to who "invented" laser scanning as we know it, one name is synonymous in this country: Ben Kacyra. From his early years in Iraq to his education and work in the US, Ben's experience ultimately led to his vision of reality capture and the story of Cyra Technologies, developer of *Cyrax*, the first laser scanning system. Ben was born in Mosul, Iraq in 1940. The passions and influence of his father, Kheder, an entrepreneur engaged in many business ventures, indelibly imprinted young Ben's life and future career. Kheder, who had been well educated at a Jesuit school in France, spoke three languages in addition to Arabic, and upon returning to Iraq rose to the number two position in the French Embassy.

The French embassy closed when the British took over and divided Iraq, the Kacyra home became the new embassy, with Ben's father as the *chargé d'affaires*. Prompted by a strong entrepreneurial spirit, Kheder soon left diplomatic work and established several successful businesses, including construction. He often took little Ben along on site visits where Ben gained an early fascination with construction.

Kheder loved history, and Iraq, being rich in Assyrian and Babylonian history, had plenty to offer. Ben spent countless hours paging through books in his father's library —history books on the ancient lands of Mesopotamia, Greece, and Egypt— and marveled at his father's old school notebook of cuneiform script.

### ➤ MARC CHEVES, PS

## BEN KACYRA'S REMARKABLE PERSEVERANCE



CyArk's first project was work with the University of Ferarra to capture 3D data from Pompeii Italy. The project validated CyArk's digital preservation mission.

From the time Ben was a toddler, Kheder took him on trips to ruins and other sites of antiquity in Northern Iraq.

Ben says his father, who died in 1980, was his role model and the biggest influence on his life.

At age 12, Ben was put on a train for Baghdad, where he entered Baghdad College, the equivalent of a junior/senior high school in the US. Run by Jesuits from Boston, all classes were taught in English with the exception of Arabic literature. During summer breaks, Ben worked with Kheder on his construction enterprises. By the time Ben was ready for higher education, the Jesuits had opened Al Hikma University in Baghdad, and Ben enrolled in the Engineering Physics program with emphasis on civil engineering. He developed a penchant for surveying and drafting classes. There he worked with plane tables and Kem surveying instruments. His Swiss surveying professor, a consultant for the oil and gas industry in Basra, was his boss one summer on an offshore pipeline alignment project in the Gulf. Along with the adventures of living and working on a barge, Ben was intrigued by the measurement and positioning exercises.

Upon graduation, Ben returned to Mosul and began work as a field engineer responsible for construction layout, as-built documentation, and quantity survey. Desiring to continue his education, he



One of CyArk's early projects, this is a 3D laser scan of the Osirid Pillars, located within the Second Pylon of the Ramesseum at Ancient Thebes, Egypt.

applied to the graduate program in the civil/structural program at the University of Illinois-Champaign/Urbana, arriving in 1964, with \$1,000 in his pocket. Kheder intended to support Ben financially, however, due to new government regulations prohibiting out-of-country transfers, was unable to do so. According to Ben, an "angel" loaned him \$500, and with that "kickstart," a part-time drafting job at the local airport, and lots of McDonald's hamburgers, he made it through to graduation in 1965.

After receiving his Master's degree, Ben looked for a job in Chicago. The construction industry was in a bad recession. The Chicago office of Vogt-Ivers, a major Midwestern highway and bridge design firm, offered him a job in Cincinnati. Ben hadn't even heard of Cincinnati, not to mention know where it was located, but he accepted the job, then bought a map, and drove to Ohio. Lucky break for Ben—there at the office he met his future wife, Barbara, who worked in the accounting department.

In 1968, looking for adventure, Ben and his new wife loaded all their belongings into a U-Haul hitched to their '65 Mustang and hit Highway 80 and headed to the Bay Area where Ben was hired by a San Francisco engineering firm.

Frustrated doing calculations long hand with a slide rule, Ben urged his boss to open an account at Berkeley to use the CDC 6400 mainframe. His boss was dubious and refused to spend money to let Ben "play" with the computer—so Ben opened his own account! Most evenings after dinner, the young couple would pack their baby daughter in a little wicker basket, drive to Berkeley, and get down to business—Ben running programs and Barbara punching cards.

Unable to get his boss to adopt computer analysis, Ben and fellow engineer, Sandy Tandowsky, started a new firm in 1973 one based on the use of new technology.

#### Cygna...

This was the first major turning point for the Kacyras. Computer use in structural engineering analysis and design was virtually nonexistent other than in research in academia. Working with Ed Wilson, a professor at UC Berkeley, Ben was the first to introduce 3D structural and dynamic earthquake analysis in his budding firm in the early 1970's. The new firm with its innovation grew rapidly, changed its name to Cygna, and by the early 1980's became one of the top 80 firms on the Engineering News Record world list of the top 500 AEC firms.

By now, the nuclear power industry was starting to boom so Ben established a subsidiary, Earthquake Engineering Systems (ultimately named Cygna Energy Services, "CES"), to offer 3d structural safety analysis to that industry.

After the Three Mile Island disaster, the Nuclear Regulatory Commission came down hard on the nuclear power industry requiring reanalysis of all existing nuclear plants for safety. CES was one of the top firms in the field doing specialized 3D dynamic analyses for earthquake and other hazards. Because of changes often made during plant construction, existing documentation was not completely reliable so CES had to perform as-built documentation prior to doing its analytical work. As-built documentation was very labor intensive manual work in those days. The engineering team used conventional measurement tools (primarily tape measures and clip boards!) while wearing radiation protective suits. While profitable work for CES, Ben knew there had to be a better way and the seeds of reality capture were born. His surveying background played a key role as he pondered what would be needed.

#### Vision...

Cygna's engineering business was acquired and merged with Kaiser Engineers in 1989 giving Ben time to think about his vision of reality capture. He knew from the outset that whatever solution was to be developed had to be an automated, non-tactile system that would be portable, very fast, accurate, eye safe, affordable, and capable of capturing very large objects or sites. In addition, it had to be integrated with CAD and visualization software to be a complete solution in order to achieve high productivity. Ben and Barbara began planning to form and finance a new company Barbara named Cyra Technologies and later dubbed the system, Cyrax.

#### Cyra...

In 1992, having developed preliminary functional specifications, Ben called on Jerry Dimsdale, a PhD from Berkeley who had consulted for Cygna, to work with him on implementation and putting together a development team. Jerry recommended investigating the use of lasers, and neither Ben nor Jerry being a laser expert, they sought the advice of Stanford Professor Bob Byer, one of the foremost authorities in the field. After listening to their functional requirements for the system, Ben remembers Bob's words: "I don't think you guys are breaking any laws of physics in this, but you will really be pushing the envelope!"

Bob Byer was not kidding about "pushing the envelope". The laser and the timing circuit were certainly the most difficult obstacles, but there were many more. (Please refer to Gene Roe's Industry Pioneer article about Jerry Dimsdale in the September issue of our *LiDAR News Magazine* which describes these adventures.)

The hardware development challenges, while enormous, were not the only ones facing the fledgling company. Ben, reminiscing on that period, said "... as though pushing the envelope on the hardware was not enough, we had to tackle the software problem ..." It is well known that in most industries companies concentrate on either hardware or software due the complexity of tackling both. Cyra had no choice but to tackle both since integration with CAD and visualization software was an essential part of the system. At the outset, Ben felt that existing CAD software could possibly be used for that purpose; it was a rude awaking when it was discovered that CAD in those days was unable to tackle more than a few thousand points at a time.

It was clear that Cyra had to start from scratch on development of new and novel 3D software. Ben called on Berkeley CS Professor Carlo Sequin. Ben says it was humbling to hear Carlo say that they were tackling the problem *backwards*... it was not a CAD problem but rather a visualization problem which once solved, can then go to CAD. With the help of Carlo and some of his graduate students, the first integrated point cloud software was born. Today it's called Cyclone, but the first version was called "CGP", which some of you might still remember.

Of course the problem of adoption of a new technology was yet another challenge that the company underestimated. Surveyors who were among the first to be invited to witness the first prototype were incredulous but were at a loss as to how to incorporate it



Cyrax benchtop prototype in the famous VW Van at the first field trial at Chevron in Richmond, California.

into their work flow and how to make money on it. To Ben, it was clear that adoption was going to be one of the most challenging efforts for the new company.

The first Cyrax prototype came in 1997, and as part of my 1999 interview with Ben I wrote the classic story of the facilities owned by Chevron in the Bay Area. The prototype instrument was huge and mounted in an old VW van, and was only capable of 30 points per second, but the vice chairman of Chevron, Jim Sullivan, showed up in a limo to observe, and was so impressed it resulted in a half-million dollar work order for Cyra. Orders from Fluor-Daniel and several others including the US Navy followed close behind, and the proof of concept was validated.

Ben says that in a way it is a blessing that entrepreneurs minimize the enormity of their undertakings ... how many innovations would we be missing if entrepreneurs were otherwise?!

2000-2001 brought the acquisition of Cyra Technologies by Leica Geosystems,



Cyrax 'Alpha' model and its giant electronics box at US Navy field trials.



CyArk and partners Christofori und Partners scanned the walls of Babylon, Iraq. Ben and his father often visited the site when Ben was a small boy



### 500 SITES • 5 YEARS

n October of 2013, CyArk launched the CyArk 500 Challenge. The initiative encourages the 3D scanning and digital preservation of 500 world heritage sites within a period of 5 years. Since the launch, CyArk has been working with the 500 Advisory Council to evaluate nominated sites based on the criteria of Risk, Significance and Benefits from Technology.

Heritage sites are a significant part of our collective memory and we are losing them at an alarming rate. At the launch last year, CyArk announced the first sites of the 500. The initial sites, called the Exemplar Projects, include Pompeii, Babylon, Mt. Rushmore, the Leaning Tower of Pisa, the Titanic, the Sydney Opera House and the Tower of London to name a few. Additional sites will be showcased at the CyArk Annual Summit, held at the National Archives, October 7-8th 2014 in Washington, D.C.

Through the CyArk 500, an order of magnitude improvement can be achieved in the way cultural heritage is documented, preserved, experienced and archived by bridging and integrating islands of automation with 3D and other digital technologies. CyArk achieves this order of magnitude improvement through a process they call Digital Preservation. You can help CyArk by partnering on current and future projects, or by contributing to efforts to archive and disseminate previously documented cultural heritages via the CyArk website. For more, visit: www.cyark.org.

now owned by Hexagon, which still commands a large market share.

#### CyArk...

Both lovers of architecture and history, Ben and Barbara wanted the proceeds from the acquisition to accomplish something philanthropic and so, the Kacyra Family Foundation was created. They started with four main areas of emphasis but the heritage preservation objective has since become the most wellknown. They had seen the destruction of the giant Buddha statues in Afghanistan by the Taliban, and the destruction of Bam, the city in Iran, by earthquake, and realized that without a permanent digital record, heritage sites all over the globe were at risk of disappearing forever from natural and man-made causes.

The Kacyras started a pilot project to investigate whether the reality capture technology they had developed through Cyra Technologies could be applied to the preservation of cultural heritage. The pilot proved to be successful and soon took on a life of its own in CyArk. Five years later in 2008, with 26 projects in the archive, and a website for public interaction with the 3D data captured, CyArk was spun off as its own independent non-profit organization.

Since then, CyArk has added another 130 (and counting!) projects to the archive and has become financially independent of the Kacyra Family Foundation by raising funds from corporations, foundations, governments, and individuals. Support has come from Fortune 500 corporations like Microsoft, IBM and Iron Mountain, as well as industry leaders Autodesk and Trimble. CyArk made international headlines last year with the launch of the CyArk 500, which aims to digitally preserve 500 sites over the next 5 years. CyArk relies on service providers and universities as partners to help execute the work, as well as on the donation of existing data sets into the archive. With the launch of the 500, CyArk has focused its efforts on the management of the data archive and of the presentation and delivery of information to conservators, educators and their students, researchers, and the general public.

Ben is delighted with CyArk's growth as well as the growth of the entire industry. "We have been so fortunate to partner with entities that share our vision for digital preservation. We created the 500 to challenge ourselves and our partners. We have had an incredible response so far, but there is still lots of room to participate in safeguarding our collective human history."

**Ben** and **Barbara** live in the San Francisco Bay Area. They spend a lot of their time with their three children and three grandchildren. Ben enjoys skiing, biking and snorkeling with Barbara.



Partners in life and business, Ben and Barbara Kacyra.