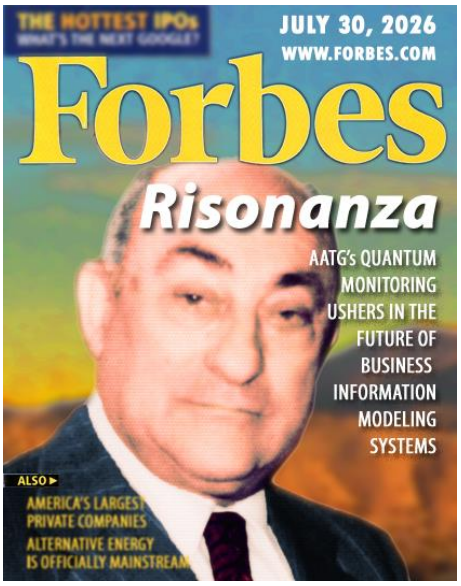
White Paper — 21st Century Technology Series

This is one of the series IDEAS CEO Peter Baston calls "Future History," a Forbes interview that we imagine will take place in 2026 with an executive from a company that doesn't yet exist, in which we project the future of rule-based cyber information modeling technologies. We're not sure about tachyon communication, but everything else mentioned in this "article" could be realized today.



Risonanza™: AATG's Quantum Monitoring Ushers in the Future of Cyber Information Modeling Systems

On the 20th anniversary of the founding of AATG, Forbes interviewed Valfredo James Segre, one of the founding partners. The growth of this company is the stuff of legend, but Segre tells us the company is not resting on its laurels.

Forbes: Val, AATG is known as one of the most innovative companies in your industry, commanding the lion's share of a $70 billion dollar market. Tell us how your company reached the success level that it has today.

Segre: Where we are and where we came from is a story in itself. Way back in 2005 we took a long hard look at the industry we were in, which was primarily a General Contractor in the construction and maintenance industry. Year after year, our profits became harder to maintain in a very competitive industry. Ours was then one of the few professions where you could bring a guy by time travel, say a mason building a temple in the 12th century BC, to a current-day construction site and he would have no problem using most of the equipment. The specialized materials and handling equipment had changed—for example, steel in place of wood—but the what, why and where had remained basically unchanged for thousands of years. Basically you would design it, build it and maintain it in 2005 according to the same principles you used in 1105. Our industry as whole is one of the few in which productivity has not improved at all over the past 50 or 60 years, no matter how much money and technology has been thrown at it.

Forbes: Wow, that's pretty hard to believe.

Segre: Yes, it was, and when we looked at the future, we saw no real change, especially in the light of the high standards of safety and efficient operations that our company had always maintained. We recognized that we were locked into the paradigm that cost and time had to escalate in lockstep with quality and scope. In other words, while other industries were delivering better quality and more scope at continuously decreasing cost and faster turnaround, in our industry the only way to cut our customers' costs without sacrificing quality seemed to be to cut our margins.

Well, we did that, but there's only so far you can go with that and still stay in business. So we thought: we have to find a completely new paradigm for doing business, one that allows us to do what every other industry is doing in the 21st century—deliver more, faster, with better quality and at lower cost.

Forbes: What did you do then?

Segre: We looked at other industries where disruptive innovation totally changed the status quo of the business. We studied Wal-Mart, Southwest Airlines, IKEA, Apple, Starbucks—companies that still today are classic cases in how to get it right and totally dominate an industry with innovative thinking by just rearranging the obvious.

Forbes: But these are totally different industries—not only different from yours, but different among themselves. What could they possibly have to do with your problem?

Segre: When you study innovation in other industries it opens the horizons of your own current narrowly specialized focus. You keep saying: wow, that's really simple, why didn't someone see this, that process is very similar to what we use, etc. You sometimes miss the obvious because you are too close. In our case, it led us to ask who our real customers were and what they really required in the long term. What is it that they are really trying to accomplish, where do they want to be in 5, 10, 25 years time? Then, we asked ourselves: how can we improve our customers' ability to get where they want to be? It leads you to reanalyze all your processes to look for hidden value. And there again, it also emphasizes the critical need to embed "do it right patterns" into those processes, so that you don't find yourself so focused on the process you can't see the value.

What each one of these businesses did was to twist an existing business algorithm just a little bit, and discover an entirely different and much more successful way to do business. They looked at their business data and extracted previously undiscovered value from it. And this, in turn, opened up an innovation paradigm of best practices that didn't exist before—not a way to do more business, but a way to do business better, which, of course, leads to more business.

Take a really simple example from Wal-Mart: They understood that a) if an item was out of stock when a customer wanted it, the cost in goodwill and credibility was far greater than the value of the lost sale; and b) if they could partner with their suppliers to eliminate the out-of-stock incident, both of them would benefit. They had point-of-sale data-collection happening already, so all they had to do was use it differently. The twist was linking the inventory module of their information management systems directly to their suppliers' factory information management systems. So when a Wal-Mart customer bought a bottle of detergent, for example, Proctor and Gamble's system automatically updated the production schedule. So both parties perceived great additional value from an "incidental" aspect of an existing data stream that led the system itself to become "intelligent" and drive better practices.

In the 1980s, that came across as a revolutionary idea. It was studied and written up and a whole new vocabulary was invented around supply chain integration—and yet, still today, there are very few companies that have built supply chain integration into the basic algorithms of their operational workflow. In every single industry, the value of the best algorithm is a thousand times greater than the value of the worst.

Forbes: When you put it like that, it sounds obvious, but putting it into practice I'm sure is not easy. Can you give us an example?

Segre: Sure. Let's consider how any project is designed: A customer makes a request to us for, let's say, a parametric interface facility. We would bid this from the client's architectural and engineering drawings, frequently making change recommendations for more efficient installation. We also have to keep in mind the cost of maintaining the facility. The client obviously is looking at his budget and balancing his total original construction costs against the cost of future operations.

One of the biggest challenges the customer faces is that the better the design, the more the upfront investment to support that design, the less they pay in continued maintenance and operation—and, of course, the opposite applies. The problem is that the expense ratio of additional maintenance costs due to poor design choices is very high: remediation costs for fixing poor design can sometimes be 10 times higher than original fixed cost. The major hurdle that we saw to intelligent design was that up-front costs are tangible, but future maintenance and remediation costs are not readily obvious.

It dawned on us that the real purpose of this exercise to actually give total value to the customer was to somehow close this loop and guarantee that no matter what happened in the future, we could take care of it. In other words, we wanted to present proactive design linked to the actual business operation with continual feedback. The paradigm shift with respect to our industry was to look at the customer's Total Cost of Ownership (TCO) rather than to define cost as the sum of our bills of materials and labor hours. TCO was introduced for valuing information technology installations in the early 1980s, but in a limited way, including upgrade and disposal costs, for instance, but not the impact of the technology on business workflow.

One of the exceptional breakthroughs that I believe we brought to our industry was to expand the concept of TCO to include the success of the building's cyber interface in supporting, even improving, the customer's operational workflow as a measurable cost factor, no matter what industry they operate in. Then, too, there was plenty of early research to show that the building's human interface—pleasing aesthetics, thermal comfort, balanced lighting, thing like that—could contribute to improved productivity. In fact, when we analyzed some test cases, the success of the design in those senses had double or more impact on the customer's bottom line than all other TCO components (initial capital outlay plus operational costs plus maintenance costs) combined.

But when we looked at customer TCO, we suddenly realized that in some ways we were just restating what the Japanese discovered when they began to apply Deming's[1] theories of Quality Assurance to the rebuilding of post-World War II Japan: that Quality Assurance is a profit driver. That is to say, if a company focuses on quality, costs will tend to decrease and quality increase over time; if a company focuses on costs, quality will tend to decrease and costs increase over time. The Japanese even reduced it to a mathematical formula: Quality equals Results of Work Efforts divided by Total Costs—which, if you get right down to it, is also the definition of Profit.

[1] Segre is referring to W. Edwards Deming (1900–1993), an American statistician, professor, author, lecturer, and consultant. As part of Japan's post World War II reconstruction efforts, the Japanese Union of Scientists and Engineers invited Deming to train hundreds of engineers, managers, and scholars in statistical process control (SPC) and concepts of quality. He was revered in Japan for his expertise in quality control techniques, and his ideas had great impact on Japanese manufacturing and business, contributing significantly to Japanese industry's later reputation for innovative high-quality products.

So, to go back to our market, when we started to talk about proactive design linked to the constructed facility with continual feedback, we were actually—though we hadn't yet realized it—talking about Quality Assurance and Continual Improvement. It goes without saying that we had always applied those principles to our own operations, but even though we were disproving it on a daily basis, we had somehow still bought into the paradigm that escalating quality meant escalating costs. It was a real "duh!" moment when we realized that we had had the means to escape that paradigm all along.

Forbes: What did that lead to?

Segre: We made this "what if" statement: "If we could continually upgrade the project design information in real time to counter any future problem, what would the value of that be to any client?" That's when, in 2006, we founded the AATG subsidiary because we realized that we needed a completely new launch platform from which we could set out to create an entirely new way to look at a building, from design through operation, so that our customers could clearly see their TCO, both projected and actual, and monitor it in real time from ideation through 20 years of operation.

Forbes: So how did you suddenly achieve this clarity of vision when everyone else was stuck into the old paradigm?

Segre: Well we had done several road shows at the beginning, and clients kept coming back saying "OK, what's next?" We realized that the whole team needed a time out—we needed to physically get out of our box so we could think out of our boxes, way out. So we all went to a little resort in the Italian Riviera, La Francesca di Bonassola, near the Cinque Terre, to just unwind. The Cinque Terre National Park is a UNESCO World Heritage Site, a perfect blending of nature and human activity, with the five villages perched on mountain terraces overlooking the Mediterranean.

Not coincidentally, the area is also the home of a research institute that looks at the real world through very different eyes—such as through painting and opera—where you can visit and see scholars clarifying their ideas through art. It's sort of an incubator for growing what Jonas Salk called "biophilosophers." During a very lighthearted orientation presentation, we were told the story of how Salk attributed the inspiration that led to his development of the polio vaccine to a trip he took to Assisi, Italy. In the contemplative setting of the cloistered courtyards and elegant architecture of the 13th century Sacro Convento attached to the Basilica Papale di San Francesco in Assisi, Salk was struck with fresh insights, including the one that led to his successful polio vaccine.

It was Salk's memory of the impact of that breakthrough that led to the design of the Salk Institute in La Jolla, California. Salk told artist/architect Louis Kahn to "create a facility worthy of a visit by Picasso" where spacious, unobstructed laboratory spaces constructed from simple, strong, durable, maintenance-free materials could be adapted to the ever-changing needs of science. And for a century the Salk Institute has been one of the leading research institutions in the world, collecting Nobel Prizes and Nobel Laureate faculty members. So, if the synergy between the structure itself and the workflow of the scientists that work inside could amplify the creative thinking and productivity of Salk Institute scientists, how could we do that for any organization?

On one of our first evenings at La Francesca, after much Chianti, awesome food and light hearted chat, one of our team suddenly blurted out "My God, we are looking at this problem through the wrong lens!" No one paid much attention, but the next morning on the veranda he insisted we all get together for a presentation. There was much groaning, but as he pointed to the beautiful azure sea he said "That is not

composed of Euclidean shapes such as circles and squares, it's made of fractal shapes. Neither does it obey Newtonian laws of linear progression—it behaves in non-linear, quantum ways." You had to be there, but when we were translating for our hosts into *la bella lingua*—Italian—it was like someone had just ripped a blindfold away and there was a sudden silence. Then like a wave the inspiration poured in "Bloody hell! We need to make the workflow models work in fractal theory." That came from one of our Brit designers who normally never said a word. Then one of our hosts said in Italian "Si, e tutto il linguagio informatico dovra seguire la logica del quantum, il linguagio del mondo, proprio come il linguagio di Leonardo." Many voices demanded a translation, and what he had said was "Yes, and all the computer language should conform to quantum logic, the language of the world, the language of Leonardo." From that little trip came a rule-set that is still the engine that drives *Risonanza* today.

Think about it: when you look how your co-workers move around an office, or even sit at their desks and perform a process, or how people perform tasks in the field—when do that and try to map what they are doing by overlaying Euclidian circle and square patterns on it, the logic of the workflow is hidden. Apply simple fractal overlays and—whammo—clarity. Do the same with Newtonian linear rules for the actions, and again best practices are hidden; apply some really, and I do mean really, simple quantum rules, and it's like shining a spotlight—every action and reaction stands out in stark clarity. We would never have made that connection except that in Bonassola we had the constant back and forth translation between languages where in our own language the description of an event seemed harsh and implausible, but a simple translation into *la bella lingua,* even for non-speakers, made the action just seem right.

It was especially funny when one of our engineers wanted to meet the "Leonardo" from the first comment burst and was told that the person being referred to was Leonardo Da Vinci, who saw our problem many hundreds of years ago, and, as we all know, had some great solutions as well. The fact that Leonardo is most frequently referred to as an artist though he was also an architect and engineer made the reference even more meaningful. It's not just that when an architect or designer remembers that form follows function the design tends to be more aesthetically pleasing, but, as Leonardo understood, that a building that is pleasant to look at and to inhabit improves the satisfaction and, yes, the productivity of those who work in it.

We gradually refined our use of 6-dimensional cyber modeling to the point where we could show our clients' operational workflow and best practices through the building design. That led to optimization simulations, where we could adjust the building design on the fly to improve the efficiency of the operations taking place inside it. Then we took the modeling one step further by adding budgetary parameters, so that the efficiency improvements could be quantified in bottom line dollars.

Forbes: I can understand adding budgetary parameters, but operational workflow? Doesn't that require a lot of knowledge of your customer's business?

Segre: Yes it does, but the client has that knowledge. What it really requires is entering into a true partnership with our clients so that we can help the client exploit the knowledge they already have by making it visible to everyone. Before Bonassola, we thought that the building was the building, and the operations of the client were the operations that took place in it, but really could take place just the same way anywhere else. Sure there had been work done in the past about the effect of the building on the people inside, things like the optimal temperature for rooms where data entry operators work so that their fingers are warm enough to stay supple and maintain the accuracy rate but the room is not so warm that it puts them to sleep, but those were linear studies of a single component of a system. Our

big revelation was the understanding that the building is an integral part of the whole naturally evolved system that is the business and that the system can only be accurately described in the language of nature—fractal geometry and quantum mathematics.

I'm not going to pretend that we were the first ones to see this, I'll just say that it was a very different way for a construction contracting company to look at their business. We'd had clients come to us and say "we want the building to have this feature or that feature," and we just took their word for it that "this feature or that feature" was right for their workflow. The big brainstorm was: "Suppose we reach across to our clients and incorporate the workflow into the building model from day one?" We take their expertise in their business, and our expertise in our business, and build the model of the entire system, the building and the workflow that takes place inside it, as a simulation of a complex system.

Forbes: So that's how you arrived at the idea of what you call operational optimization?

Segre: Yes, exactly. We call it 6-dimensional cyber modeling, but really it's multi-dimensional, non-linear simulation of the behavior of the whole system. Well, not exactly the whole system, because of course if you take it all the way, you need to expand the model to include the universe, but I'm not that ambitious. We knew building models, our clients had workflow models, and we believed integrating them would lead to a quantum leap in productivity for our clients. We convinced a few of our clients to beta-test the idea, and it turned out that we were right.

The first time we cyber-modeled a project using operational optimization for a client, we found the value of the operational optimization that emerged from the simulation was greater than the complete cost of the design-build project and building maintenance for the first ten years! In other words, by increasing the efficiency of what went on inside the building by 15 percent, we had recovered the entire cost of construction and operation of the building. It was a real eye-opener, both for us and for the client, and we went on to develop this process into a robust standard that could be applied to all of our contracts.

Forbes: That standard being Cyber Resonance Model Imaging™ linked to Real Time Structures™?

Segre: Yes, but you must remember that this was nearly unheard-of in the first part of this century. The standard design system was always subordinate to the construction process, as nobody foresaw how to use it any differently. Then we had computer aided design, building information modeling, and, in some cases, parametric modeling with crude simulation. All of these early systems focused on the infrastructure, with only minimal (if any) attention to the human interface. By introducing CRMI™/RTS™ we could have a working rule-based model in the virtual world that is linked to its big brother structure in the real world, with feedback between them on the status of operations. CRMI™ also has the ability to run "what if" improvement scenarios constantly and check feedback from the real world. This, of course, led to the creation of the famous AATG Optimal Structure Model Set™: perfect designs that recommend upgrade improvements in the real world.

Forbes: So it was AATG who developed the CRMI™/RTS™?

Segre: Yes, indeed. In fact, our designs became so popular that we now make most of our money building and selling the CRMI™—more than we ever did building the real thing. AATG, once an experimental subsidiary, has become our core business. The focus on CRMI™ also opened up whole new markets for us, such as insurers, who have a very direct interest in having access to reliable information

about how well the real world structures and facilities are working because this decreases their risk tremendously.

We also found an emerging need for a major independent trusted player to handle the entire data verification infrastructure of everything that was being collected, because so much of what was then called building information was incomplete, piecemeal, or slanted to prove a point. And we said: heck, why not us? The data alone is worth 50 to 100 times the normal contract fee, and when you then look at who needs it, the value expands exponentially. The true turning point with this type of information came when the foremost designers and architects discovered that if you could improve what really happens inside the building or structure—hospital, factory, whatever—by ±15 percent, that would pay for the full cost of everything, including the outrageous fees they wanted to charge.

An important aspect of the breakthrough here, in my opinion, was that we showed our customers how to return to the same fundamentals of Quality Assurance that had driven the first renaissance of Japanese manufacturing in the post-World War II era. You have to remember that Deming was invited to Japan to rebuild the economy. He saw quality assurance as a profit driver, right up alongside giving your customer more than what they want. There's nothing new in the idea of building a business not around what you can sell, but around what your customer wants to buy, and in building your profit around delivering that in the most efficient way possible. In the 21st century, we have new tools to help us deliver what our customers want, and new tools to improve our efficiency, that's all. That's why so many of our customers now incorporate their Quality Assurance program into their CRMI™ installation and their continuous improvement program into RTS™. The more components of the system are included in the model, the more accurately the simulation correlates to the system, and the easier it is to optimize; the more you optimize the system, the higher your profits.

Forbes: So what you are saying is that CRMI™/RTS™ is not a building information management program, but a cyber business information system. It's a tool that turns what your customers used to consider an expense into an investment on which they can expect a specific return. Can you give us some examples of customers who transformed their business using CRMI™/RTS™?

Segre: Sure. Let me cite two examples of which we are particularly proud: industrial infrastructure, and education. We are the primary contractor for all SCADA (System Command Control and Design) and data transmissions and operations for the North American power grid. We supply rapid deployment data collection maintenance systems (RPDMS) to all the fossil, nuclear and renewable power plants. We provide monitoring capability and power availability and operational license compliance services to the US and Canadian governments as well as the major power purchasing markets and all the secondary compliance services such as the International Atomic Energy Agency (IAEA), the International Energy Agency (IEA) and, of course, the utilities themselves and their insurance companies.

We have duplicated these services to all major petrochemical plants as well as other industrial infrastructures such as bridges and offshore oil platforms and many more. The engineering and R&D equipment companies in all these markets are also primary customers. Our design sets are a standard requirement for major re-insurance and insurance companies and, as a result, it's a good bet that if you look at any major mechanical infrastructure system, there is an AATG model template in there somewhere.

We really operate the entire North American Grid Infrastructure Monitoring independently from NAOC (North America Operations Control) in Toronto, but we have mirror and back up and disaster recovery

primaries in Seattle, Phoenix, Atlanta and Charlotte. In the Far East, we work closely with Fujitsu technologies and in Europe with ABB and Siemens. Moving the operational efficiency of existing conventional power production and distribution facilities in North America from somewhere around 25 percent to over 40 percent is what really allowed the U.S. and Canada to exceed their goals for reducing greenhouse gas emissions in the last decade.

We are also the central source for all educational performance data in the US, Europe and other continents, as the human performance data of the students—and remember, behavior patterns are different worldwide—is correlated with our cyber building performance data. The building system information is always sending design upgrades to our central systems to develop ***real*** best practices infrastructure patterns for educational excellence. We also control and lease total turnkey education packages so that schools and colleges can forget about design, development and construction of schools and colleges and concentrate on making all their clients (students from Pre-K to 12th grade and beyond) ***truly*** learning-empowered. Again, the insurers and all the administrators support our system because the building success rate is over 95 percent, which we guarantee, and no company or system in the history of education has ever done that. We're very proud of the educational performance division.

Basically, each division of AATG operates a truly totally human-centric and not building-centric infrastructure system whose logic can be traced back to Christopher Alexander's *Pattern Language*. His work described building usability patterns in narrative form; we've just translated the description of successful buildings into parametric form. We also incorporated the vision of Friedenreich Hundertwasser, a 20th century architect and artist who developed the theory of the five skins of man. In his vision, a person's home was one's third "skin," what he called the social environment was the fourth, and the global environment the fifth. I've always thought that by naming them skins, he invoked not only the need to shape them in natural ways, but the interconnectedness of the various skins both among themselves and with the core of blood and guts.

Forbes: Ah! Of course: CRMI™/RTS™ is the catalyst that really started to drive smart cities.

Segre: Yeah, absolutely. Because when smart cities were first tried, when innovation in the energy industry was first tried, nobody really understood what a lifecycle cost analysis based on quality of life, quality of economic life, and improvement in quality of life really meant. They kept focusing on antiquated business models and, just as we learned from our study of what was really behind the paradigm-shattering innovation of Wal-mart and Southwest Airlines, working out your business model first and only then promoting the enabling technology is the key to real deployment. CRMI™/RTS™ was the basic tool that enabled the first smart cities

Forbes: Wow! That's quite a handful. Anything interesting on the horizon?

Segre: Well, yes. CRMI™/RTS™ is still the only smart city engine that really works, and we've incorporated it into a new family of quantum cyber monitoring systems that takes it to the next step. We built on CRMI™/RTS™ to develop a dozen or so expansion modules that have been under field test for about six years and have now reached what we call peak interface intelligence level, making them ready for full-scale deployment. We are just about ready to announce the release of *Risonanza™*, our new family of quantum cyber monitoring systems.

Forbes: Quantum systems—isn't that the technology where the data models are now powered with artificial intelligence and inherently aware of the real world infrastructure, and they are constantly communicating and updating their needs with tachyons?

Segre: Yes, indeed. Before the models were really working from rule sets that the designers incorporated, so even after simulation, recommendations would still be a human endeavor. Now we have introduced self-learning genetic algorithms, which capture the patterns of operation that drive the cyber models and learn from the feedback loops into the real world, enabling the model to directly make recommendations for optimization and, in certain cases, to automatically optimize systems without waiting for the human interface.

We named this family of models *Risonanza™* because it establishes and maintains a resonance between the real and the virtual world based on patterns of activity; that is, it continuously seeks to harmonize the patterns of activity in real and virtual worlds. Like a human being, it continues to learn from experience, targeting emergent disharmonies revealed by the feedback monitoring and working to eliminate them. It's the ultimate cyber Quality Assurance program, continuous improvement realized as a system, if you will. We conservatively expect it to treble our potential markets and open up many new avenues of business by providing our clients a way to easily, fully and systemically integrate continuous improvement into their standard operating procedures. The companies that we worked with for the first field tests realized a minimum 30 percent improvement in productivity in the first year. Being able to provide that kind of return on investment to our clients is the ultimate marketing advantage.

Forbes: Didn't you also conduct successful experiments with the communications taking place across the fourth dimension (time) using tachyons?

Segre: [Smiling and blushing] That, I am afraid, is proprietary information until our next version release of *Risonanza™.*

Forbes: Val, thank you very much for this brief glimpse into a fascinating company. If you could think of a catalytic moment in your company's metamorphosis, what would it be?

Segre: Funny you should mention that: it all goes back to one of our senior partners who calls it "Bleep and the Rhodesian and the Rubber Boat" ... but that's another story for another time.

Interview ends with much laughter.