Dick Caro—One of the Most Influential Persons in the Field of Industrial Networking—Part I

Dick Caro is without doubt one of the most influential persons in the field of industrial networking and in the automation business at large. Dick led the charge for adopting Ethernet as a fieldbus and as a means of achieving interoperability between hundreds of manufacturers' products, and prior to that held important positions at Foxboro and Automation Research Corporation. He's the author of three books and more than 45 papers and articles, served as chairman of the Fieldbus Standards Committee, and was elected to the Automation Hall of Fame. He's a frequent speaker at automation events and his Boston-based consulting firm, CMC Associates, advises vendors and users on strategic planning for communication systems.

Perry Marshall caught up with Dick to find out more about his interesting career in the automation business, and cutting-edge, computer-control applications dating before the modern digital era.

Here's part one of that interview.

Where did you grow up? What were your parents like?

I was born in New York City. I went to grammar school in Queens, a part of New York City, through the fourth grade. I moved to Hollywood, Florida, near Ft. Lauderdale, when my dad started a business there.

What I got from my dad was the value of hard work, but he didn't like to work for other people. He had been employed as a salesman and as a machinist. My mother was the classic homemaker. She actually met my dad when she went to work for his mother, who ran a millinery, or hat business, in New York City. Dad was just a few years older.

I was never what you might call a "geeky" kid, but I was always bright in school. I had a strong interest in math and science.

During the first few years in Florida, we didn't own a TV set. My grandfather was not well off, but he had money. He used to send me very nice gifts. My grandfather used to send me Tinker Toys, Erector Sets, chemistry sets, all of that kind of stuff. I actually experimented a lot. I created designs based on the diagram structures in my Erector Set.

During that period, I developed an idea for a perpetual motion machine, but I didn't know that's what it should be called. I couldn't understand why it wouldn't work.

Was it like a motor and generator hooked up together or something?

Yes. Finally, I took it to school. I just took the paper idea in to discuss with my teacher. She couldn't help me in figuring out why it wouldn't work, but she thought it was really good, very creative.

Two years later, when I went to Ft. Lauderdale High School, I finally found a science teacher to whom I could show my drawing for that idea. I showed it to him and said, 'What's wrong with this? Why don't people build these things?'

He told me that losses in resistance and friction required the power input to be greater than the power output. I hadn't thought about that, but these are the kinds of ideas I thought of in those days.

A little later, I became fascinated with automobiles, and I was going to design a car. I thought a really great car would have a turbine engine powering an electric generator, with electric motors at each wheel. This was during the 1950s.

Fast-forward 50 years. I was doing some consulting work for Arthur D. Little, in Milan. I wanted to see if we could find somebody at Fiat who might be interested in pursuing my design for an all-electric automobile.

I wrote a 10-page proposal in 1997 based on the ideas I'd had when I was about 10 years old. I included all of it— the turbine engine, electric motor at each wheel, and powered by waste fuel. A turbine can run on practically anything. It was not like the hybrids that are being made today. It was ahead of its time.

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By 1997, the world had changed enough that it was now ready for what I had invented when I was 10, but Fiat didn't want to invest in it. Without that project, you see their effect on the American market. You can't find a Fiat anywhere outside of Italy.

After graduation from high school, one of my friends decided to go to Georgia Tech, another to MIT. I didn't want to go that far away so I went to the University of Florida. I majored in Chemical Engineering, then accepted a job with a chemical company, Ethyl Corporation in Baton Rouge.

Ethyl was the very first user of Univac One, which was a wired-board, programmed digital computer. Some of my work involved laborious calculations for sizing heat exchangers and distillation columns. I wrote the programs to do these calculations on Ethyl's small scientific computer. It would take the computer one-half hour to run through the calculations that used to take me three to five days to figure manually. You couldn't buy those programs off-the-shelf then.

I was involved with instrumenting Ethyl's semiworks processes— starting them up, debugging what happened during operation, and troubleshooting when things went wrong. I used analog pneumatic instrumentation.

Something really captured your imagination there, didn't it?

It gave me that extra edge. You know, it's nice when you can make your work fun.

I understood distillation better than anybody else in that company because I had to write the program for it. I worked in control engineering for some time, and that was good. Those were the days when computer control was just beginning.

Also around that time, I read the articles about the application of computers to operating boilers and Ted Williams' early work for Monsanto and TRW Computers. That did light a fire under me.

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Eventually, I landed a job with Union Camp Pulp & Paper in Savannah, Georgia. Union Camp pioneered the use of computing in the papermaking field. At Union Camp we used the IBM 1620 for offline calculations. We ran Fortran programs on it while I learned all about papermaking.

I programmed all of the possible calculations that you could make with data manually logged from paper machine pneumatic instrumentation. One time they had a serious problem on the paper machine. They had put a new wire on it. The paper machine wire is a bronze screen that allows the water to drain out of the pulp.

The machine would use up the wire in about three weeks, then they would have to stop the machine and put on a new wire.

Stopping a paper machine is not a trivial thing, right?

Not trivial at all. The wire cost, I think, $39,000. They had a brand new wire on the machine, and they lost it. You lose production during the time it takes to change the wire, and it takes lots of people to do this.

> ***"We installed one of the very first IBM 1800s directly on the paper machine. That was my project; I was the pioneer. We had the third 1800 ever delivered. The first one was in an IBM lab. The second was to NASA. We had the first private sector 1800."***

This means that it broke during operations which is very bad because the loose ends of that phosphor bronze wire can take out some of the paper machine rolls.

Sure enough, the data indicated where the problem had occurred. We showed it to mill management and asked, 'Will you now support putting a real-time computer on this paper machine?' They bought it.

Based on our proposal, they would avoid unnecessary expenses and maybe, if they monitored that particular factor, they could run the wire for a longer period of time. We worked out a justification that repaid a couple of million dollars in a year, just on maintenance for one paper machine.

We sold the idea to management. We installed one of the very first IBM 1800s directly on the paper machine. That was my project; I was the pioneer. We had the third 1800 ever delivered. The first one was in an IBM lab. The second one was to NASA. We had the first private sector 1800.

Do you remember how much that machine cost?

No, I don't have a clue. It was basically a minicomputer. I think my watch has more computing power. It was slow by today's standards.

We then took this very same computer and extended the IO wiring and did control on a continuous digester. Nearly all of our justification for doing this was reducing the cost of maintenance. We proved that justification many, many times.

Did you get any big "attaboys" for this? What was the end result for the company, or the department, or your boss?


IBM 1800

I got to keep my job for eight years. Nobody in the industry ever knew that we were doing anything different, but our mill knew. When Measurex came in to give us a proposal on a paper machine control system, I asked them if they could supply the same calculations we were already making. They looked at me like I was speaking Esperanto.

I eventually decided that, in spite of my original work, there was no good, long-term future for me at Union Camp. I started looking, and finally took a position with Foxboro Company in Massachusetts, in 1970. Foxboro had been our supplier of the digital interface stations that would link Union Camp's IBM 1800 and the pneumatic instruments on the digester.

Foxboro was building a digital systems division. At the time, they had a PCP-88 that was a dual PDP-8 control system.

For big process control installations, right?

Yes. The PDP-88 actually did the direct digital control for which earlier systems from TRW had done. At that time, Foxboro was the largest OEM account for Digital Equipment Corporation.

I had simple projects at first. Before very long, they were looking for someone to lead a new project that they had planned: How do we take our existing knowledge on the 12-bit PDP-8, and port it over to a 16-bit minicomputer, and which computer should we use?

Three of us went up to Maynard, to the old mill building, and met with the guys at Digital. They showed us the prototypes of the PDP-11, which eventually became their biggest selling 16-bit computer. We standardized our programs on the PDP-11 as the corporate 16-bit minicomputer base for Foxboro. Out of that came Foxboro's FOX 2 computer control line of products.

That was Foxboro's most successful computer- based control system. They sold hundreds of them.

Foxboro had, before my time, contracted with Sylvania to adapt a computer that was originally built for the military to process control. They wanted someone to take what had already been done in development and technically commercialize it. They gave me a department to do that. It was Foxboro's FOX 1 control computer.

In addition to managing the testing and commercialization work, I personally developed a lot of engineering software for the FOX 1. From there, I moved into marketing because there wasn't a marketing manager for the FOX 1.

Everything you described so far is extremely meticulous engineering—programming process control. I mean, thoroughly roll up your sleeves on everything, right? Now you're talking about marketing? That's a different animal.

While I was an engineering manager for the FOX 1, whenever Marketing and Sales needed someone to do a presentation on the system, they would have me do it. They needed a technical guy to do the presentation, but they also wanted somebody who could speak "process control." So I was already doing a lot of work for marketing.

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They took me out of the in-depth technical work and put me into marketing to do all of the sales support presentations and technical literature. I also got involved in doing the future product evolution for the FOX 1 product.

How did you feel about this change "to the dark side," as they say?

I loved it because it carried me into a higher level. I never lost my technical background, but I didn't have to do the detailed programming anymore, or even supervise it.

During this time, I proposed several things. The original FOX 1 had a custom-built graphic operator console that was incredibly expensive. I proposed a way to reduce the cost by using a standard CRT using bitmap graphics. They eventually did that.

> ***"My biggest project was going to California and setting up a relationship with Intel, so that Foxboro was an Intel partner. They sent Foxboro advance notices for the new chips that they were producing , and Foxboro, as a result, standardized on Intel chips. They're still there."***

Anyway, Foxboro was good to me. It was just a very difficult company for someone that had ambitions for top management. I tried, but pretty soon they said, 'We've got to do something with this guy,' and they banished me to Corporate Research.

My last two years at Foxboro were spent working in the Corporate Research organization, but I loved it because I could do absolutely leading-edge projects. A lot of the ideas that eventually were encapsulated in Foxboro's I/A came from the research projects that my group was doing those last two years.

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Did that become a long-term advantage? Was that prescient?

Yes. Up to that point, companies in our business hadn't done that.

I took a very early architecture announcement for the 8086 into my chief architect and said, 'Could we use this chip for control?' We reviewed his conclusions. We found that it was missing an essential feature. There was a period of time after receiving an interrupt in which the chip architecture did not apply a mask, in which it could get a second interrupt and lose the first.

That was a window of vulnerability, and we told them about it. They said that they had reviewed it dozens of times internally and no one else had ever picked that up.

Wow. By what virtue did you pick that up? Your guy was just really smart?

He was smart, but he didn't know if this was valid or not. I went through it with him, and he was absolutely right. That's because I built a good team. I had hired that architect.

Good teams are a great thing, right?

Yes. Later, I was recruited from Foxboro by Modular Computer Systems in Fort Lauderdale. If you remember, Fort Lauderdale is my hometown. ModComp was busy selling minicomputers into process control applications at Alcoa, Union Carbide, Johnson Controls, and several other companies, to do the old direct digital control thing. I was recruited to go there, and it was an easy jump back to Fort Lauderdale.

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Tune in next time for the rest of Dick's story.

Highlights include:

- Redundant Digital Control with Fiber Optic Ethernet—in 1983
- A milestone paper in 1998 that opened the door wide for Ethernet on the factory floor
- The real reason for the fieldbus wars
- Dick's crystal ball on the future of U.S. manufacturing