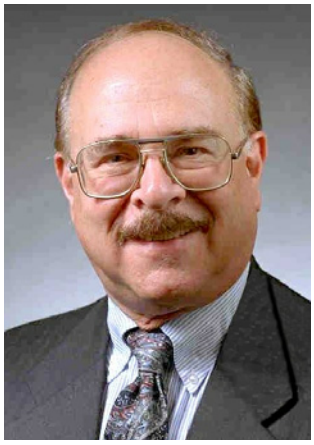
Dick Caro—One of the Most Influential Persons in the Field of Industrial Networking—Part 2



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.

Contributing Editor 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. Highlights include:

- *Redundant Digital Control with Fiber Optic Ethernet—1983*
- *A milestone paper in 1998 that opened the door wide for Ethernet on the factory floor*
- *The real reason for the fieldbus war*
- *Dick's crystal ball on the future of U.S. manufacturing*
- *A special report on "Why The Fieldbus Wars Happened"*

Here's Part 2 of that interview.

In Part 1 of this interview at www.ccontrols.com/DickCaro.htm, Dick Caro told his story of growing up in New York and Florida, getting into the controls business, working in manufacturing, and ultimately arriving at Foxboro where he made key contributions to some of their best selling designs.

You left Foxboro with a lot of experience under your belt. What did you do then?

In 1978 I joined ModComp in Fort Lauderdale as the Director of Marketing for process control. That was good until they went through an FCC investigation. The board of directors fired the company CEO, Ken Harple, who had hired me. He was a good man.

I was unprotected at this point. The internal vultures started eating at the company and eventually destroyed it. People were trying to get more for themselves. It was not a nice place to work.

I worked for myself for a while. Ken Harple, meanwhile, had founded a new company. I decided I would see what they were doing so I called one day and they said, 'Come have lunch with us.' I went up there. I met Ken Harple and half the team who had formed ModComp. They were now running a new venture called Autech Data Systems.

They told me what they were doing. It was clear they were doing custom work for a client and were going to deliver exactly what he wanted, but other than that, they were leaderless. They had no mission. I told them so. I gave them my take on it and they said, 'Well, what can you do?'

I said that I thought there was a need for a distributed-control system using features that they were already offering; primarily, the physical ruggedness of their equipment. They said, 'Good, come to work for us.' So I did. I worked there for four years or so, running the product planning side of marketing.

I created a product line called the DAC-6000. This was a distributed-control system that we eventually presented at the 1983 ISA show. It had a microprocessor-based controller that was dual redundant with diagnostics, meaning a 1oo2D configuration for redundancy. It had fiber optic, dual data highways that were based on Ethernet.

We chose to use fiber optics. The Ethernet cable, the Ethernet taps on cable (which was the copper version of Ethernet) were 10Base5. That is the old, thick cable material. It was completely unreliable. On the other hand, the fiber optic version of it was completely reliable. So we used fiber optic and dual data highways. We used a color graphic operator console with touch screen.

That sounds so ahead of its time. Was it a recipe for starvation or was it accepted?

We had people from all the instrument companies coming by for demos. They couldn't figure out how we were doing any of it.

The controller was a masterpiece. It was an all-aluminum casting with heat sink doors. There was a motor that pulled the doors closed. The cabinets were hermetically-sealed and could be air purged. This meant that was an option that would make them intrinsically safe, if needed. We were way ahead of our time.

"The financing community never understood industrial automation."

Eventually, Foxboro's I/A series used much of our ideas: no moving parts inside the cabinet, convection cooling, and heat sink doors. We were the original, but financing was a big problem. The financing community never understood industrial automation.

Still doesn't, right?

We tried three times to raise the $6 million necessary to keep the company afloat, but they all failed. The company went under. I became a consultant again and worked for Computer Products in that area.

Eventually, I was recruited by Arthur D. Little in Cambridge. They were looking for a staff consultant who understood process control. That took me back to Massachusetts. I was employed with Arthur D. Little for about nine years.

Overlaying the time I spent at Autech Data Systems, some of my independent time, and the time that I joined Arthur D. Little, was the time in which the ISA Fieldbus Committee began in 1985.

I was in the first meeting which was called during the ISA show. We found out about it and a few of us, about 75 people, joined that very first meeting. I told them that we had to find a better way than paper to communicate with everybody. I suggested that we communicate by e-mail.

In 1985?

Yes, this was 1985. I was already signed up with MCI Mail. I told everybody, 'Here is my MCI Mail address.' At that time, it cost a pittance, about $10 a year, to get on. I gave them my address and said, 'If you have anything to send me, send it this way, electronically.' Most people had never even heard of using e-mail before, but we did.

We got ISA interested in supporting us. ISA first explored E-mail because of what the Fieldbus Group was doing. Fieldbus activities started, and I was involved during that entire time.

When I took the job at Arthur D. Little, I told them about fieldbus activities. That was part of my marketing duties because that was part of my contact with people in the industry.

Yes, and it has been ever since, right?

Yes, they allowed me to budget for that as part of my marketing activities. Arthur D. Little was a good company to work for at that time. I was in a technically-focused group, and I was doing a combination of general electronic projects and a lot of telecommunication projects, and industrial automation projects when I could.

When they needed somebody to do the industrial automation work, I was available. I was actually able to sell some work myself.

I was also involved in several other projects that placed me in the middle of work related to telecommunications. For example, I was involved in the cable modem project that eventually created the DOCSIS specification for Cable Labs. This was the data over cable standard.

An inventor had come to us and said, 'I want to build a VCR that will skip through the commercials on playback.' He had an idea of how to do it, but wasn't technically competent himself. Arthur D. Little supported him with a project that created the technology to do what we called "Commercial Free."

Arthur D. Little patented the idea with the inventor. My name is on a couple of those patents because I was the project leader and actually helped to create the decision-logic and tape-marking technology. Then we sold the technology to all the VCR companies. The high end of all the VCRs now comes with the commercial-free patent that many call "Commercial Advance." That was a lot of fun, learning about video technologies.

That's a different subject!

Something I never learned in Chem Engineering. The Cable Labs project was to develop the protocol to carry a digital video signal, and being able to carry IP traffic at the same time. It was useful to have this television background.

We then did some other projects that focused on the cell phone industry and a bunch of other very interesting projects, but the company itself was in a downward spiral.

They eventually started laying people off. They made it a very difficult place to work. When I couldn't work there any more, because the demands for billable work were in excess of what I could actually sell, I departed and went to the ARC Advisory Group.

This was when, now?

This was at the end of 1997.

I joined Andy Chatha's group to handle a lot of the consulting demand that Andy was facing and also to become his network guy. One of Andy's services was putting together market reports. I read the previous market reports on networks, and they were all good, but they were missing something very important.

I got an opportunity, in February of 1998, to make a presentation at the ARC Conference in Orlando. I gave what, to me, was a milestone paper in which I tackled the myths around Ethernet. It was at that conference, and in that paper, that I systematically tore down every myth surrounding Ethernet: it's nondeterministic, it's inefficient, and the link is too limited.

I tore those myths down by detailing the use of active switches, the reliability of active switches, what they did for the network, and the benefits of full-duplex switched Ethernet in creating a completely deterministic Ethernet.

As I walked to the back of the room after the paper, there was John Pittman, Steve Glanzer and the technical steering committee for the Fieldbus Foundation. They waved

me over and said, 'Can we do Ethernet instead of H2 for fieldbus?'

I said, 'I was hoping that you would ask me that. Absolutely. It's the right way to go. You just have to do a good job of it, and make sure that it can't be subverted in its implementation.'

That was in February and, by the end of April, the entire project had been funded. Foxboro had volunteered space in the back of their training building and by May, it was fully staffed and under way. One of the members of my fieldbus committee, Lee Neitzel, was the technical lead. That's how HSE got started, as a direct result of the paper I gave.

"The IEC standards document wasn't being approved due to an organized campaign by Profibus. The Profibus group gave us all technical reasons why they were voting against it. We countered every one of their technical reasons by making changes in the standard, but they still voted against it. We had a lot of difficulty figuring this out."

Wow! I didn't know that story. I do remember when, and it would have been right at that time and probably as a result of your paper, that the rumors started flying about Ethernet as a fieldbus. That was just when DeviceNet and Profibus were really starting to take off. Keep going.

Andy gave me a good pulpit. My mission was to see the fieldbus standards work completed before the end of the century. I didn't want fieldbus work ever to go forward into the 21st century. I was anxious to have the work completed. The work at ISA had already been done, but there were fights at IEC.

I took over the Fieldbus Standard Committees in 1993. I took over both the ISA SP50 Committee and the IEC Working Group Six chairmanships. The work had essentially been completed at IEC, but the voting had not yet finished. The work that the committee had done was being voted down by too many nations. It had to be approved by 75 percent of the parent committee member nations.

It wasn't being approved due to an organized campaign by Profibus. The Profibus group gave us all the technical reasons why they were voting against it. We countered every one of their technical reasons by making changes in the standard, but they still voted against it. We had a lot of difficulty figuring this out.

The ultimate challenge was the IEC meeting in 1998 at the George Brown Convention Center in Houston the week before the ISA conference.

I called my Working Group Six meeting and, when I called it to order, the delegate from Germany got up and moved that we adjourn the meeting. I ruled him out of order. He said, 'But Roberts Rules say...' I said, 'This meeting is not run by Roberts Rules. It's run by Caro's rules. Please be seated.' They had a taste of the way things were going to work. Nevertheless, their constant opposition got in the way.

What we were working on at the meeting, or what we were going to work on, was a response to the negative ballots that had been cast against the IEC standards document. They wanted to stop that.

Eventually, they just withdrew from the meeting. Their walking out of the room gave me an opportunity to sit with the delegates who remained from the U.S., England, France, Italy, and Canada. We actually went through and wrote opinions on each of the negative votes, invalidating the technical reasons that the dissenting National Committees had given.

That weekend it rained fiercely in Houston. It was a hurricane. I stayed in my hotel with my laptop computer and the notes from all those highly competent people like Tom Finney, Lee Nietzel, Graham Woods, and others.

I put together a response to the international vote. I had lots of time on my hands. As you know, I can write pretty well.

It's a great skill to have. Isn't it?

When the IEC meeting was convened after that weekend, they asked for a report from each of the standards committee chairmen. I submitted a report in which I systematically, again, went through each of these international votes and said, 'These are not valid because of these reasons.'

At the end, I submitted a motion that we invalidate these negative votes because they did not follow the instructions and issue valid technical comments.

The German team immediately ran to the rules for the IEC. When in doubt, look in the rule book! They were looking for the requirement for valid technical reasons, and it was there. I said, 'Since their reasons were invalid, we must disqualify these votes.'

That came to a vote at the IEC meeting, and it carried because it only had to have a simple majority at the IEC meeting. What that meant was that it had to go to letter ballot. I won't bore you with all the details about international committee standards voting. It was an amazing tactic to submit such an unexpected document when they thought they had me.

In the months before the final vote was to be submitted, I was with ARC at Interkama in Düsseldorf. My boss and I were called to meet at the conference room in the back of the booth of a large automation company.

One of the high ranking officers of that company asked us to please make sure that the current vote before the IEC passed, because that was the position that his company wanted to take. It was an eight-part document by that point, and they wanted to make sure it got approved. Wanting to keep my job, I agreed.

Because I am a man of my word, I did not contact the IEC national committeess in three friendly countries whom I knew. If I had asked, they would have cast a negative ballot, and changed everything.

I had also made a comment at ISA that same year that, if the eight-part standard was approved, I would resign my chairmanship of the IEC subcommittee. I followed through on that, also. I resigned as the convener of Working Group Six. The reason being that I couldn't be involved in the ongoing support of something that I didn't believe in. That made a little bit of news.

I remember that clearly. What kind of conversations did you have with, say, your wife about this? How did you feel about this thorny, multi-faceted situation?

I had lots of conversations, with lots of people. I decided that the honorable way was the best. I just backed out. If there was no one to leap into the breach, it might have been another story. Tom Finney was there. Tom is probably the most knowledgeable and capable network architect I have ever known. His intellect has no bounds.

For the people who aren't intimately familiar with the fieldbus wars, could you spell out why there was all this opposition? What was at stake? Could you just spell that out for people?

I might want to do that in writing because it's a very subtle and intricate thing. I'll give you the synopsis, though.

Fieldbus was not the issue. The issue was international standardization. Before the fieldbus wars, international standardization was just like standardization in the U.S. This meant that the standard was done for the benefit of the user. The user saw a commonality amongst his suppliers. This is the only reason the world could have come to the 4-20 mA standard, for example.

Before the 4-20 mA standard, there was the 3-15 psi standard. It was 40-200 kilopascals internationally. It's the same stuff, and actually that's pretty close, but a little different. The 4-20 mA became the world standard for the electronic analog transmission that had been reduced from two.

There was a 10-50 mA range that Foxboro was proposing, and a 4-20 that everybody else wanted. Foxboro held out because they didn't have the technology early enough to do 4-20. Eventually, they got the technology in place and agreed. That alone took eight years. The 4-20 mA standard took 11 years.

This was the drive toward a single international standard. We took votes all along the way in fieldbus. Do we want to have a multi-standard or do we want to have a single standard? Every time, the vote came out strongly for a single standard. That's what happened when we were starting in the fieldbus activities. During that time, the Europeans formed the European Common Market. The common market was supported by the need for Euro Standards.

Euro Standards have a different mission. The mission for a Euro Standard has nothing to do with the use of the standard, or the end-user. It's to make sure that governments do not impose laws, or local standards, which restrict international commerce between the nations of the European commonwealth. This is a totally different kind of standard than the consensus standard for the benefit of users that was established for American standards, or that, at the time, was being written into the IEC bylaws.

The European-based companies' goal was to change the mission of the IEC to match the European commonwealth standards mission. That is, to decrease barriers of trade between nations. It had nothing to do with developing a single standard for the end-user. Because of that, the Europeans felt the need to build multi-standards. Once a multi-standard is approved, then you can sell products based upon it in any country in the European commonwealth.

We got caught in the middle.

Honestly, Dick, I thought this was all about a bunch of DCS vendors and such.

No, that had nothing to do with it. It was a much bigger issue.

So, there I was. I parted from Andy's employment. He hadn't supported me as I thought he should. He was definitely doing what was necessary to run his business and to maintain his employees. It's hard to fault him for that.

He also wanted to de-emphasize consulting and do more reports. Reports are okay, but they're not fun.

They're not even fun to read!

I departed from Andy with a couple of expert witness projects for which I was the consultant. Andy would just as soon not have this type of business so he gave me those cases to take with me. I started my own business about three years ago.

Tell me about your business and what you do. For that matter, give a little commercial for Dick Caro.

CMC Associates is the name that I gave to the business because there was a parent corporation that I had for many years since my first independent stint. I incorporated in Delaware as Control Master Corporation with the initials CMC.

"Control Master" sounds like Venetian blinds or something. As a matter of fact, the website that exists at ControlMaster.com is a Venetian blind company. So, I took CMC Associates. I was able to get the .net website. It sounds more like a business than "Control Master."

I have a website at www.CMCAssociates.net. It has pictures and bios of a few of my friends. We struggled as a business after the initial assignments. Those were both legal cases. I was the expert witness on the Opto 22 side suit when Schneider sued Opto 22.

"I had also made a comment at ISA that same year that, if the eight-part standard was approved, I would resign my chairmanship of the IEC subcommittee. I followed through on that, too. I resigned as the convener of Working Group Six. My reason was that I couldn't be involved in the ongoing support of something that I didn't believe in. That made a little bit of news."

After that was settled, there was a dry spell. That's when I started writing books. I've known Susan Caldwell at ISA for a long time. We've always talked about writing books, and I finally had the time. I wrote my first book.

The book was called *Automation Network Selection*. It follows on some work that I had been doing for the past several years. It deviates from process control in that it covers all the networks that are associated with industrial automation. I limited the focus to open networks.

These were the only networks that were available to me at the time. Since then, a few more have come out that claim to be open.

I covered ASI Interface, PROFIBUS, Foundation Fieldbus, Modbus, LonWorks, ControlNet, DeviceNet, EtherNet/IP, and PROFInet. I tried to do it in a very unbiased way. I presented what those networks do, why they were designed, and how they were supposed to be used. My idea was to give the reader some basis for making a network decision.

It has been pretty well-accepted. I think between 300 and 400 copies have been sold. That's good. It boosts my credentials for consulting.

I had another book in me. I had been working on a book that focused on wireless technology. Again, it's one of those interest areas. I developed a modest-sized book. We decided that, because the field was changing so rapidly, we would just publish it digitally. It was a little ambitious. The first edition of the book came out in mid-2004. The second edition has just recently been completed. The book is called *Wireless Networks for Industrial Automation*.

The first edition covered wireless networks for industrial automation. It takes the industrial automation viewpoint and looks at all the network standards that are being offered. Again, I didn't include any of the proprietary networks that only belong to single vendors. I only included those things for which there are open standards or at least open organizations.

I discussed all the wireless local area networks like 802.11 A, B, and G. I covered the emerging networks that are called "personal area networks." That's 802.15.3 and 802.15.4, and also Bluetooth, which is 802.15.1 of the same series. I also talked a little bit in the book about future developments called WiMax and WiMedia.

I also have included considerable discussion on 3G networks now used for wireless telephony, but have some properties suitable for use in industrial automation data networks.

The second edition of the book goes into more depth on the Ultra Wide Band, that's 802.15.3. It's called WiMedia which is basically cordless USB. I mention about developments in WiMax which is long distance radio developed for IEEE 802.16. I talk about developments in RFID which is in the new edition of the wireless book.

I also just completed a book with Dave Spitzer in which I've covered the three networks used for process control. That's HART, which I'm considering a network now, PROFIBUS-PA, and Foundation Fieldbus. I covered those three as a progressive set, showing the advantages and limitations of each.

The goal is to help readers make a decision on which network they want to use for a process control system. It's just for process control, not factory automation. This book is called *Consumers Guide to Fieldbus Network Equipment for Process Controls*. Those are my three books.

What do you see in the next five years for U.S. manufacturing, and for the automation industry in particular? What's the big picture, what are the warning signs, good things, bad things, stuff to watch for?

For one thing, our problem in manufacturing is twofold. One problem we created ourselves. We made our manufacturing so efficient that even a fool could do it because it was so automated. That means I can ship it off to someplace that has a relatively untrained labor force. We made it easy to ship overseas.

At the same time, we took the people out of it. That's what automation does. Being human, we can now complain about it.

Do you agree with Dick Morley that automation is done because people don't want to do stuff, not that people lose their jobs because of automation?

I don't really believe that. I think it's a little different. We apply automation to correct a problem in which humans make errors because things are boring. Automation fixes that. It makes it reliable and repeatable. It makes job satisfaction greater because people aren't bored doing repetitive work. That's why we do automation. The loss of manpower is fallout from that.

As I indicated, back when I was at Ethyl Corporation during their work stoppage period, there were 700 managers and engineers doing the work of about 3,300 union people. During that time, we took notes and gave reports on the job hazards and inefficiencies being carried out by the union workers. This data also educated the engineers on how to automate a lot of those jobs.

Some of those jobs were actually dangerous. We replaced the jobs, all of them, that were dangerous, with automated systems. I think there's an awful lot of dangerous jobs being replaced by automation.

Do you think the outsourcing, and all the offshore manufacturing is going to be really detrimental or do you think there's a bright side?

It's hard to say. It's a dynamic situation. It's not the first time that outsourcing has been done. Shoemaking, clothing, textiles, from the 19th century, were all done in this area—meaning Massachusetts and New Hampshire.

By the end of the 19th century or the early 20th century, all had been displaced to the southern part of the U.S. Eventually, the shoes all went overseas early and then the clothing went overseas.

This is a process. Because those are labor-intensive industries, your only choices are either to automate to reduce manpower or to send it off to where the manpower is cheaper. That's going to happen regardless.

I see all of this as a continuous process. We're simply observers in the middle of it. I don't think we can stop this any more than we can stop the wind from blowing or a tsunami from landing on a beach. It can't be stopped. It's a process. It will continue. There will be fallout, but there will be compensations as well.

For example, those low-wage areas of the world will not remain low-wage for long. Eventually, they will advance and increase their own consumption of goods and services as they increase their standard of living. They too will become markets for automation products.

That's fair enough. Everybody has to roll with the punches.

Ten years from now, people will still be working at jobs for a living. Eventually, there will be work for people. If history repeats, many of those jobs will be in areas that do not exist today, and often for businesses that do not yet exist. I don't think we want to put people back into casting molten iron in the old steel mills. I don't think we want to do that anymore.

Bonus Report: Why the Fieldbus Wars Happened

By Dick Caro

By the time the IEC Fieldbus Committee (SC65/WG6) was ready to submit its work for IEC ballot in 1997, both PROFIBUS and Foundation Fieldbus had already become commercial, but very strongly polarized to Europe and North America, respectively. In fact, they had already become standards in these respective territories.

Also, by 1997, the entire rationale for international standardization was being changed. Initially, international standards were prepared for the benefit of the user so that they were not faced with so many alternative choices. For example, imagine if every time you rented an automobile, you needed to take lessons on the location of the brake, gear selector, ignition keylock, etc. We were required to read a book on how to read the speedometer, fuel gauge, gear selector (automatic transmission), warning lights, and other gauges. These items are standards of the automotive industry to allow people to drive cars without needing training.

However, by 1997, the European Economic Community (EEC) had refined its own standards body, Committee for Economic Normalization (CEN), with its own objectives and rationale. Standards within CEN had the primary purpose to supercede national standards within each member nation in order to prevent standards from being used as barriers to free trade. CEN correctly recognized that their form of standardization was usually a political treaty rather then a technical achievement, however, the effect on the European community was to encourage free trade in the EEC nations. By 1997, CEN was already at work to change the methods used by the IEC (International Electrotechnical Commission) and ISO (International Standards Organization) to develop and approve their own standards, to that more closely meeting the needs of the EEC.

At the time, and probably today, national standards organizations, such as ANSI (American National Standards Institute) and CSA (Canadian Standards Association), that are members of ISO and IEC, are unaware of this deep change in the meaning and application of standards.

Compounding these problems is the fact that the major vendors in the industrial automation market are mostly large multinational companies selling in the EEC, as well as the Americas and Asia. They are faced with a choice of support for standardization philosophies:

1) Standards that erase barriers to trade between nations, or

2) Standards that make life easier for the end-user by limiting product uniqueness

All suppliers have consciously or unconsciously decided on choice 1. Since it is the suppliers that usually control national standards committees, the methods used to attain international standards have now almost completely use the procedures proposed by CEN to both IEC and ISO. The international fieldbus standard with its eight parts is now one of these new forms.

Here is a quotation from ISA on standardization, with [my comments]:

IEC PASs [Publically Available Specifications] are a service to the manufacturers because they help to rationalize efforts and to offer valid guidance in a shorter time than a consensus-based international standard can be made available. Generally, PASs are expected to be transformed into IEC International Standards within a few years. They were introduced at the end of 1997 as a response to industry calling for quicker standardization in areas of rapidly developing technology [Fieldbus was the stimulus for this change]. An IEC PAS is often a de facto industry standard, which may subsequently be transformed into a de jure International Standard.

Contact Information:
Richard H. Caro, CEO
CMC Associates
2 Beth Circle, Acton, MA 01720
Tel: 1-978-635-9449; Fax: 1-978-246-1270
E-mail: RCaro@CMC.us
Web: http://www.CMC.us

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