Automation Presentation Notes For MMBA – District Michigan

General Discussion

What is automation where should you use it? Automation's goal is to perform highly predictable repetitive manufacturing operations with accuracy and repeatability to insure consistent quality and throughput. The best things to automate are those things that are repetitive and readily quantifiable. In general if it is difficult to explain it is typically costly to automate.

Human Beings are inherently capable of extremely complex communication and decision making processes. Even the least intelligent person you know is capable accomplishing what we might consider "everyday" tasks that are actually extremely complex and nearly if not completely impossible or impractical to automate. A computer control system needs to be told (programmed) to do absolutely everything down to the minutest detail that we take for granted. If you break everything you need to do to automate something down to its most rudimentary steps and begin to write out what is involve this overlooked complexity will rapidly become apparent.

Make sure the hardware and software you have chosen is chosen for what you intend to do not because it is the least expensive. As a rule less expensive hardware is often lesser capable or requires more of your time to get it working. Apply the same philosophy you want your potential customers to apply when facing the choice between Natural Lite and your brand (quality vs. quantity or price).

Try as much as possible to think about the future, 5 to 10 years out. Will I be able to leverage what I have already done in a cohesive manner so that it looks and behaves like it was planned or will it turn into a collage of afterthoughts? Obviously budget will always prevail but is it better to do a little less right now with components I can grow into by expanding as budget allows?

I want a system that research chemists can design and program. There are always exceptions but as a general rule control engineers shouldn't do research chemistry and research chemists should design controls. I'm not talking about Process design here I am talking about process automation and controls design. Sometimes it may not be immediately apparent but spending the money to consult with an experience controls engineer will most likely help you from having to learn the hard and often more expensive way.

In control system programming often times less can be more. The majority of people (including controls engineers) are often too quick to add something to correct problems with software. Many times analytical reduction of a program is more effective at revealing the real issues. Only the best controls engineers will thoroughly evaluate what is already there before jumping to the conclusion that something needs to be added to correct an issue. Troubleshooting is largely an innate talent or ability. Contrary to the widespread belief within the business community everyone cannot be trained to troubleshoot. If your resource's answer seems to always be to add additional code you might want to consider alternative resources.

Most Common and Costly Mistakes

Not formulating a long term plan.

1. Expandability - "I am only going to automate this little corner of my process/plant so the bottom of the product line hardware will be enough for now".
   1.1. Think long term. Is what I am buying truly expandable or is disposable a more accurate description?
   1.2. Is it something I can grow into or is it something I will grow out of?
2. Connectivity – Networking things together can be as easy as plugging them in or as difficult and costly as having to buy additional hardware, software and engineering time to integrate.
   2.1. Does the platform I am considering talk to what I want it to today with minimal cost and effort?
   2.2. What about what I might add tomorrow?
   2.3. The equipment vendor wants to charge me another 15K to put on my preferred system. How much will the cost be when you eventually (or immediately) want to network this to your dissimilar systems? That cost could well be more than 15K adding significant complexity to the final system. That additional complexity has guaranteed additional long term cost related to maintainability, system upgrades, and additional potential points of failure.
3. Commonality – "I know I used this platform last time which was different from what I used before that but I think this new one is really the hot ticket."
   3.1. How many different spare parts do you want to have to inventory to maintain your system?
   3.2. How many different interface software packages at multiple thousands of dollars per package do you want to have to buy and pay support costs on?
   3.3. How many different external support resources do you want to have to have?
   3.4. What are the most readily available system components and external resources in your area?
4. Plug and Play usually isn't. Just because the literature says its "Ethernet" compatible doesn't mean it can be plugged in and it just works and plays nice with everything you have.

Support Resource Qualifications

Misconceptions - I can open the controls interface software, plug in the cable and make edits to the program that make me a controls engineer. Most actual process automation and controls technicians and engineers have a technical or engineering degree as a basis. Since the real world aspects of industrial controls are generally not taught at a university the only way to assimilate the knowledge is to be one. For all intents and purposes, ALL truly qualified individuals working in this field started by getting hired into their role as what can only be called an apprentice and working under a more experienced mentor(s). From there the overall competency and knowledge of controls engineers is born of their experience. For instance someone working in the same plant on the same process for 20 years is less likely to possess the same breadth of knowledge, level of exposure to common practices and cross platform capability as another individual who has worked for a variety of industries.

Remember that my equipment is "working" is not a black and white conclusion. "Working" covers the spectrum from not at all to a wide variety of possible metrics including such things as availability, repeatability and efficiency (to mention a few). If your resource considers working to mean something is coming out the other end you may want to reconsider your choice.

Often times you do get what you pay for and there is a reason one integrator can command a higher charge out than others. "I'll just use just use Al's Automation their only $60/hr and Eric's Esoteric Engineering costs $120/hr". If Amazing Al takes five weeks to complete the task with less than stellar results whereas Eric produces more satisfactory results in two week what did what did you save? If someone takes up residence in your facility not because you are always upgrading and investing new capital but rather there is always another problem, be suspicious.

Interview prospective service providers, ask for resumes of the resources they will use, ask for references that you can talk to. Due diligence, due diligence, due diligence. I personally would recommend going with someone who is more of a straight shooter and less of a sales type. Remember, just as in the rest of your interpersonal interactions, if they always agree with you something is wrong.

If you are just starting out with automation and aren't sure which platform to go with you might be best served to first select an integrator who is in a reasonable proximity and you are confident in via the interview process. Once you have selected your integration partner you can leverage their expertise in helping making the platform decision.

Controls Terminology and misc.

1. Acronyms
   1.1. PLC - Programmable Logic Controller
   1.2. PAC - Programmable automation controller
   1.3. DCS - Distributed Control System
   1.4. HMI - Human Machine Interface
   1.5. SCADA - Supervisory Control and Data Acquisition
2. Discrete Control – a.k.a. Digital or ON/OFF type controls
   2.1. open/close valves,
   2.2. Across the line motor starters (no), state machines, sequences, etc.
3. Continuous Control – also known as analog or 0-100% type controls.
   3.1. Temperature, Pressure, and Flow
   3.2. Control Loops
      3.2.1. Open Loop – no feedback. Output is controlled directly.
      3.2.2. Closed Loop – feedback is used to influence output setting based upon algorithm or characterization.
   3.3. P, PI, and PID controls
      3.3.1. P = Proportional (direct response error)
      3.3.2. I = Integral (response to error accumulated over time)

3.3.3. D = Derivative (response to the rate of change of error)

3.3.4. SP = Setpoint – desired point of operation

3.3.5. PV, MV, ACT = Process Variable, Measured Variable or "Actual" – measured process value as indicated by a transducer/transmitter device. Sometimes the result of a calculation.

3.4. VSD – Variable Speed Drive. This can mean a Variable Frequency or Direct Current Drive. VSD generically refers to either.

3.5. Servos – an electromechanical system providing closed loop actuation and measurement. Most commonly used for highly accurate and speed sensitive positioning controls.

3.6. Hardware formats.

3.6.1. Fixed Platform – No expandability. It is what it is.

3.6.2. Modular Platform – Expandable. Can be added to (within limits) over time as more automation is added or accommodate process growth.

3.7. Relative System size. (Numbers below are for illustrative purposes. Different vendors have different offerings and their product lines are constantly changing.

3.7.1. Pico – also known as smart relay 6-8 I/O.

3.7.2. Nano – typically less than 16 I/O points

3.7.3. Micro – 16-64 I/O points

3.7.4. Medium – 64 to hundreds of I/O points

3.7.5. Large – hundreds to thousands.

3.8. Networking. Today almost all but the smallest controllers can be networked. It is important to keep in mind that the networking capabilities and type often vary by vendor so different systems can usually be brought together on a network but it isn't always pretty and can often require additional software and hardware. Today Ethernet is being more and more widely in the control realm.

3.9. HMIs, Historians, and Enterprise Systems. Once again this is a broad topic with a vast variety of offerings from simple 4"x4" relatively "dumb" touch screens, to large multi-monitor single operator workstations with historical trending capability for every process variable, to full blown Enterprise Resource Planning systems which integrate the business level production planning, inventory and maintenance systems with the real-time controls.