ExxonMobil's Quest for the Future of Process Automation

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Keywords

Cloud Computing, DCN, DCS, DDS, ExxonMobil, FACE, Future Airborne Capability Environment, Open Source, Process Automation

Overview

This text is taken from an address given to combined Business Security, Information and Communication working groups of the International Business Congress (IBC) by ARC Research Director Harry Forbes, who spoke to the IBC on 8 April 2016.

I thank the IBC and the organizers of this meeting for the opportunity to speak with you today. I will discuss a new program to develop systems for process automation. This program is noteworthy for several reasons: First because it is being done for ExxonMobil, a leading international oil company with a long reputation for operational excellence. Second, because the products of this program will be technologically quite different from the process automation systems used today. Third, because the organization and the value chain executing this program are also quite different from the way the process automation market works today.

ExxonMobil has shaken up the process automation market by beginning a program to develop both a new process automation system architecture and a new automation value chain. This report is taken from a recent address by ARC Research Director Harry Forbes discussing the origin and scope of ExxonMobil's program.

But first, perhaps I should explain how it came about that someone from a consultancy is discussing the program of an international oil company. My employer, ARC Advisory Group, is a small but worldwide privately held firm, with headquarters in the United States. ARC has four business areas:

- First, market research focused in all areas of industrial automation. ARC market research covers products and services for the design, construction, operation, and maintenance of factories and plants. ARC is perhaps best known for market research in areas of process automation

systems, programmable logic controllers, process measurement, and software for manufacturing.

- Our second business is advisory services, provided on a subscription basis to manufacturing end users and suppliers of automation equipment. Here I should note that ExxonMobil has been and ARC advisory service client for about 20 years.
- Our third business is consulting engagements, which are usually performed for existing ARC clients, both end users and suppliers.
- Fourth and finally, ARC hosts several events each year where end user clients share and discuss their experiences with new technology and practices in manufacturing. Here please note that ExxonMobil discussed this particular program in detail at the most recent ARC Forum event.

The material I am presenting consists of public information, with the addition of some assessments of ARC itself. ARC has non-disclosure agreements in place with many end user and supplier firms, which we rigorously honor. The information in this presentation has been made public and is not now subject to any ARC non-disclosure agreements. This information was made public by ExxonMobil at two presentations given by ExxonMobil managers in February, 2016 at the ARC World Industry Forum in Orlando, Florida, USA.

During their 2016 ARC Forum presentations, ExxonMobil stated clearly that one objective in making their automation plans public is to promote the development of a business "ecosystem" (a market segment with many companies supplying products and services). This ecosystem eventually would support and enhance the new automation technology that ExxonMobil is adopting. They explicitly said, "We do NOT want to create a system that is only used by ExxonMobil. That would represent a failure of this program."

Strategies are being developed now with the objective to enable multiple end user and supplier firms to effectively collaborate on the standards and practices that will be required for the ExxonMobil automation development program. These plans should be announced shortly, probably in the second quarter of 2016. The material I am presenting consists of public information, with the addition of some assessments of ARC.

Key Differentiators of ExxonMobil's Program

Let me note that the plants for which tis automation systems are being developed are those of the downstream and chemical operations of ExxonMobil. As I said, this program of ExxonMobil is noteworthy for many reasons, here is my assessment of the three most important distinctions of this program.

- First, the organization of the program and the value chain is different from the way today's process automation market is structured. There is a distinct role of the system integrator. The firm that serves as the system integrator does not supply any of its own hardware or software to the program.
- Second, the effort will adopt a rigorous software architecture that is designed to optimize portability of software and to make the resulting systems highly interoperable, easily extensible, and more modular in comparison to today's automation systems.
- Third, the program will include new electronic equipment which is dedicated to the management of a single control loop (for example control of a single liquid flow or tank level). This represents a return to past practice from several decades ago, and a departure from the practice of today's Distributed Control Systems, or DCS in process automation.

ExxonMobil Automation Context

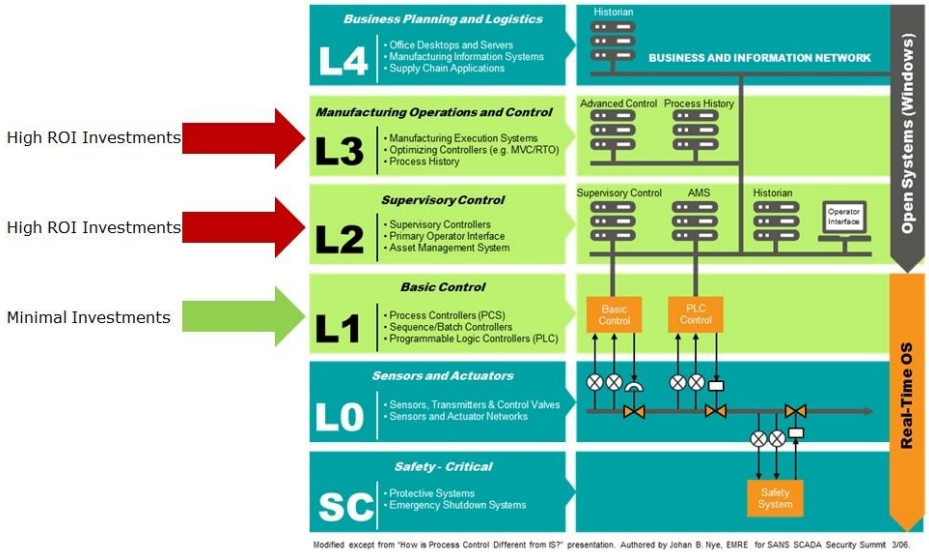
Let me now provide some historical context that will help explain why this new program came to be. This is the historical context of automation within the downstream and chemical operations of ExxonMobil.

These operations represent a very large installed base of plant and automation systems. There are dozens of production sites and hundreds of process unit involved. Literally hundreds and hundreds of large automation systems. And most of these systems are very old, especially certain parts of them. Much of the regulatory automation equipment dates from the early 1980s

This equipment has been carefully maintained for many years, but issues of available parts and also of support for such old technology are becoming more pressing. It was clear that despite the efforts to prolong their life, the use of these systems would have to come to an end in the next 10 years or so, and they would require replacement. Internally, ExxonMobil was seek-

ing a way to realize some business value from the replacement process for these systems. In their evaluation, replacement of these old systems with today's equivalent systems would not provide this value (apart from longer expected life), and so they looked for a different kind of replacement solution. Let me explain this a bit more.

Within ExxonMobil as with most process manufacturing companies, the automation and production management systems are thought of as hierarchical layers or levels. Each component operates at a specific level. The basic regulatory controls, the base-level automation of the process is designated as "Level 1". These might control a single temperature, flow or level. The tasks of higher level functions are things such as providing broader situational awareness and to driving the operating point of the overall process to goals that meet business-related objectives. It is at these higher levels that the economic optimization of production operations occurs.



ExxonMobil Automation Level Designations
(Sources: ExxonMobil, ARC)

Historically the ExxonMobil automation investment strategy was to focus its investment in these higher levels, where return on investment was higher. The Level 1 equipment is well maintained, but has not received nearly the same level of ongoing investment. It is the Level 1 equipment that is now the target of replacement, and there is a great deal of this equipment to replace, as I said before.

However at the end of its operating life, refreshing or replacing the level 1 equipment (DCS controllers and DCS I/O equipment) is technologically complex and very disruptive to operations. This equipment is closely coupled to both the field and to higher automation levels. Replacement requires system-level projects that cannot easily be subdivided into very small steps. ExxonMobil wanted very much that their new replacement level 1 systems would never again require such a complex and disruptive replacement program. They wanted new automation that was substantially simpler to refresh. So they began to envision replacing their Level 1 equipment with a very different type of system.

Developing an Automation Vision

They developed a detailed vision and strategy for replacement of these systems. This was done internally using a small group of experienced thought leaders from within the company who were temporarily removed from their normal work responsibilities for a period of several months and given the task of precisely defining this automation vision. They collaborated to develop several documents that described it.

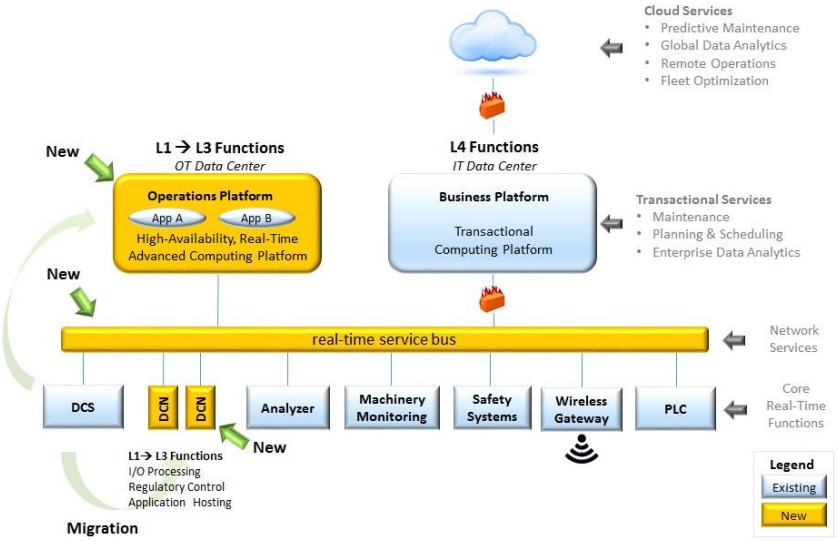
A Sequestered Team Developed and Documented a Future Automation Vision

This was all done through purely internal work, but in February 2015 ExxonMobil discussed this vison publicly (though in general terms) at the ARC World Industry Forum in Orlando. Following that event, they continued to discuss the vision privately and in more detail with a number of automation and system suppliers and potential suppliers. In late 2015 ExxonMobil announced a contract with Lockheed Martin. This contract calls for the development of a new set of process automation products.

Components of the Automation Vision

Next let's look at the broad outline of this automation vision. Here is a chart of the envisioned architecture. The new components are colored yellow, while the existing systems are light blue. The new capabilities break into 3 major areas:

- A new Operations Platform. We have all heard of IT and OT. This is a new type of OT platform that will be implemented using highly standardized IT-like software and hardware. In my view this likely will be implemented using on premise cloud platform with some additional real-time capabilities, and will make extensive use of virtualization and of open source software.
- Second is a real-time data services "bus". This is this set of data services that ties the system together and enables incremental expansion and change. This also may be implemented using open source software, but regardless the definitions of the services will certainly be public and probably already standardized.

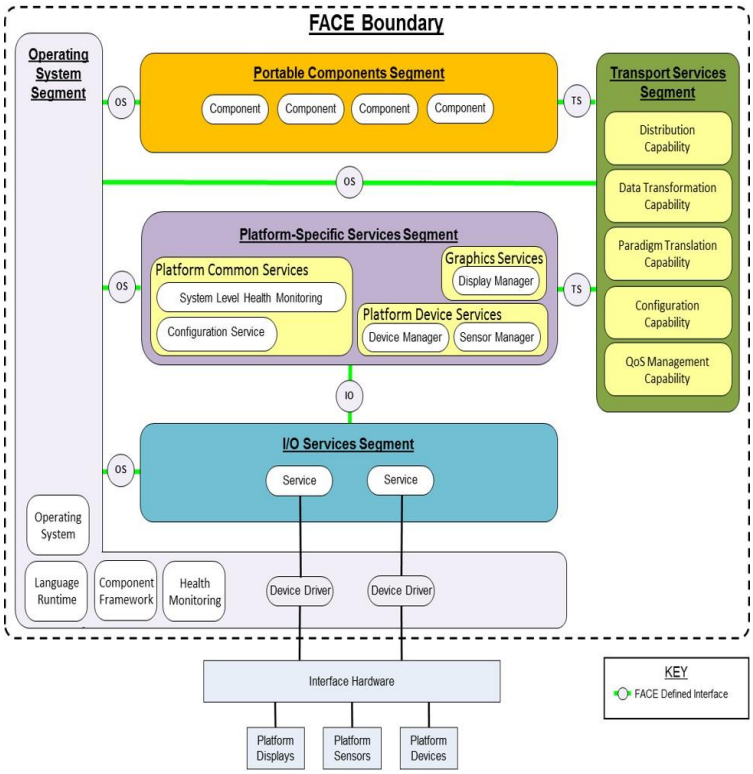


New Components of ExxonMobil Automation Vision (Sources: ExxonMobil, Lockheed Martin)

- Third is a dedicated single loop controller module, given the acronym DCN – for distributed control node. This is highly distributed edge module, and there may be a great many of them in each system. In most cases a DCN may regulate just a single control loop. This has the advantage of liming the span of an automation control module failure. Today's DCS controllers may manage hundreds of loops rather than just one, and are therefore much more critical system components. Over time existing DCS functions migrate either to the DCNs or to the real time operations platform. Both of these will have their own computation and storage resources, albeit of different orders of magnitude.

A Software Architecture for Interoperability and Re-use

Besides the system architecture, software is an absolutely critical component of the program deliverables; truly the most important part. Therefore program will adopt a rigorous software design framework. This framework serves to isolate all platform dependencies and require that software components use only fully specified interfaces for their interoperation.



FACE Software Architecture Segments and Interfaces (Source: FACE Consortium, The Open Group)

What is notable about this framework (named the Future Airborne Capability Environment, or FACE) is that it has been developed over the past several years by firms serving the United States Department of Defense. The framework is now used in the development and procurement of many avionics systems for US military aircraft, including unmanned aircraft, and its use within the Department of Defense may expand further in the future. The overall reasons for using FACE in defense projects is to speed up system delivery through re-use of validated software components and to enable rapid and simpler incremental improvements to avionics systems installed in fleets of aircraft.

Please note that these objectives of FACE in military avionics programs (rapid development and incremental expansion/improvement) are the very highly aligned with the objectives that ExxonMobil articulated for the replacement of its Level 1 or regulatory automation systems.

ARC Assessment

Finally, speaking as an industry analyst let me provide a brief and highly preliminary assessment of this program, given of course that it is now in its very early stages, so that very much remains to be learned and there is nothing to be concluded at this point in time.

First risks of the program; the greatest risks from the perspective of end users is the need to integrate a number of software capabilities for configuration, operation, monitoring, and management of such an automation system. Some key features of DCS software have historically been difficult to implement. Examples are online control parameter and configuration changes, alarm management, system-wide I/O and data use analysis, and online device and system software upgrade. This type software needs to be rock-solid through years of continuous operation, since it fundamentally manages the process operations. Any new technology program cannot compromise the operational integrity of the plants.

Second it will be necessary for the program to cultivate a support ecosystem of businesses. While ExxonMobil envisions that in this new architecture many routine maintenance tasks should become much simpler, the lifetime of process automation systems is measured in decades, and therefore ongoing support through the system life cycle is critical. Finally, the schedule for this program is very ambitious, with the first actual installations now scheduled for 2019.

The potential benefits are those envisioned by ExxonMobil; a simplified automation system architecture, ease in updating or extending the system and thus smaller and more incremental system upgrades and extensions. Another benefit may be greatly reduced dependence on any single automation supplier going forward, albeit that the overall system and its architecture will inevitably require life-long support.

While this program carries considerable risk, ExxonMobil's evaluation is that now is an appropriate time, technologically, for the process automation industry to move in an important way toward a new architecture featuring much higher levels of system interoperability and much smaller modularity than is common in DCS products today. ExxonMobil may well be correct in that evaluation.

I thank the IBC for this opportunity to share with you and for your time and attention.

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