New technologies, trends and challenges

Impact of new technologies and trends on SPI

The contributor

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Times of change

- Petrochemical boom initiated by cheap shale gas followed by
- Prolonged oil & gas downturn
- Driving cost cutting and search for efficiencies
- Increased competition in engineering and
- Reduced investments in design solutions development

Design and Integration trends

- Continuation and extension of data-centric approach creating “big engineering data”
- Expansion of the data exchange through maximum mapping of the attributes of the individual design solutions and disciplines
- Alternative , simplified integration solutions
- Multi-vendor approach to the design solution, owner will get whatever he specifies, yet preferred vendor remains – Intergraph, Aveva, Bentley, etc.

Design and integration trends in (contd.)

- Use Intergraph's SPF, other vendors data warehouse (DW) and development of own proprietary data storage with ability to export in the format desired by the client.
- Automating secondary tasks (equipment lists, pipe list, ISO drawing management, etc.) not sufficiently handled by the primary design solutions.
- Lack of factual progress with the ISO 15926 (latest news date back to 2014) – everybody went BIM ☺. And Fiatech appears to be re-integrating with Construction Industry Institute (CII)

What is happening

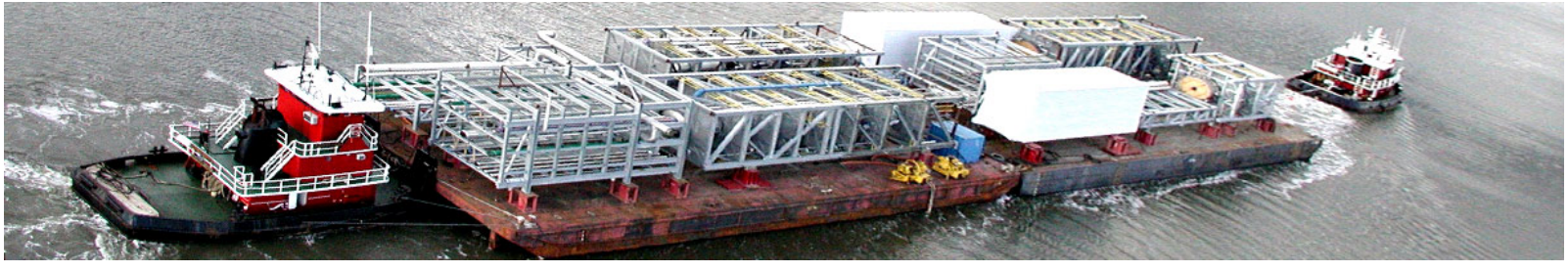
- Over the last 20 years CAD/CAE tools and IM solutions matured and reached base level satisfaction, large initial savings are achieved, business operations are optimized (e.g. offshoring)
- Platform replacement (like PDS 3D to SP3D) are not on the horizon, in part because of the energy crisis and associated budget constrains
- Bigger focus on downstream functional tasks, for example material management based on the 3D model, design progress within overall project management, leading to 5D or 6D models

What is happening (contd.)

- New software development is slowing down (overall R&D reduction) due to the industry downturn
- High external and internal cost of software and general technology upgrades
- Capitalizing on proprietary design automation and construction and intellectual property protection

New modular construction

- Modular construction - 3’rd Generation Modular Execution – allows to reduce Total Installed Cost (TIC) by reducing construction and start-up costs including reduced construction space and, mostly, reducing the field construction labor costs, moving “field-work” to manufacturing site, reducing and simplifying the quality control procedures (using stationary equipment for weld checks, for example) and related field work.
- Shell Quest Project (Carbon Capture and Storage – CCS) total costs were reduced by 30% compared to the previous pre-crisis estimates, peak construction staffing reduced from 1,000 to 450 people and construction site size reduced by 20%
- 15 of the 30% cost reduction were directly attributed to the modular construction.



Modular construction design impact

- Modular construction is not new – Jacobs and others used it from 60's but for compact and expensive projects (semiconductors and pharmaceutical), in space constrained projects (off-shore platform integration) and in remote construction sites, so challenges are know.
- Modularization will impact design costs from the current 8-15% average (varies by industry)
- Increased design quality requirements – no more "by field" or "by field contractor" clauses
- Fluor believe in this technology to the tune of US$500 mln co-investing with China National Offshore Oil Corporation (CNOOC) in one of the world's largest 2 mln sq. meter fabrication facilities in China capable of accommodating 50,000 ton modules.

Modular construction impact on SPI

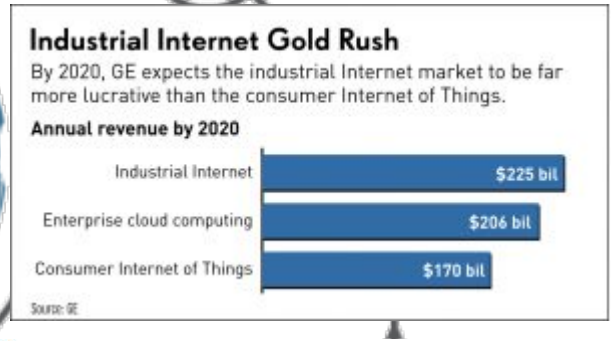
- ✓ More requirements for the physical design:
  - ✓ Hook-ups and associated small bore process connection tubing
  - ✓ Extended use of DDP and modeling instrumentation in the 3D model
  - ✓ Closer SPI to SP3D Integration (SP3D is uniquely fit for modular design)
  - ? Possible feedback of the XYZ instrument coordinates along 3D cable routing into SPI wiring
- ✓ Possibly less requirements on the material estimates like cable lists, etc. – these will be accounted for in the manufacturing site.
- ✓ Work process chain – addition of the manufacturing facility link
- ? Wiring may require changes and can be a challenge, requiring quick connectors for cross-module wiring

“Cloudification”

- Market initially dominated by original vendor solutions – Intergraph, Aveva, Autodesk
- Moving into general purpose hosting platforms – Azure, Amazon, Microsoft, IBM
- Separation of the infrastructure (platform) and service providers
- Increase of the managed services – original SPI providers (EPC, SPI service companies, etc) as well as general purpose business application managed services (TechSurge/Intergraph);
- Some vendors, like Endress+Hauser are betting on entirely cloud-based integration
- **Conclusion**: With hosting knowledge available and product ready fit for hosting, hosting generally and SPI hosting specifically will evolve around a combination of price competition and managed services Service Level Agreements (SLA)

“Industrial Internet of Things (IIoT)”

- Industrial Internet of Things – Is it serious?
- General Electric - 124-year old company with US$130 bln revenue, US$6 bln software revenue with 20% growth now position iyself as a “Digital Company”
- Siemens, Honeywell, Emerson, Microsoft, Apple,
- Cisco CEO estimated (in 2014) Internet of Everything potential market in US$19 trillion, Accenture estimates global economy add-on of US$14.2 trln by 2030
- Industrial Internet Consortium (March 2014): Intel, Cisco, AT&T, GE, IBM and others – a total of 249 organizations including Microsoft, NIST, 18 universities and institutes



FOUNDING & CONTRIBUTING MEMBERS

BOSCH Invented for life, EMC², GE, HUAWEI, intel, IBM, SAP, Schneider Electric

IIoT impact on engineering and plants

- Many questions remain:
  - Who will be responsible for these IIoT - mesh wireless networks and devices – instrumentation or IT? This will determine the impact on the instrumentation community and SPI.

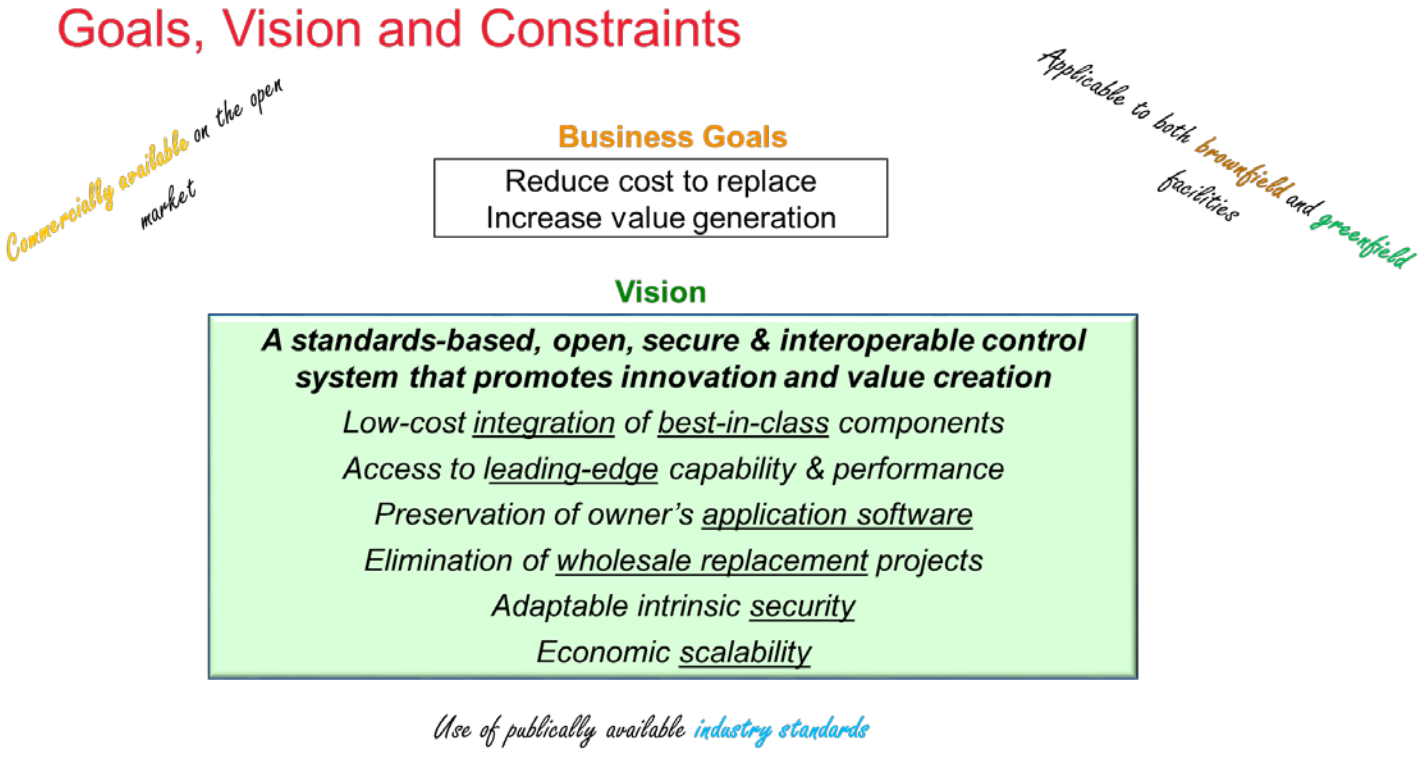
  NB: Western model separated business engineering applications from the automation and control systems departments, some places they are still historically combined.

  - Will separation of the process control, SIS and auxiliary networks (F&G, physical monitoring and security, etc) remain or will they merge?

IIoT impact on SPI

- Task is similar to the Fieldbus:
  - Special development in SPI in cooperation with Fieldbus industry experts (Meir Stein);
  - Initial assumptions were challenged and adjusted - Segment diagram vs. Fieldbus loop;
  - Partial implementation – SPI Fieldbus stops at S-1.
- Similar challenges are expected for main SPI tasks – identify, buy, install and manage the change:
  - ? Identification (tagging) – partial, wireless infrastructure is not likely to have instrument tagging.
  - ? Procurement – partial, tagged items can be procured, but most equipment is likely to be ordered in bulk, untagged;
  - ? Installation and wiring – hook-ups can be done (for tagged items), but wireless wiring reporting is lacking (see N.Faitouri presentation at Hexagon 2016)
  - ? Plant management of change – dependent on the above.
- **Recommendation to Intergraph**: Work with the members of the Industrial Internet Consortium who are current SPI users to identify requirements for design and documentation. Otherwise there is a risk of multi-year gap between technology requirements and SPI capabilities.

New control system architecture

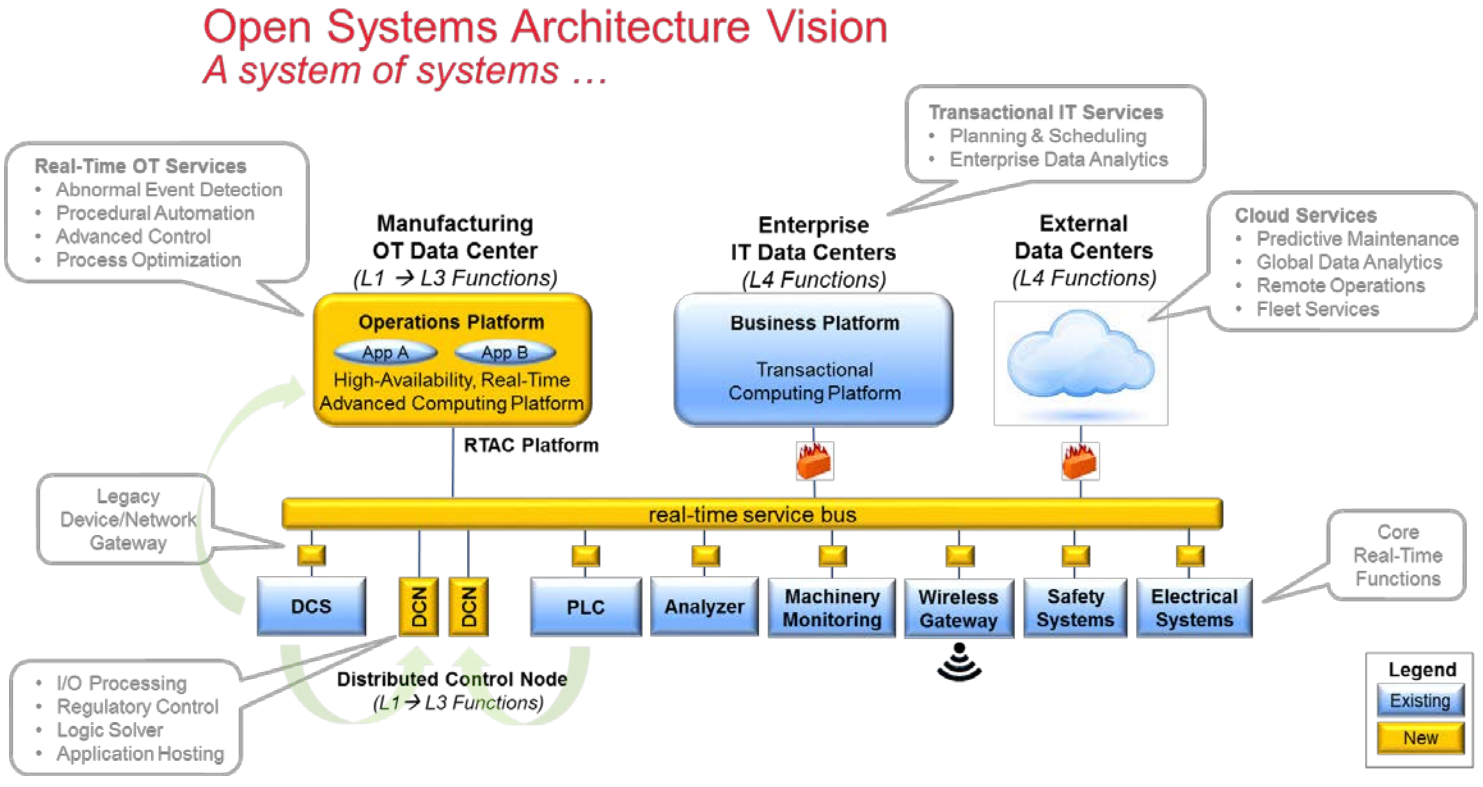


From January 25, 2016 presentation by Steve Bitar, ExxonMobil, at Texas A&M

Open Automation Initiative

- New initiative by ExxonMobil (4’th largest vertical O&G company with $400 bln revenue) to introduce new open control system architecture
  - 2013 – began R&D reviewing aviation experience, real-time virtualization, software defined networking in telecoms, IT/OT sybersecurity, IIoT, wireless and cloud services;
  - 2014 – developed Functional Characteristics to engage industry;
  - 2015 – Contracted Lockheed Martin (world’s #1 defense contractor with $40 bln revenue) as system integrator to define requireemnts and build a prototype;
  - 2016 – formed an **Open Process Automation Forum™** to develop standards.

Open Systems Architecture Vision



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Open architecture impact

- Main idea – military experience in system integration without associated costs
- Over 140 companies including large owner operators already signed up behind this initiative;
- ExxonMobil, Shell and Dow are industry leaders in effectiveness, innovation and safety in the industry;
- ExxonMobil has unprecedented influence on the market and need competitive field for imminent upgrade of all downstream DCS systems (refining and chemicals);
- Raise competition for parts of the business previously dominated by a single DCS vendor, a path likely to be repeated by many owners held “hostage” by proprietary nature of control systems;
- A possible domino effect on all production support systems – from design, to ERP, to reliability and safety lifecycle management – over time.

Impact on design and tools

- Design tools will not have any influence on the architecture (too small economically and too much downstream) but will bear the downstream pressure to document design;
- Established project practices will be shaken up - it will be harder to outsource MIC role to a single control system vendor, providing opportunity for multi-vendor system integrators, more responsibility and liability for EPCM;
- For EPC's – new technology will change previous cost estimation process increasing fixed price contracts risks;
- Plants may find themselves in the environment when they cannot outsource control system [hardware and software] support to a single vendor and thus will need to increase staffing and in-house expertise or grow multi-vendor support service companies.