Emergent Technologies; Compare and Contrast

Dave Bernert

IT Senior Director Enterprise Architecture & 2nd Century Enterprise Systems The Boeing Company



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Boeing has to move forward with the use of emerging technologies with *purpose* and *focus*—it is an imperative.

"One hundred years ago, Boeing did things that others could only dream of. We were the pioneers. To stay competitive, we must continually stay ahead of the curve by introducing new technologies to change the way we work. If we don't continually push the boundaries and drive to implementation, where will our leading edge have gone? We focus on current and future business challenges, conduct early research to identify high-value opportunities, and chart a path to the desired future state. We evaluate and drive the implementation of emergent technologies use by Boeing and in the industry for success."



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Purpose and Focus

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We evaluate and drive the implementation of emergent technologies use by Boeing and in the industry for success.

To retain our position we have to:

- Innovate faster
- Fail faster
- Throw away concepts that don't work
- Retain concepts that maximize value

- Staying ahead of the curve requires the ability to continually widen the span of Systems Engineering, simulation and prediction to cover all of the product lifecycle
- This capability enabled by the digital thread and twin requires introduction of new technologies in a way not supported by current architectures

AHEAD OF THE CURVE

- Our ability to introduce technologies, to enable newer business models, safer and easily maintained products in a cost-effective way depends on industry collaboration.
- GPDIS is one forum where industry leaders come together to identify the challenges to the future state, and discuss possible solutions.

INDUSTRY COLLABORATION

- Value creation is distributed, multi-disciplinary and collaborative
- We have to partner in building platforms that enable innovation where data, process & infrastructure are distributed at the same time
- Challenges: Scalability, Data Consistency, & Transaction Integrity
- Vendors and standards bodies have to collaborate more
- Phase lag in which standards are developed, and the pace at which Industry demands interoperability.

PARTNER FOR VALUE

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INTEROPERABILITY AT SCALE

Emerging Technologies and Systems of Use for Purpose

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Boeing's enablement
 2nd Century Enterprise Systems Boeing enterprise digitalization Enterprise function defined through business architecture IOT system everywhere Digital Transformation Environments for Dev/OPs Mobility AnalytX and analytic fabric everywhere Cloud and SaaS Microservices and API interconnected fabrics for automated OSS controls Emerging technologies like BlockChain and others moved to central service delivery All these in cumulative effect create

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2CES – Business Transformation to Industry 4.0

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"Photo credit Christoph Roser at AllAboutLean.com."

Interoperability via Internet of things (IoT)

- People
- Machines
- Devices
- Sensors

Information transparency

- Digital Twin Functional/Logical/Ph ysical
- Digital plant models enriched with sensor data Analytics

Technical assistance

- People Decision Insight
- Automation (D,D,D) & Additive

Decentralized Decisions

- Automation Autonomy
- Interferences / Conflicting Management

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Analytics Journey

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Why Digital Transformation Environment (DTE)?

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Support Boeing 2025 goals Revenue, Margin, Services Sales



De-risk 2CES

30% assumed productivity improvement



Accelerate innovation & vertical integration

Airplane programs, supply chain, AnalytX



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Digital Transformation Environment (DTE)

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DTE Business Case (Oct. 2016)

Business case developed by IT Finance Competitive Assessment Group (Nov. 2016)

- Strategic priority alignment to 2nd Century Foundational Architecture
- 1st investment request to go through new process
- 5+ year view (2016-2021) analysis included:

Potential licensing/sourced labor/compute resource benefits

□ Funding structure spans across IT&DA by benefitting orgs/ADMs consuming services

□ IT Labor Productivity Savings Analysis



(2017 Update) Acceleration:

- This plan has been accelerated since the business case was approved, pushing both expected investment and returns to the left.
- 2018 funding requirements align to increased acceleration.



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KPIs: How We Measure Success

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Product vs. Non-Product Time

- 30-40 percent → 80+ percent
- One team, one backlog, one focus



ATP-to-MVP Cycle Time 1-3 years → 3-5 months



Value Delivered

"We are delivering at the speed of business."

- Began XY: in June instead of waiting months; now have MVP scheduled for September
- Reframed AP to a user-centric approach the IT team is now in tune with the business requirements
- Productized and prioritized analytics platform
- Delivered Boeing avionics tool
- E2E automated DTE Toolchain and Cloud Foundry platform
- Responsive, user-centric teams are enabling business agility
- Deeper relationship with the business
- Stronger technical capabilities delivering code to users daily
- Significant reduction in non-value-added features



Team Morale Index

- "Extend the engagement to the fall? How about October 2020?"
- "DTE brings the modern product development environment that I have been waiting for."



Customer Satisfaction

Every DTE-enabled team wants an extended engagement for broader transformation

- (NPS) Receiving multiple referrals from customers
- 60+ projects in the pipeline globally



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DTE: An Environment for Transformation

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DTE: An Environment for Transformation

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A monolithic application puts all its functionality into a single process...



...and scales by replicating the monolith on multiple servers



A microservices architecture puts each element of functionality into a separate service



...and scales by distributing these services across servers, replicating as needed.







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Service-Oriented Architecture to Microservices

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Service-Oriented Architecture (SOA) is not a technology – it is a design methodology.



Microservices are a specialized implementation of SOA for building flexible, independently deployable (DevOps) systems.

A microservices architecture puts each element of functionality into a separate service...



... and scales by distributing these services across servers, replicating as needed.





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Why Cloud?

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CLOUD IMPROVEMENT PLATFORM

100x Improved Delivery Speed - Automated Self Service -

6x Increased Asset Utilization - Shared Infrastructure -

Global Reach

- Enabling Global Nimbleness -

CLOUD BUSINESS LEVERS

Status Quo

- On-Premise Single User Ownership Model for Compute, Network, & Storage
- Continued Capital Investment in Equipment & Data Centers
- Limited Agility & Adoption Speed for Market Driven Capabilities

Versus Cloud

- · Shared Infrastructure Ownership Model Both On and Off Premises
- Reduction in Costs for Compute, Network, & Storage as Utilization Increases
- Nimble, Market-Driven Global Services Through Operating Expense vs. Capital

SAVINGS CATEGORIES

ONE-TIME COSTS

Application Transition Costs

Automated Orchestration Implementation

RECURRING OPERATIONS Server Hosting

Storage Depreciation/Interest Operations Network LICENSING VMWARE OpenSource







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The Drivers for IT Architecture and Interoperability: The Grand Equation

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Perspectives on the IoT design space

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The design, manufacture, operation and support contexts/environment/data analysis requirements, determine the interoperability options used in an IoT architecture

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https://medium.com/@dconrad/how-new-long-range-radios-will-change-the-internet-of-things-ed8e6b5e367f#.cjl3ngpcc

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Product Data Interoperability in the Context of IoT

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Traditional

Product Data Interop challenges:

- Diversity of CAD/CAM/CAE tools,formats
- Specialized analysis, processing tools (FEA solvers, NC code,CMM)
- Interaction between systems
 Engineering models of various types: electrical, hydraulic, etc.
- Decision making typically within tools.
- Interop issues dealt with data standards

Additional

Interop Challenges Introduced by IoT in Product Lifecycle

- Diversity of protocols, sensors, sensor integration
- Diversity of gateway architectures, security, device management
- Diversity of analytics models, and where analytics gets done at the gateway or cloud
- Diversity in assembly of analytics models, data and operational models
 aka digital twin
- Understand failure modes
- Diversity in cloud platform architecture
- Security models
- Power, data, range, environmental
- Cost and profit models.
- Visualization and service management

Industry has yet to recognize IIOT interop as a serious issue.

If you thought reconciling product structures was challenging enough, think about an assembly of sensors and predictive models, their representations from various vendors, and the interoperability challenge thereof.



Image: http://www.brakeandfrontend.com

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High-Level Capabilities

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NOTIONAL DIAGRAM



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ROPERABILITY

New STEP Architecture Based on Model Based SysML Approach for Data Interoperability

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Data Integration

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What is absolutely needed for data integration?



Machine-readable format to describe data (properties and relationships)

Unique data identifiers

Protocol/API to access data





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Data Integration

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What is data integration?

View data from different sources as one integrated dataset

Integrated dataset consisting of (subsets) of individual data sources and links crossing data sources





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Moving Forward into the Future

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Thank you!



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