

# Architectural Measurements & Metrics at All Scales



Presentation to the  
Software Engineering Institute's SATURN 2009

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## Architectural Measurements & Metrics at All Scales

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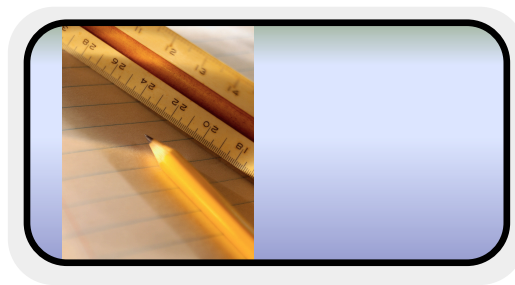
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## Presentation Abstract

- The value of IT architecture is difficult to demonstrate. The right set of measurements and metrics is essential. Such measurements and metrics must be relevant and traceable to the business, and understandable to its stakeholders. They must also support decision-making, and be meaningful to executives, managers, and practitioners. Establishing measurements and metrics is not easy or reliable. Many IT organizations fail on their first attempt. This presentation describes the use of definitions, models, and selection criteria for establishing a rational and manageable set of measurements and constituent metrics to demonstrate the value of IT architecture and support operational decision-making as well as continuous improvement. Upon overcoming several challenges, dashboards and scorecards report the measurements and metrics for architecture maturity, governance vitality, and solution conformity. These communicate the value of IT at all levels.

## Introduction: Purpose, challenges, and limitations



## Westfield Group's Solution Architecture Practice & Governance disciplines were at a formative and rapidly evolving stage



- The initial Measurements & Metrics effort attempted to answer a couple basic questions
  - Identifying where we were at relative to Maturity, Vitality, and Conformity
    - How much do we suck now?
  - Identifying where we improved, or not, relative to Maturity, Vitality, and Conformity
    - Do we suck less that we did before? If so, in what ways?

NOTE: Measurements & Metrics do NOT identify where one must improve. The current state, target state, roadmap, and gap analysis are used in combination to identify where improvement is needed.

- This effort also attempted to answer management requests for “hard numbers”

## The Westfield Group IT Architecture Team applied the Scientific Method to overcome inherent challenges



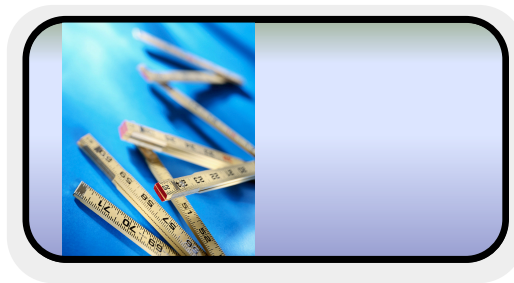
- Problem
  - Most IT groups fail to successfully define their Measurements & Metrics on the first attempt
- Hypothesis
  - A model-driven criteria-based foundation can overcome the known challenges
- Procedure
  - 'Pilot' the model-driven criteria-based foundation on the Solution Conformity Scorecard and the SOA Value Chain within the Solution Architecture Practice & Governance context
    - Models provided essentially traceability to the business
    - IT Guiding Principles and their supporting Applied IT Architecture Principles benchmarked the measurements
    - Specific criteria were applied to select Measurements & Metrics
- Experiment
  - The 'Pilot' was applied to several IT portfolio projects
- Conclusions
  - A model-driven criteria-based foundation is useful to selecting appropriate Measurements & Metrics
- Results
  - In the end, uncontrolled variables, such as executive or management actions, over-shadow the disciplined approach; we'll discuss this further in 'Lessons Learned'

### The IT Architecture Team believes that others may benefit from our experience; however, some limitations apply



- Our Measurements & Metrics effort encountered several constraints due to the “soft” insurance market and the global economic downturn
  - Did **not** leverage the *Va/IT* framework
    - ISACA: [www.isaca.org/valit/](http://www.isaca.org/valit/)
  - Did **not** participate in measurement training
    - SEI: <http://www.sei.cmu.edu/products/courses/index.html>
- Though this presentation examines a single IT solution, the model-driven criteria-based foundation approach can be, and is, applied at all scales
  - In addition, our lessons learned regarding uncontrolled variables are especially applicable at all scales
- This presentation does **not** attempt to replace, modify, or comment on any IT industry framework for IT value or IT measurements and metrics

### Value: Establishing an understanding



## The first obstacle we overcame was our own bias toward seeing the IT benefits rather than the business value



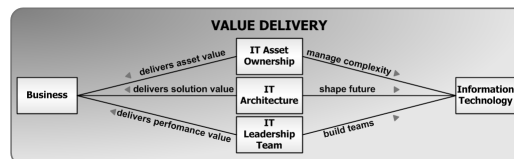
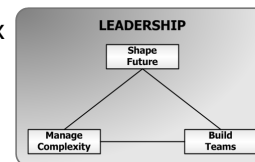
### Business Value

- The business value of an IT solution is determined before the IT effort begins
  - The business case is developed during IT Portfolio Planning
- The business value of an IT solution is relevant only to the business sponsor
  - This implies that IT professionals do NOT set or evaluate the IT solution's business value
    - However, IT professionals are responsible for communicating changes to costs, dates, or deliverable completeness or quality that may alter the business case
- The business value attaches only when an Architecture Decision is made
  - Architecture Decisions are made to **realize** the business value, through IT solutions, to the business sponsor in accordance with the requirements and constraints
  - The Architecture Decisions also yield IT benefits including improved TCO, time-to-market, and flexibility as well as ease of maintenance
- The business value of an IT solution is subject to various influences
  - Commission: Business value is delivered through IT solutions realized
  - Omission: Business value is lost through IT solutions, or parts thereof, not realized or poorly realized
  - Emergence: The business value emerges from an IT solution through its integration and interaction with other processes, systems, applications, and services

## Once business value was fixed in our minds, we examined the means by which it is delivered



- IT leadership plays a key role in delivering business value
  - It provides the context in which IT Architecture seeks to maximize the 'Commission' of business value while minimizing 'Omission'
  - It also provides the other processes, systems, applications, and services for business value 'Emergence'
- The IT organization's structure supports a complex business value ecosystem
  - It consists of the IT Leadership Team (ITLT), the IT Architecture Team, and the IT Asset Owners
- IT Architecture delivers business value through IT Solutions
  - In sum, these comprise the Enterprise Architecture



## Definitions: Sharing a language



## The second obstacle we encountered was the general misunderstanding of the terms 'Measurement' and 'Metric'

### Measurement

- (1) A metric combined with an aggregation type such as average, count, maximum, minimum, sum, or average.
- (2) Metrics such as count, maximum, minimum, sum, or average that are used in a fact table. Measures can be calculated with an SQL expression or mapped directly to a numerical value in a column.

[IBM, IBM Terminology,

<http://www-306.ibm.com/software/globalization/terminology/mn.jsp#m12>]

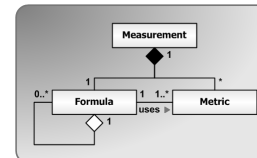
### Metric

- (1) A measurement type. Each resource that can be monitored for performance, availability, reliability, and other attributes has one or more metrics about which data can be collected. Sample metrics include the amount of RAM on a PC, the number of help desk calls made by a customer, and the mean time to failure for a hardware device. See also service level objective.
- (2) A holder for information, usually a business performance measurement, in a monitoring context.

[IBM, IBM Terminology,

<http://www-306.ibm.com/software/globalization/terminology/mn.jsp#m12>]

- After researching the published literature, we concluded that **Measurements are made of Metrics**



"Formally, we define measurement as a mapping from the empirical world to the formal, relational world. Consequently, a measure is the number or symbol assigned to an entity by this mapping in order to characterize an attribute."

N. E. Fenton and S. L. Pfleeger, "Software Metrics: A Rigorous and Practical Approach", 2nd Edition Revised ed. Boston: PWS Publishing, 1997, p. 28.

## Once 'Measurement' and 'Metric' were fixed in our minds, we defined several terms pertaining to their usage and reporting



- **Architectural Maturity:** having architecture standards, processes, and assets in a state of full development; having same in a perfected condition.
- **Architectural Vitality:** having the capacity for continuation of meaningful existence for the purpose of architecture practice or governance.
- **Architectural Conformity:** corresponding in form, nature, and/or character to the provisioned Target Architecture; having congruity with the provisioned Target Architecture.
- **Architecturally Operational:** Pertaining to, relating to, or based on IT Architecture operations. Example: A Measurement used to monitor and adjust IT Architecture processes including practice and governance.
- **Architecturally Actionable:** Capable of being acted upon through an architectural or managerial decision. Example: A Measurement used to change or correct IT Architecture processes.
- **Architectural Distribution:** The frequency of occurrence for the member components composing an architectural Measurement during a reporting period. Example: A Measurement showing the distribution of Architecture Issue resolutions by governance level during a given quarter.
- **Architectural Trend:** The course or tendency of an architectural Measurement, and/or its member components, over a time period. Example: A Measurement showing the level of Architecture Issues raised over the past five (5) quarters.
- **Architecturally Significant:** Affects, or is likely to affect, an Architecture Decision; Material to, or potentially material to an Architecture Decision.

## Models: Making the connection

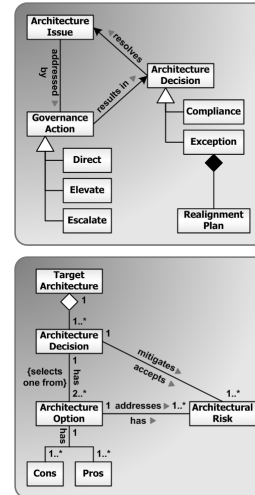




## Architecture Decisions provided the starting point for modeling Measurements & Metrics



- Solution Architecture Practice & Governance revealed the role of Architecture Decisions in realizing business value
  - Architecture Decisions are essential to resolving Architecture Issues
    - Architecture Issue escalation was among the first processes modeled and implemented for Solution Architecture Practice & Governance
    - The nature of the resolution, either Compliance or Exception, affects the magnitude and timing of the business value realized
  - Target Architectures are crafted from Architecture Decisions
    - The Target Architecture attempts to maximize the business value realized
    - The Target Architecture serves as a 'Vector' providing both 'Direction' and 'Distance'
- Architecture Decisions are the starting point for tracing value back to the business



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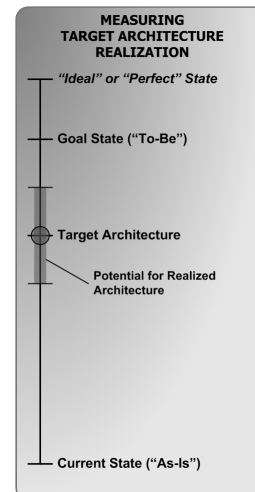
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## The third obstacle we overcame was project team resistance to the provisioned Target Architecture



- The definitions and models for our Measurement & Metrics countered the perception that the Target Architecture prescribed an unattainable "Ideal" or "Perfect" state
  - One or more IT projects may be required to reach the specified Goal State for some part of the enterprise
- These definitions and models provided a basis for the Solution Conformity Scorecard
  - The Target Architecture score sets the mark for the IT project
  - The Realized Architecture score shows the mark the IT project reached
    - Architecture Exceptions may result in a score lower than the target
    - The IT project team may deliver more than provisioned and have a score higher than the target



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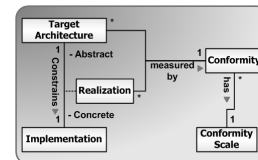
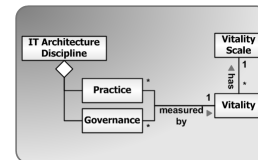
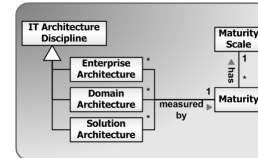
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## Precise definitions for Measurement & Metric terminology built common understanding and facilitated agreement



- The terms 'Alignment' and 'Compliance' were often used to describe IT solutions; unfortunately, these proved to be incorrect
  - The modeling followed the term's meaning, not our intention, and the problem quickly became apparent
    - Example: Compliance: 1) the act of conforming, **acquiescing, or yielding**; 2) **a tendency to yield readily to others, esp. in a weak and subservient way**; 3) **cooperation or obedience**.
  - The resulting ambiguities led to heated discussions and disagreements
- Definition and modeling demonstrated that the terms 'Maturity', 'Vitality', and 'Conformity' correctly described the respective measurements
  - Conformity: 1) action in accord with prevailing social standards, attitudes, practices, etc.; 2) **correspondence in form, nature, or character; agreement, congruity, or accord**.
  - Maturity: 1) **the state of being mature; ripeness**; 2) **full development; perfected condition**.
  - Vitality: 1) **exuberant physical strength or mental vigor**; 2) **capacity for survival or for continuation of a meaningful or purposeful existence**; 3) **power to live or grow**; 4) **vital force or principle**

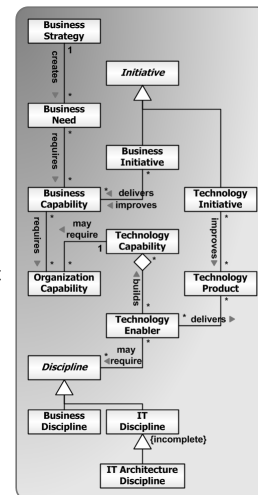


Random House, Random House Webster's Unabridged Dictionary, 2nd Ed., Random House, New York, NY, 1986.

## Once the basics were in place for Solution Architecture Practice & Governance, we focused on traceability to business value



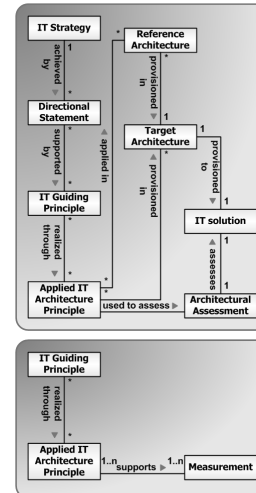
- We started with a few basic premises
  - Business goals, objectives, and requirements (needs) drive IT solutions
    - IT delivers to and measures against this
      - Function, performance, cost, time-to-market, etc.
  - IT and IT solutions provide the essential components to automate the business
    - IT Architecture is required to assemble the components into meaningful IT Solutions
      - Problems that must be solved through IT Architecture cannot be solved with design or code
  - IT Architecture is at the nexus of business and information technology
    - IT Architecture provides the framework, that is the consistent coherent context, necessary to align and optimize IT and IT solutions with the business
      - Any lack of or weakness in alignment and/or optimization detracts from the business value delivered



## IT Guiding Principles and their Applied IT Architecture Principles establish the reference point for the Measurements & Metrics



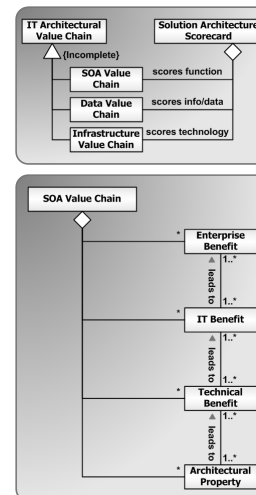
- We recognized the utility of IT Guiding Principles and their Applied IT Architecture Principles to Measurements & Metrics when we began using them in IT Architecture Assessments
  - We referenced IT Guiding Principles and their Applied IT Architecture Principles to build agreement before the IT Architecture Assessment
    - IT professionals will agree with a principle more easily than with the evaluation of "Their" IT solution
  - The IT Guiding Principles and their Applied IT Architecture Principles provided the agreed-upon 'yardstick'
  - This eliminated any argument regarding the IT Architecture Assessment
- IT Guiding Principles and their Applied IT Architecture Principles are the basis for measuring the Current State, setting each Target Architecture, and measuring the Realized Architecture



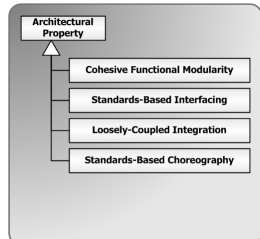
## Westfield Group's SOA discipline was also at a formative and rapidly evolving stage



- We recognized that an IT solution involved multiple IT Architecture domains
  - This implied that our Measurements & Metrics must align with these domains
    - Our initial Measurements & Metrics focused on the SOA, Data, and Infrastructure domains
- We also recognized that value builds upward
  - Architectural Properties give rise to Technical Benefits; Technical Benefits give rise to IT Benefits; and, IT Benefits give rise to Enterprise Benefits
  - Collectively, the Enterprise and its IT Solutions serve the business and realize business value
- The Value Chain supports our Measurements & Metrics and helps us communicate both technical and business value at all levels
  - Our initial Value Chains focused on the SOA, Data, and Infrastructure domains
  - We are working to address the domains that reflect our legacy IT environment which serves as our SOA Resource Layer

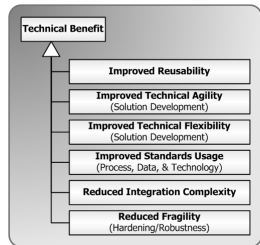


## The SOA Value Chain helped the IT Architects measure SOA progress and answer objections to SOA establishment

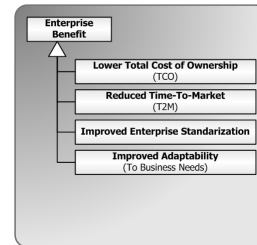
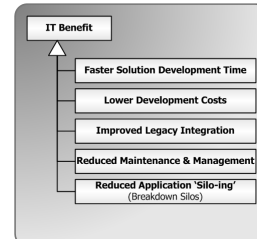


▪ The SOA properties and benefits were derived from Thomas Erl's work and other published sources

▪ The SOA Value Chain was applied to several new SOA services



- The steadily improving scorecards showed SOA maturity evolving over time
- The specific strengths and weaknesses in the Architectural Properties for each SOA service were traced to benefits realized or lost respectively

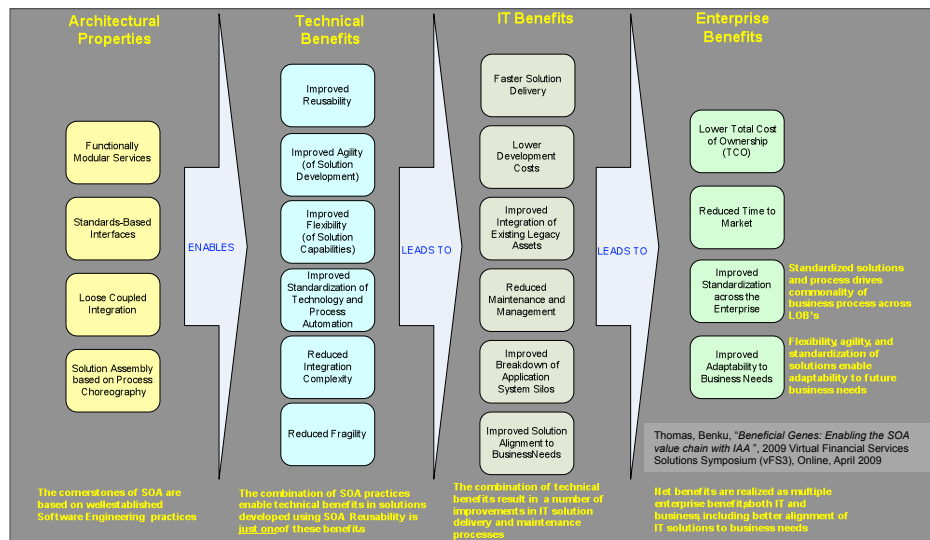


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## The SOA Value Chain traces a connection for better or worse, and allowed us to show how value is realized or lost in IT solutions



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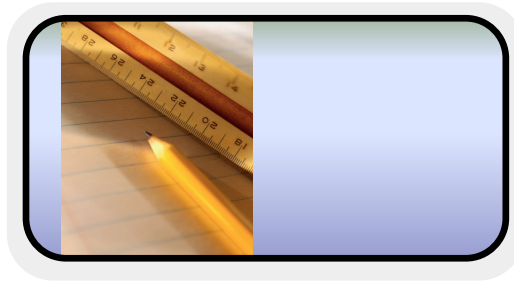
## Characteristics: Evaluating measurements and metrics



## Observing other IT Measurements & Metrics efforts led us to criteria-based selection of 'good' Measurements & Metrics

- Measurements & Metrics should possess certain characteristics (O'METRIC):
  - **O: Objective** – Must be objective rather than subjective; ideally quantitative
  - **M: Manageable** – Must be relatively easy to obtain, store, analyze, and understand; not difficult or obfuscated
  - **E: Essential** – Must be the most significant among several similar candidates; ideally fewer essential Measurements & Metrics are better than many non-essential ones
  - **T: Traceable** – Must be traceable to goals and objectives of the Business; this includes the Business of IT (BoIT)
  - **R: Relevant** – Must be immediately pertinent to the given subject; not more closely related to some other subject
  - **I: Indicative** – Must be indicative of the given subject; not easily influenced by extraneous subjects
  - **C: Criteria-Based** – Must have fixed distinguishing criteria, not arbitrary questions or presuppositions

## Delivery: Approach, techniques, and lessons



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Our observations also led us to conclude that a few essential Measurements & Metrics were more effective and manageable

### ■ Discipline (Maturity)

- $M_{EA-D}$
- $M_{DA-D}$
- $M_{SA-D}$

### ■ Governance (Vitality)

- $M_{EA-G}$
- $M_{DA-G}$
- $M_{SA-G}$

### ■ Practice (Vitality)

- $M_{EA-P}$
- $M_{DA-P}$
- $M_{SA-P}$

### ■ Target Architecture (Conformity)

- $M_{SA-TA}$
- $M_{SA-RA}$

Where  $M = \{\text{Measurements \& Metrics}\}$

There are potentially 11 sets of Measurements with their respective Metrics.  
 Focusing on only the essential Measurements & Metrics is critical to ensuring manageability.

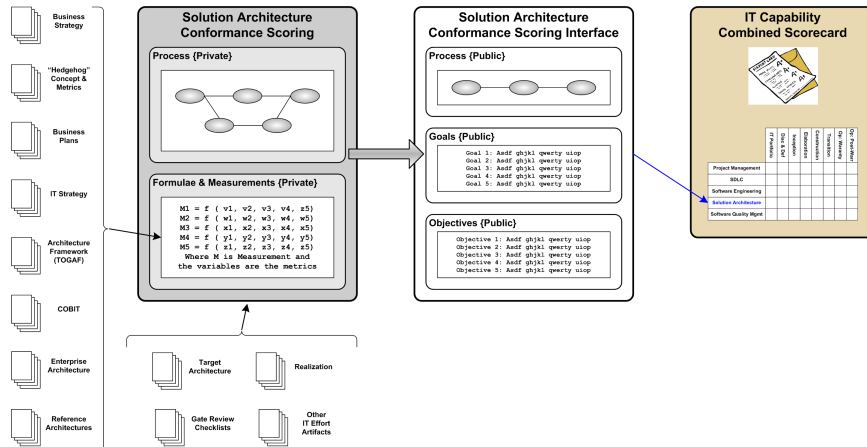
If there were, on average, 5 Metrics for each Measurement, and each of these sets had only 1 Measurement each, then these 11 Measurement sets would involve gathering and managing 55 Metrics.

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## Our observations also led us to apply a façade pattern to reporting the IT Architecture Measurements & Metrics



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## In the end, we learned that it's all about people



- Your executive's or manager's idea for a measurement will trump modeling and mathematical rigor
  - Responding to another executive's or manager's scorecard
  - Responding to pressures for "Hard Numbers"
  - Recommendations: [1] Use the Scorecard façade to maintain mathematical and statistical integrity; and, [2] Set expectations for incremental improvement
- Those stakeholders who most directly received the value and benefits will perceive the value of IT Architecture as greater and accept of your Measurements & Metrics more easily
  - Those who do not want their "Cheese" to move will be the loudest in attacking IT Architecture and its Measurements & Metrics
  - Recommendations: [1] Enlist the IT Asset Owners as allies for they must live with the costs and headaches of ill-architected and un-architected IT solutions; and, [2] Avoid answering to designers, developers, and project managers for they have no "skin in the game"

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## The maturity of other IT disciplines and processes will limit IT Architecture Measurement & Metric effectiveness



- The absence of a Business Process Modeling discipline and its models makes tracing and measuring IT Architecture value more difficult at any scale
  - Existing IT solutions implement business processes that are not otherwise modeled
  - Use Cases provide additional insight into business processes
  - Recommendations: [1] Leverage the Business Strategy and IT Strategy along with IT Guiding Principles and Applied IT Architecture Principles; and, [2] Trace the positive affects from Architecture Decisions
- The absence of a Total Cost of Ownership discipline and its measurements makes measuring and valuating IT Architecture more difficult at any scale
  - Most people over-estimate the value and benefits, and under-estimate the costs and risks
  - The value of IT Architecture becomes more apparent when ill-architected or poorly-architected IT solutions fail
  - Recommendations: [1] Leverage the values stated in the business case from IT Portfolio Planning; and, [2] Trace the adverse affects from failed IT solutions

## A bottom-up incremental approach limits adverse affects from early mistakes



- Work from the bottom up
  - Start with Conformity and Governance for Solution Architecture
    - Solution Architecture Scorecard for projects
  - Expand to Vitality and Governance for Solution Architecture
    - Architecture Issue & Exception Tracking
  - Expand to Vitality and Practice for Solution Architecture
    - Architecture Artifact (Asset) Tracking
  - Continue to other Disciplines and Aspects
- Work incrementally
  - 'Pilot' release and 'Rollout' releases
  - Across Conformity, Vitality, and Maturity
  - Across Solution Architecture, Domain Architectures, and Enterprise Architecture
  - Across Governance and Practice



**Our future direction emphasizes greater conformity with IT standards, frameworks, and best practices**



- Under consideration:
  - Va/IT Framework (ISACA)
  - Measurement training (SEI)
  - Architecture Tradeoff Analysis Method (SEI)
  - Value Chain Analysis (Michael Porter)
  - IT Options Valuation (Black-Scholes Formula)
  - Improved Automation
  - Improved financial, mathematical, and statistical rigor

**Questions & Answers**



Thank You!



If you would like a copy of this presentation containing the speaker notes, please send an e-mail to e-address indicated below.

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## Biography

- Mr. Starwood is an IT Architect with Westfield Group, a regional insurance company in Ohio. He spearheaded the establishment of Solution Architecture Practice & Governance for Westfield Group's 300+ person, \$70 Million per year IT department.
- Mr. Starwood has more than 22 years experience in the IT industry, and more than 13 years experience in IT architecture. He is an OMG Certified UML Professional and an IBM Certified IT Architect.
- Before joining Westfield Group, he was a member of IBM Global Services' Enterprise Architecture & Technology COE, and served on its thought-leadership team for Composite Business Services. Prior to that, he co-founded Keane, Inc.'s e-Business Architecture National Practice, and co-authored its Multi-Tier/Client-Server Development Method.
- Mr. Starwood is a frequent presenter and contributor to IT professional organizations
  - Presented "Enabling Conformance: Solution Architecture Governance in IT and Enterprise Model Contexts", Northeast Ohio – International Association of Software Architects (NEO-IASA), Cleveland, OH, March 2009
  - Presented "Blended Family: Bringing IAA & SOA home to your legacy environment", 2009 Virtual Financial Services Solutions Symposium (vFS3), Online, April 2009
  - Presented "Solution Architecture Governance in an IAA Context", 2008 Financial Services Solutions Symposium (FS3), Boston, MA, April 2008
  - Contributed to the "Hard Problems in SOA" workshop, Software Engineering Institute, Pittsburgh, PA, January 2008
- Mr. Starwood serves as Secretary for the Northeast Ohio – International Association of Software Architects (NEO-IASA).

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