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Operational Risk in Global Financial Organizations in the small

COMPLEX COMBINATIONS

Overview

- Context
  - Potential areas and topics for research related to Operational Risk management in the financial sector.
- Background – 2007-Present
- Key Perspectives, Issues, and Missing Pieces
- Models and Tools
  - How we're trying to solve the problem in practice
- Possible areas or directions for investigation

DEFINITION

"Operational Risk refers to financial loss resulting from a host of potential operational breakdowns that we can think of in terms of people risk, process risk, and technology risks (e.g., frauds, inadequate computer systems, a failure in controls, a mistake in operations, a guideline that has been circumvented, or a natural disaster)." – BASEL II

The "kitchen sink" – People, Process, and Systems

BACKGROUND

"The modern financial complex has morphed into something unrecognizable to many astute market veterans and academics." **Bill Gross, PIMCO, October 2007**

"...in order to be sustained in an orderly fashion, the proliferation of structured products requires retooling and upgrades at virtually every level of the financial system, including a revamping of the pipes through which transactions flow. This inevitably takes time and requires managerial focus."[i]

"When Markets Collide" by Mohamed El-Erian, 2008

Supply Chains – Cumulative Risks and Errors
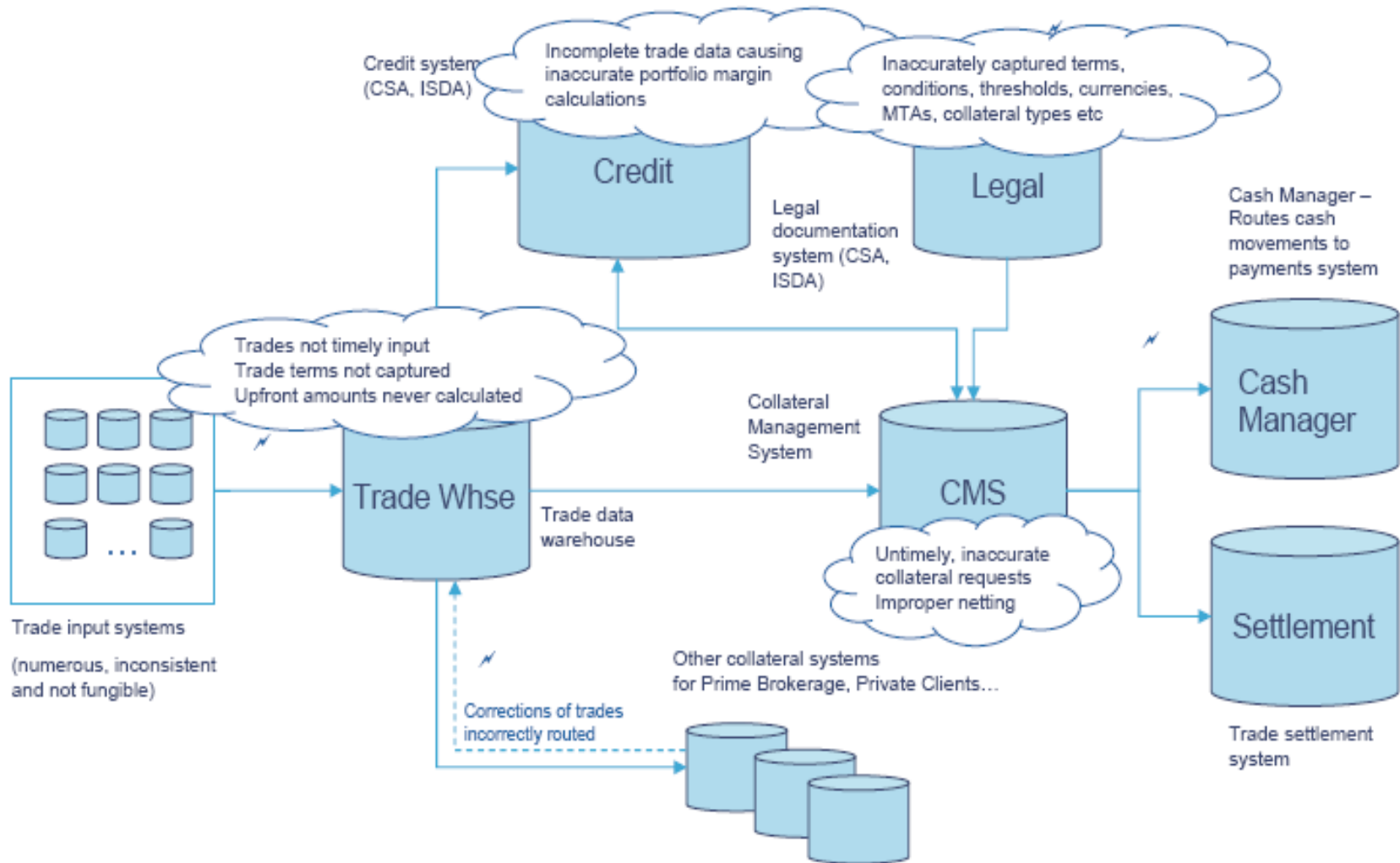
Source: PWC – Collateral Management · Challenges & Opportunities, April 2008

Supply Chains – Cumulative Risks and Errors

In summary

- Certain clients are experiencing significant error rates and exposures generated from broken operational processes and flawed data – leading to as much as hundreds of millions of dollars in margin deficiencies and untold billions in parameter errors

- A root cause of the high levels of operational risk and/or actual operational failures can be traced to fragmented processes and siloed systems that can't keep pace with product and volume growth

- We recommend that organizations undertake end-to-end operational effectiveness assessments in highly complex product areas

- Processes need to be re-designed to meet the current and future needs of business and large stores of critical data may need to be remediated

- Experience shows millions (USD) or more may be at unnecessary risk and can be identified and collected in an early phase of the overall project

Source: PWC – Collateral Management · Challenges & Opportunities, April 2008

Firm Level Risk Management Challenges

- **Spreadsheets** are often used to consolidate data from smaller branch offices, this means information needs to be entered, often manually, into larger systems resulting in data errors.

- **Inconsistent systems and terms** from different bank locations results in errors in reporting and inconsistent information from different locations.

- **Regulations** continue to change or be updated, it is often difficult to implement changes or report in a timely fashion.

- Acquisitions result in many divergent systems that do not communicate with each other, this increases risk and accuracy in reporting

- Point-to-Point integration of disparate systems is complicated and costly to reporting in this setup. Rarely actually occurs ...

- Agility to grow the business through new acquisitions is restrained, change management is complicated and cumbersome.

- Cumulative effects of above are rapidly degenerative...

Enterprise Risk Management – State of the Art

# INDUSTRY PRACTICE – EXAMPLE

Risk Management in the small

Event: any incident that needs to be captured, measured, and contextually analyzed.

For any event, Risk Management personnel need to know...

- what (Transaction \ Event Alert)
- where (Branches)
- which (Transactions)
- when (Frequency)
- why (Associate Links)
- who responds (Managers)
- HOW? (PROCESS/SEQUENCE)

Need to *relate*—not just copy—information from many sources

ACCOUNTS CRM BI Tools GIS ALERTS
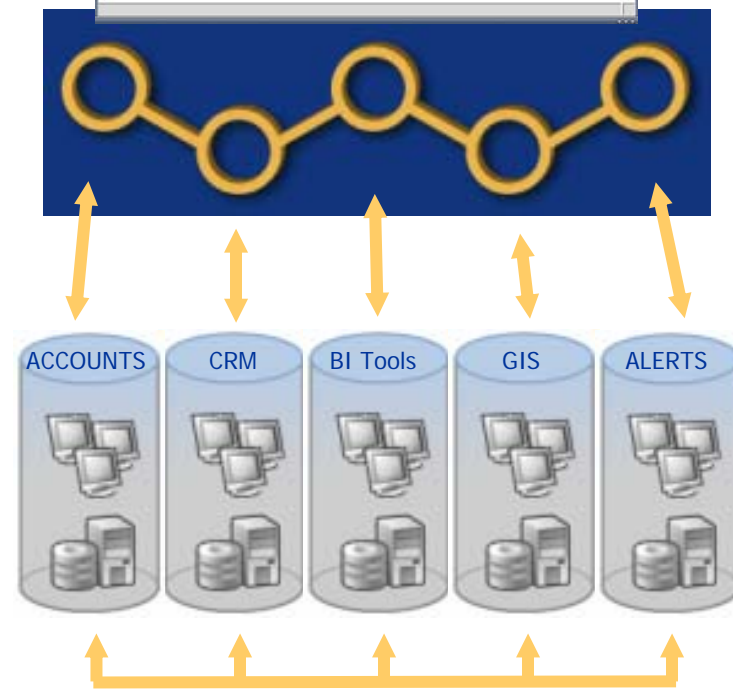
Data Models are required

Using Modeling Tools (MagicDraw) to Visualize:

- Traceable, Modeled representation of granular data requirements for firm-level risk management applications (including market, credit, liquidity),

- Connection between data management and operational risk.

Model all the Risk Management Formulae for banks' major products: e.g. corporate, small–medium enterprise (SME), residential mortgage and qualifying revolving retail exposure.

Corporate exposure[10]

Correlation (R) = $0.12 \times (1 - \text{EXP}(-50 \times PD)) / (1 - \text{EXP}(-50)) + 0.24 \times [1 - (1 - \text{EXP}(-50 \times PD))/(1 - \text{EXP}(-50))]$

Maturity adjustment (b) = $(0.11852 - 0.05478 \times \ln(PD))^2$

Capital requirement[68] (K) = $[LGD \times N[(1 - R)^{-0.5} \times G(PD) + (R / (1 - R))^{0.5} \times G(0.999)] - PD \times LGD] \times (1 - 1.5 \times b)^{-1} \times (1 + (M - 2.5) \times b)$

Risk-weighted assets (RWA) = $K \times 12.5 \times EAD$

Corporate exposure adjusted for SME[11]

Correlation (R) = $0.12 \times (1 - \text{EXP}(-50 \times PD)) / (1 - \text{EXP}(-50)) + 0.24 \times [1 - (1 - \text{EXP}(-50 \times PD))/(1 - \text{EXP}(-50))] - 0.04 \times (1 - (S-5)/45)$

Residential mortgage exposure[12]

Correlation (R) = 0.15

Capital requirement (K) = $LGD \times N[(1 - R)^{-0.5} \times G(PD) + (R / (1 - R))^{0.5} \times G(0.999)] - PD \times LGD$

Risk-weighted assets = $K \times 12.5 \times EAD$

Qualifying revolving retail exposure[13] (credit card product)

Correlation (R) = 0.04

Capital requirement (K) = $LGD \times N[(1 - R)^{-0.5} \times G(PD) + (R / (1 - R))^{0.5} \times G(0.999)] - PD \times LGD$

Risk-weighted assets = $K \times 12.5 \times EAD$

Blueprints – Models based Traceable Enterprise Framework

Requirements Documents are formally traced to 73 other formally modelled artefacts: business processes, strategic goals, business functions, processes, static data models, infrastructure topology models in order to:
- *share and scale best practices and*
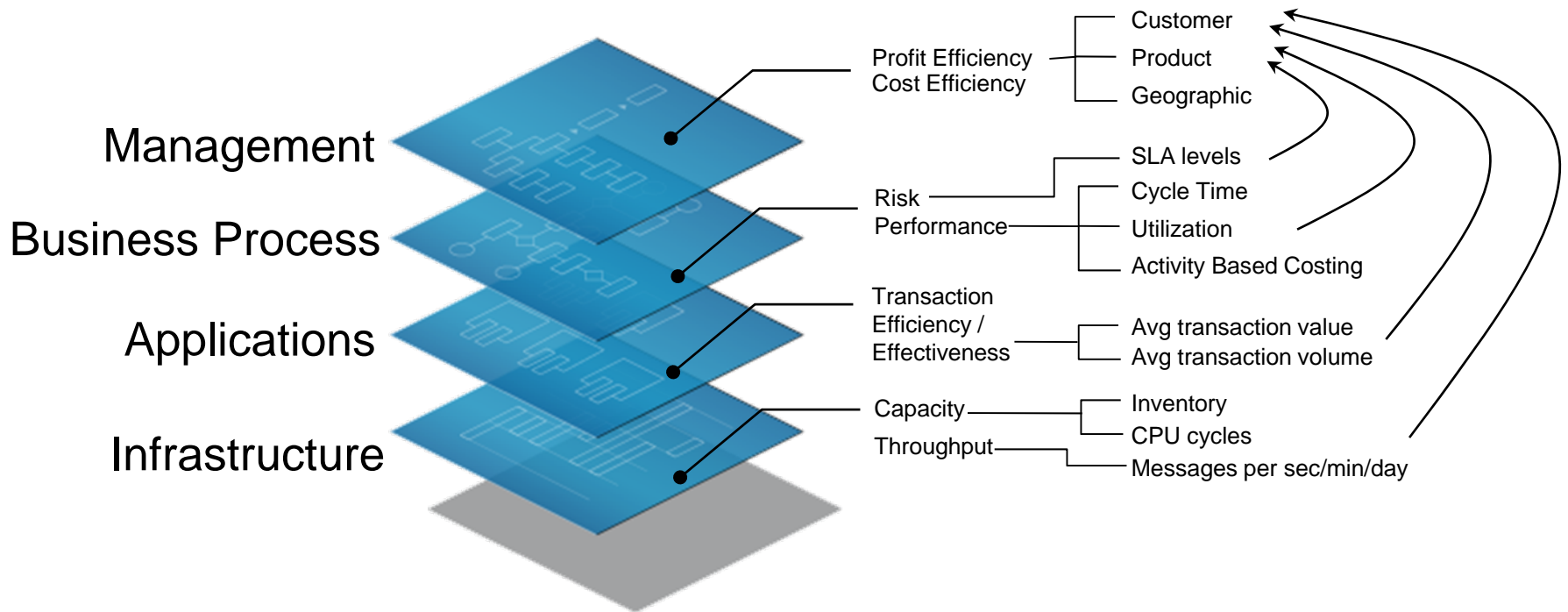- *be able to view requirements from the perspective of all relevant types of stakeholders*

Requirements (word) document for OPS RISK traceable to:

- Traceability is the backbone for maintaining and managing the alignment between different stakeholders during requirements gathering.

Strategic Goal Model, Measurement Model

Process & Organization Models

Static Data Models

Infrastructure & Topology Models
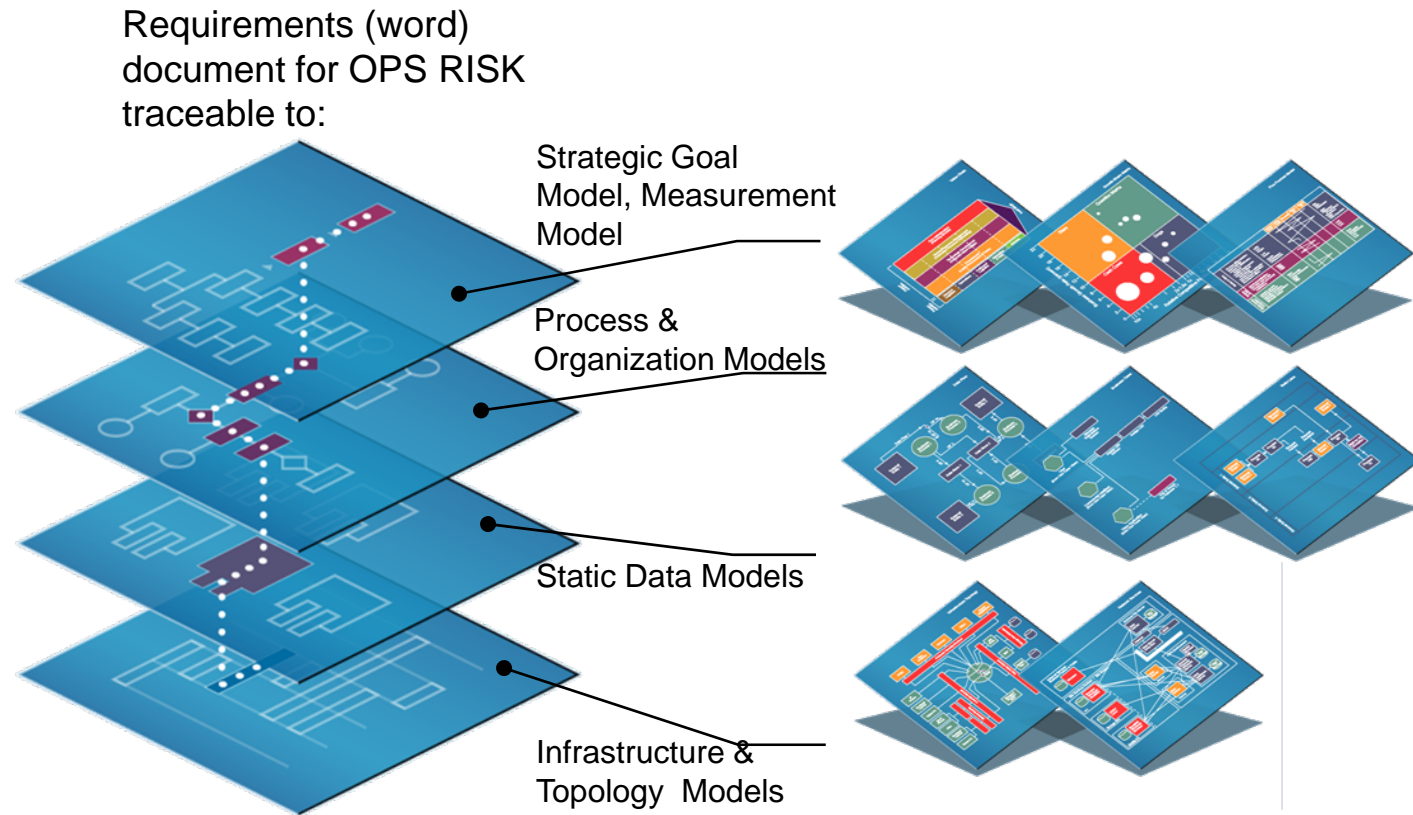
For example: Clicking on process activity allows you to see corresponding requirement, goal or static data model

Accurate Measurement

- *Operations should be designed to meet Key Performance Indicators (KPIs).*

- *KPIs are derived from information in many levels of an operating enterprise*

- *Blueprints aligns these metrics.*

Management

Business Process

Applications

Infrastructure

Profit Efficiency
Cost Efficiency
- Customer
- Product
- Geographic

Risk
Performance
- SLA levels
- Cycle Time
- Utilization
- Activity Based Costing

Transaction Efficiency / Effectiveness
- Avg transaction value
- Avg transaction volume

Capacity
Throughput
- Inventory
- CPU cycles
- Messages per sec/min/day

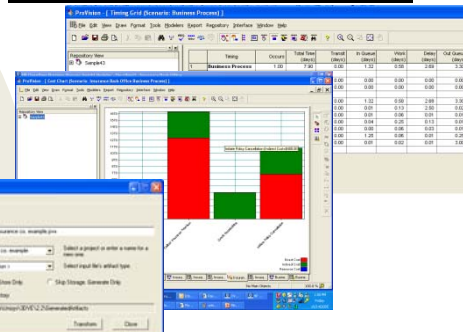*You cannot improve what you cannot measure!*

Standards based Firm Wide Risk Management – Tracing Data to Real Time Ops Risk
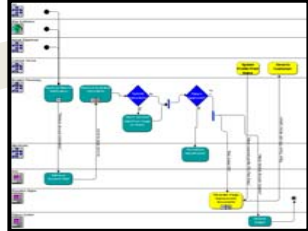
Start here

1. Standards based business and system models
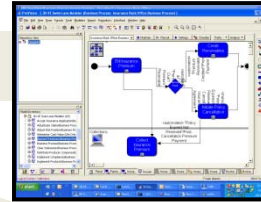
2. Perform simulations to optimize business models

6. View dashboards & perform gap analysis

Adjust

Plan

7. Update business models

Includes emergency and other Notifications

5. Monitor application operation & collect metrics

Execute

Develop

3. Using 3D-VE approach, create detailed models & implementation

4. Instrument the deployed application

Includes automated execution of ACTION PLANS

Risk Management in the Small
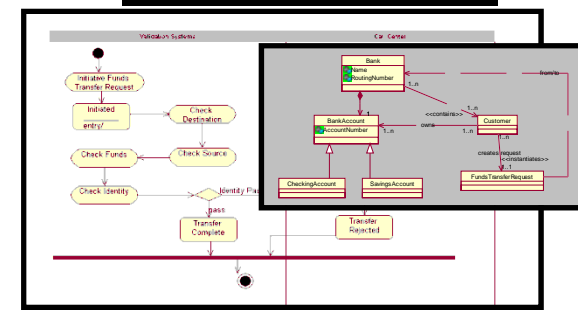
Comprehensive TRACEABLE visibility into policy compliance

- Document and manage goals, policies, rules, and action plans
  - Capture from source documents
  - Linkage
- Enforce standards
  - During message capture & transformation
  - At transaction level
- Track and report violations
  - Clear traceability. Exceptions linked to rule that is violated
  - Record remediation
  - Custom reports and charts

```
Goals
  ↓
Action Plans ← Policies
               ↓
            Rules & Data
               ↑
            Real Time Events
```

Risk Management in the Small
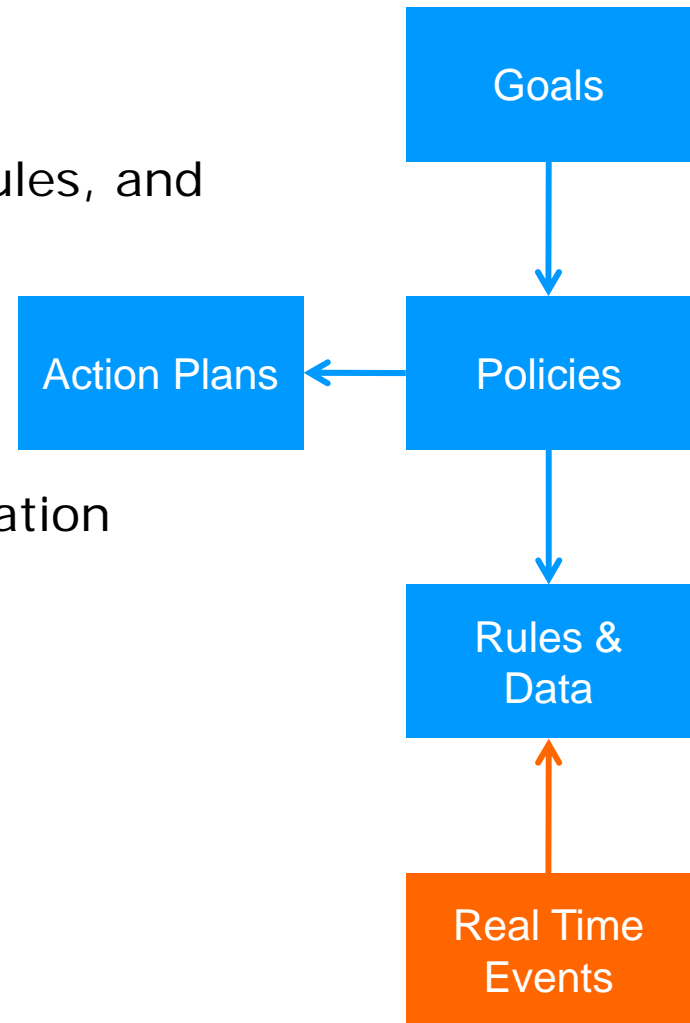
Quick Dashboard Demo
– KPIs for Risk Management in the small

Real World Challenges for building comprehensive Automated Risk Compliance solution for Financial Institutions
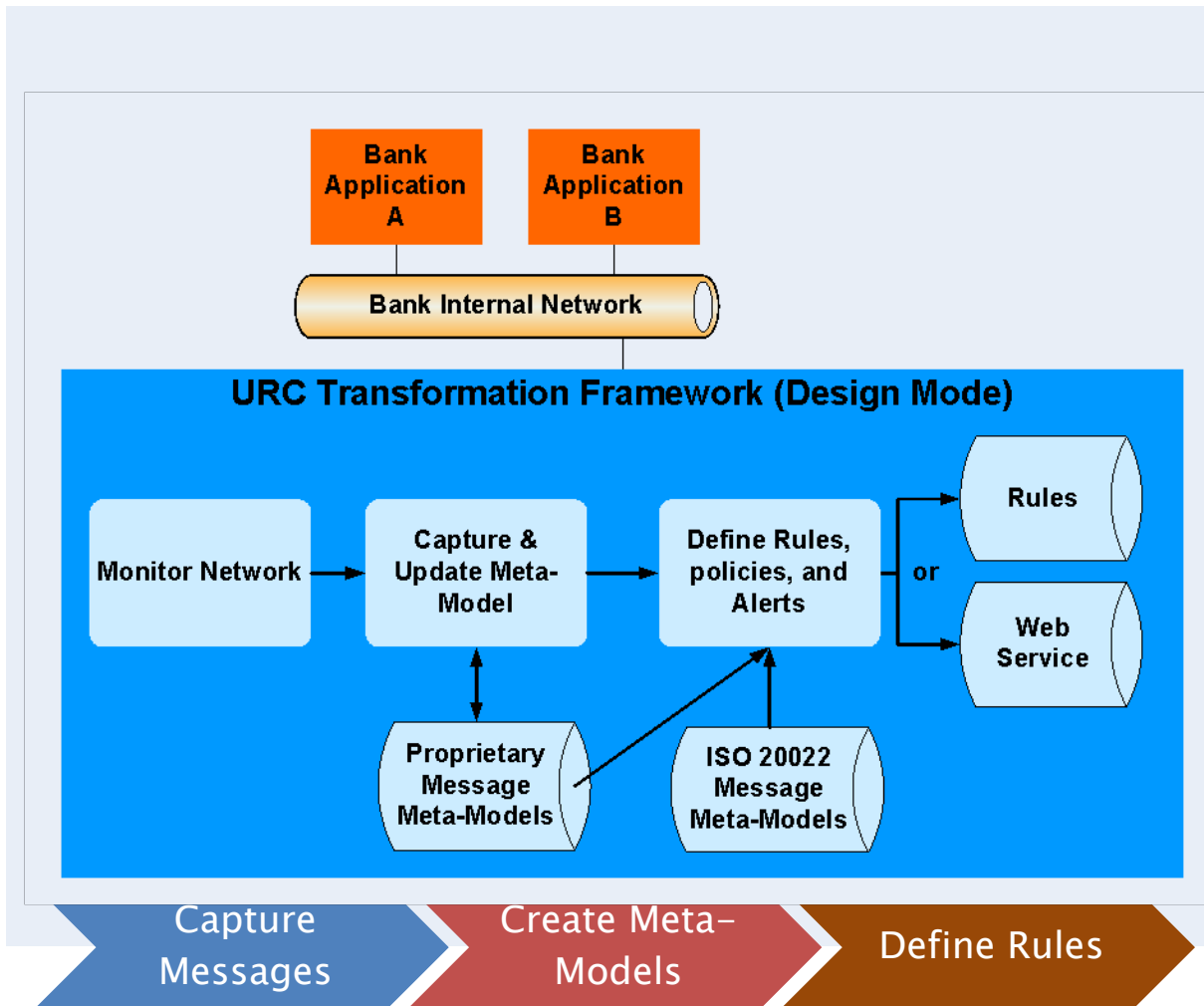
- Define transformations from proprietary to standard formats

- Identify exceptions and create alerts

- Implement custom weightages

- Remove sensitive data like names and account numbers

Risk Management in the Small

Real-time transaction capture and standardization

Monitor network

- Capture messages of interest

- Discard other messages

Transform messages

- ISO 20022 format

- Rules based

- Remove sensitive information

Identify violations

- Bank specific policies

- Basel II rules

- Raise alerts

Risk Management in the Small

Tie up of Data Analysis with OPERATIONAL RISK ASSESSMENT

Risk Categories	Approaches to calculate capital requirement
Credit Risk	Standardized
	Foundation IRB
	Advanced IRB
Operational Risk	Basic Indicator
	Standardized
	Advanced Measurement
Market Risk	Value at Risk
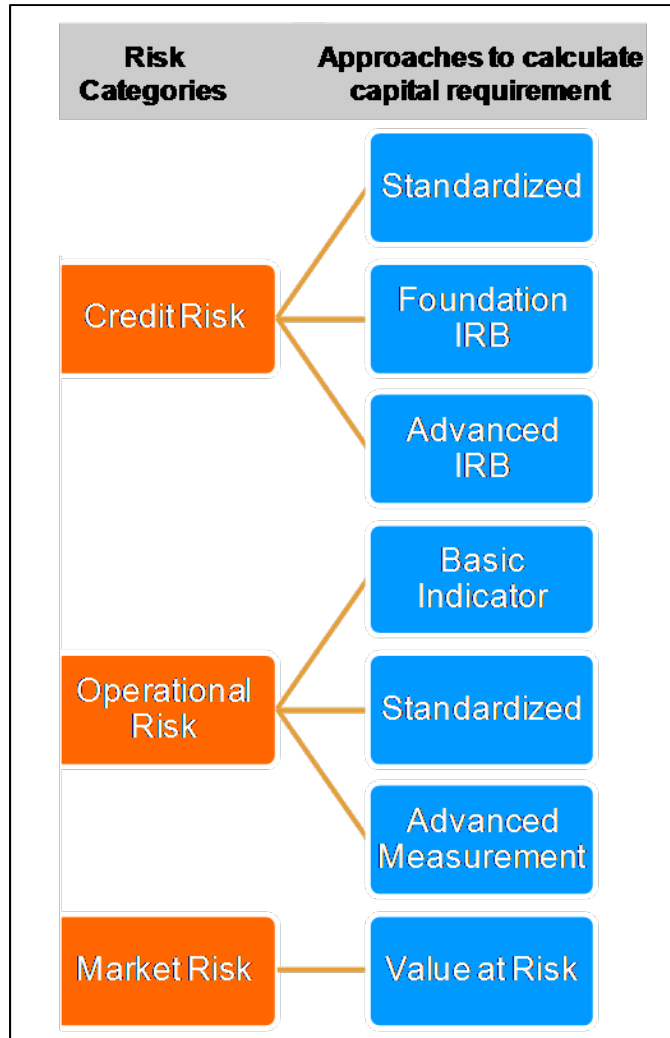
- SYSML content can be easily updated for regulatory changes
- Certified by the Basel Committee of Banking Supervision (BCBS)

Bank

Industry Models

Bank Specific Models

Regualtory Compliance Service

Risk Management in the Small
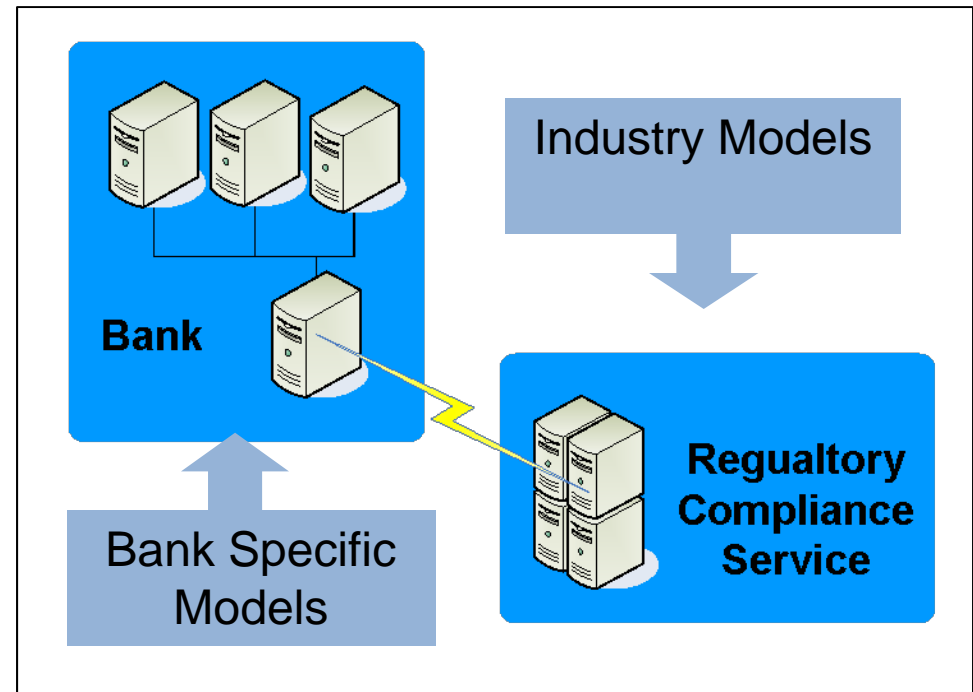
Model validation using artificial intelligence engine

- Artificial Intelligence engine
  - continuously learns
  - provides better insights into operations
  - facilitates the creation of new policies
  - model based simulation and assessment of the impact of new policies
- Identifies new cause and effect relationships between multiple variables by learning from real data.
  - Automatically determines mathematical formulas (with a specified range of error)
- Bayesian Reasoning application was developed and proven within NASA's Mars Rover™. Project enabled the rover to make decisions on its own.

Frequency of loss

Normal cost of doing business covered by provisioning and pricing policies.

Potential unexpected loss for which capital should be held.

Potential unexpected loss against which it is judged to be too expensive to hold capital against. Unexpected losses of this extent lead to insolvency.

Expected loss   Unexpected loss   Stress loss

Potential credit losses

Risk Management in the Small

ADVANCED RESEARCH – ARTIFICIAL INTELLIGENCE engine to monitor and analyze continuously changing cause–effect scenarios: B.R.A.I.N (Bayesian Reasoning Analytics in Intelligent Networks)

Results \ Inferences

R E A L   W O R L D

Transducers

Patterns

EVENTS In SBVR

$$P_W^e = \begin{cases} \{r_{e,i} \mid i \in in(e)\} \cup \{c_{e,o} \mid o \in out(e)\} & if\ e \notin \mathcal{I} \\ \{r_e\} \cup \{c_{e,o} \mid o \in out(e)\} & if\ e \in \mathcal{I} \end{cases}$$
$$T_W^e = \{t \in T_W \mid \bullet t \subseteq P_W^e \wedge t\bullet \subseteq P_W^e\}$$
$$F_W^e = F_W \cap (P_W^e \times T_W^e \cup T_W^e \times P_W^e)$$
$$L_W^e = L_W[T_W^e]$$

Mathematical WHAT–IF inference calculations

Inference Engine based on Agents

Patterns of events causing state changes in models

Actuators

Actions from

Inference results

Learn and Remember for future inferences

Analyze during inference

Modeling and Meta–Modeling Patterns Repository (MEMORY)

GOALS and Constraints in the form of SBVR Rules

7/27/2010

Risk Management in the Small

Areas for Investigation

RESEARCH TOPICS
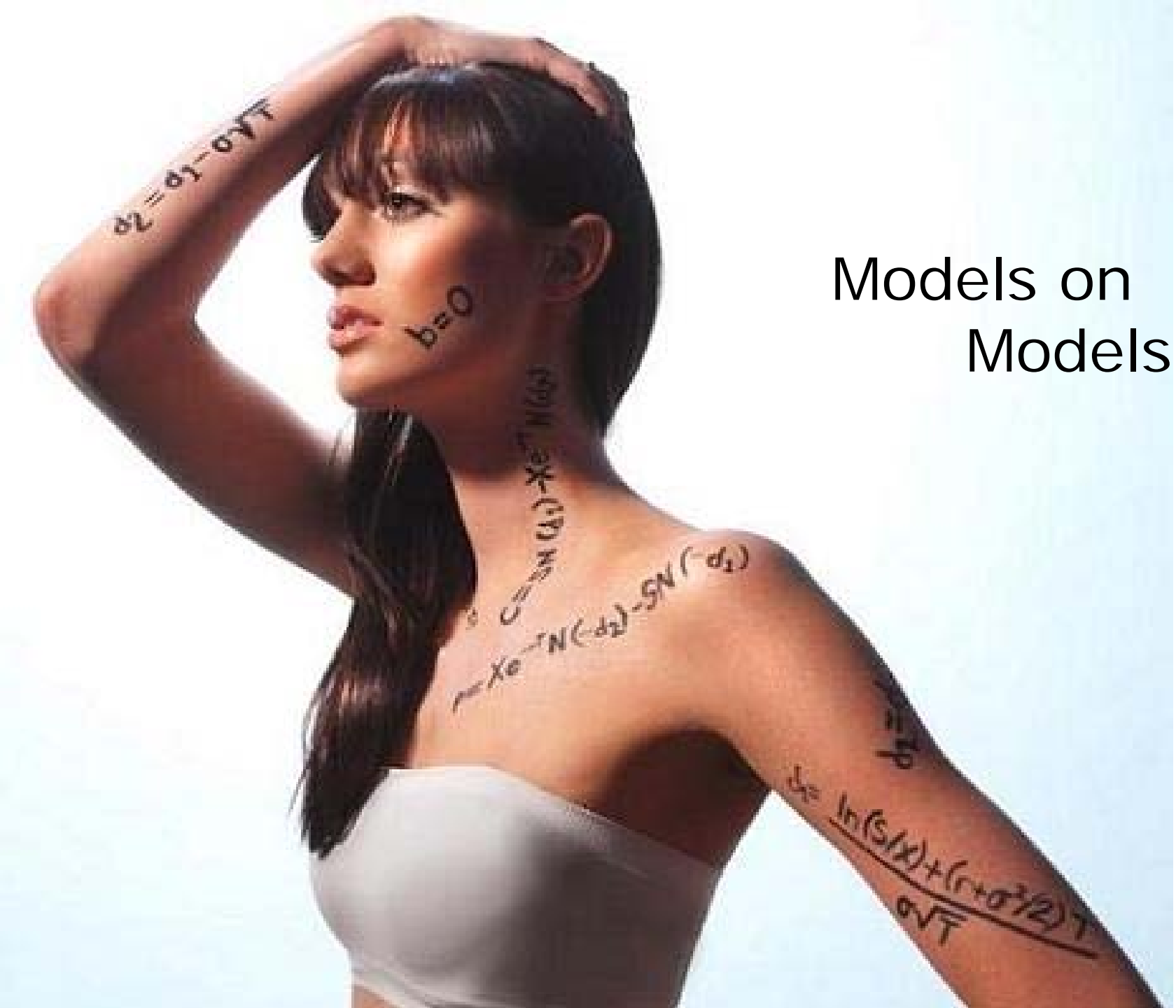
Models on Models

"What has the credit crisis taught us? First, that typical observed diversification doesn't always work. You've got to worry about all of the effects—on equity, on liquidity, on capital availability, etc. Also, whatever you imagined as an extreme tail event, imagine something even worse. And then make sure you understand all its implications to your business as a whole and also to your various entities."

— Insurance Chief Risk Officer

A Current Example

Table 1: Long-Term Correlations

	S&P 500	Large Growth	Large Value	Mid-Growth	Mid-Blend	Mid-Value	Small Growth	Small Blend	Small Value	Int'l Stocks	Emerg. Mkts.	High Yields	U.S. Bonds	Global Bonds	Cash	Real Estate	Natural Res.	Long-Short
S&P 500		.96	.92	.86	.93	.87	.79	.79	.78	.55	.59	.50	.23	–.03	.02	.52	.01	–.01
Large Growth	.96		.81	.92	.91	.75	.84	.78	.72	.53	.57	.48	.19	–.03	.00	.45	.00	–.22
Large Value	.92	.81		.72	.91	.96	.70	.80	.82	.51	.54	.49	.24	–.05	.03	.60	.05	.30
Mid-Growth	.86	.92	.72		.93	.73	.94	.91	.77	.54	.60	.50	.02	–.04	.00	.40	.04	–.33
Mid-Blend	.93	.91	.91	.93		.93	.91	.93	.91	.55	.63	.54	.20	–.06	.04	.59	.17	–.04
Mid-Value	.87	.75	.96	.73	.93		.70	.79	.89	.51	.54	.52	.11	–.05	–.03	.63	.07	.29
Small Growth	.79	.84	.70	.94	.91	.70		.98	.87	.50	.62	.51	.06	–.08	.00	.52	.19	–.25
Small Blend	.79	.78	.80	.91	.93	.79	.98		.95	.47	.63	.55	.15	–.10	.00	.65	.10	.06
Small Value	.78	.72	.82	.77	.91	.89	.87	.95		.49	.58	.57	.14	–.12	.02	.71	.19	.15
Int'l Stocks	.55	.53	.51	.54	.55	.51	.50	.47	.49		.56	.34	.13	.44	–.01	.36	.09	–.02
Emerging Mkts	.59	.57	.54	.60	.63	.54	.62	.63	.58	.56		.44	–.06	.00	–.02	.31	.09	–.05
High Yields	.50	.48	.49	.50	.54	.52	.51	.55	.57	.34	.44		.28	–.01	.00	.43	–.04	.08
U.S. Bonds	.23	.19	.24	.02	.20	.11	.06	.15	.14	.13	–.06	.28		.38	.34	.14	–.14	.06
Global Bonds	–.03	–.03	–.05	–.04	–.06	–.05	–.08	–.10	–.12	.44	.00	–.01	.38		.03	.03	.13	–.09
Cash	.02	.00	.03	.00	.04	–.03	.00	.00	.02	–.01	–.02	.00	.34	.03		–.02	–.12	.09
Real Estate	.52	.45	.60	.40	.59	.63	.52	.65	.71	.36	.31	.43	.14	.03	–.02		.08	.27
Natural Res.	.01	.00	.05	.04	.17	.07	.19	.10	.19	.09	.09	–.04	–.14	.13	–.12	.08		.05
Long-Short	–.01	–.22	.30	–.33	–.04	.29	–.25	.06	.15	–.02	–.05	.08	.06	–.09	.09	.27	.05	

= .80 to .99   = .60 to .79   = .40 to .59   = .39 to Negative

How do we know they are changing?

"*Almost no one expected what was coming. It's not fair to blame us for not predicting the unthinkable.*"

Daniel H. Mudd, former CEO, Fannie Mae

Questions and Answers