A man in a white shirt and blue tie stands with his left hand on his hip, holding a glowing golden orb in his right hand. The background is a soft-focus collage of digital and business-related icons, including binary code (0s and 1s), a globe, a bar chart, and various symbols like '@', '#', and 'z'. The overall color palette is light and airy, with a blue gradient at the top.

An Integrated Framework for Measuring and Managing Operational Risk

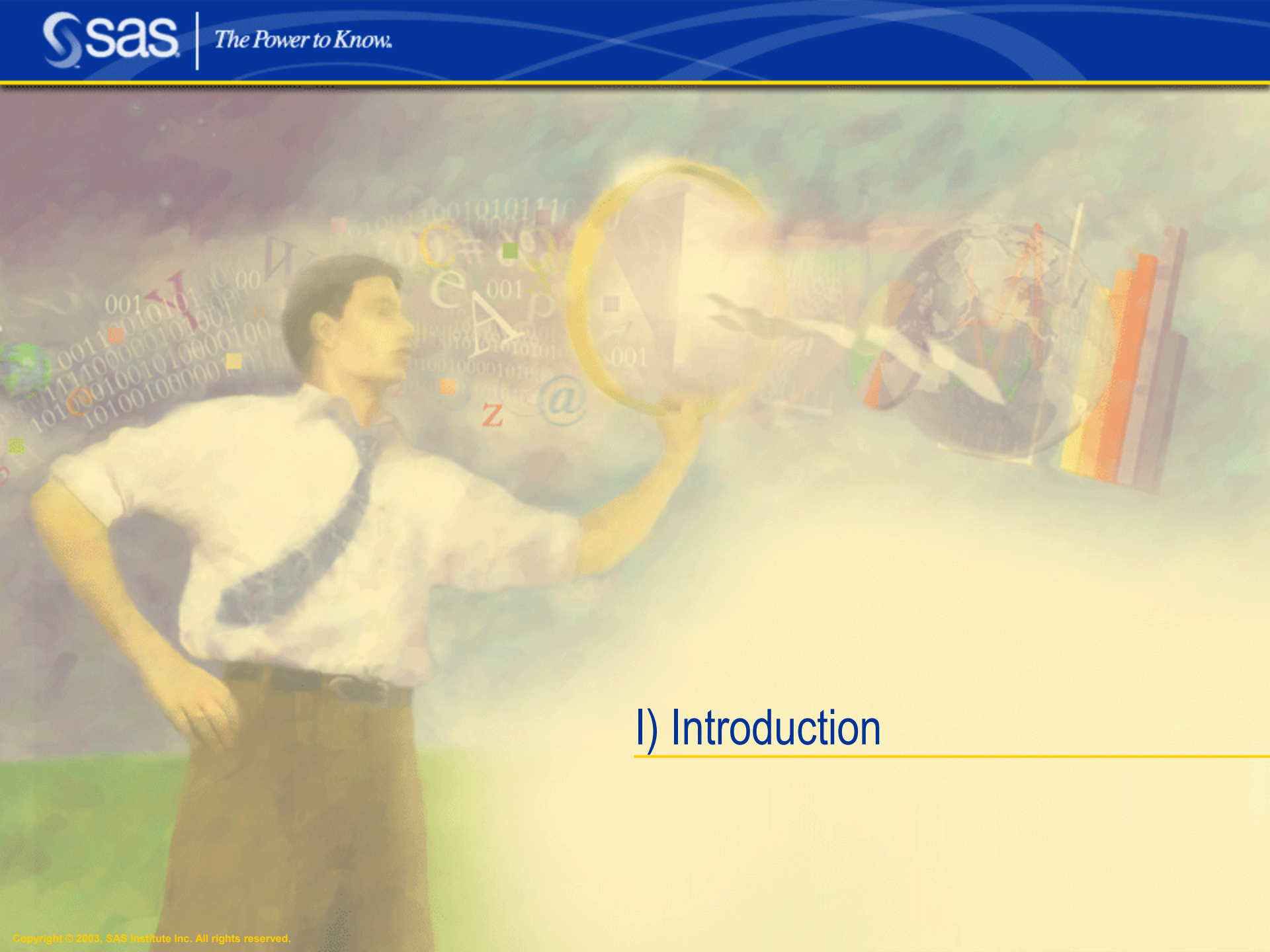
Ali Samad-Khan

Global Head of Operational Risk Strategy, SAS Inc.

December 1, 2003

Agenda

- I Introduction
- II The Elements of an Integrated Approach
- III Definition and Categorization Issues
- IV A Viable AMA Framework
- V Collecting Loss Data
- VI Standards for Control Assessment and Indicators



I) Introduction

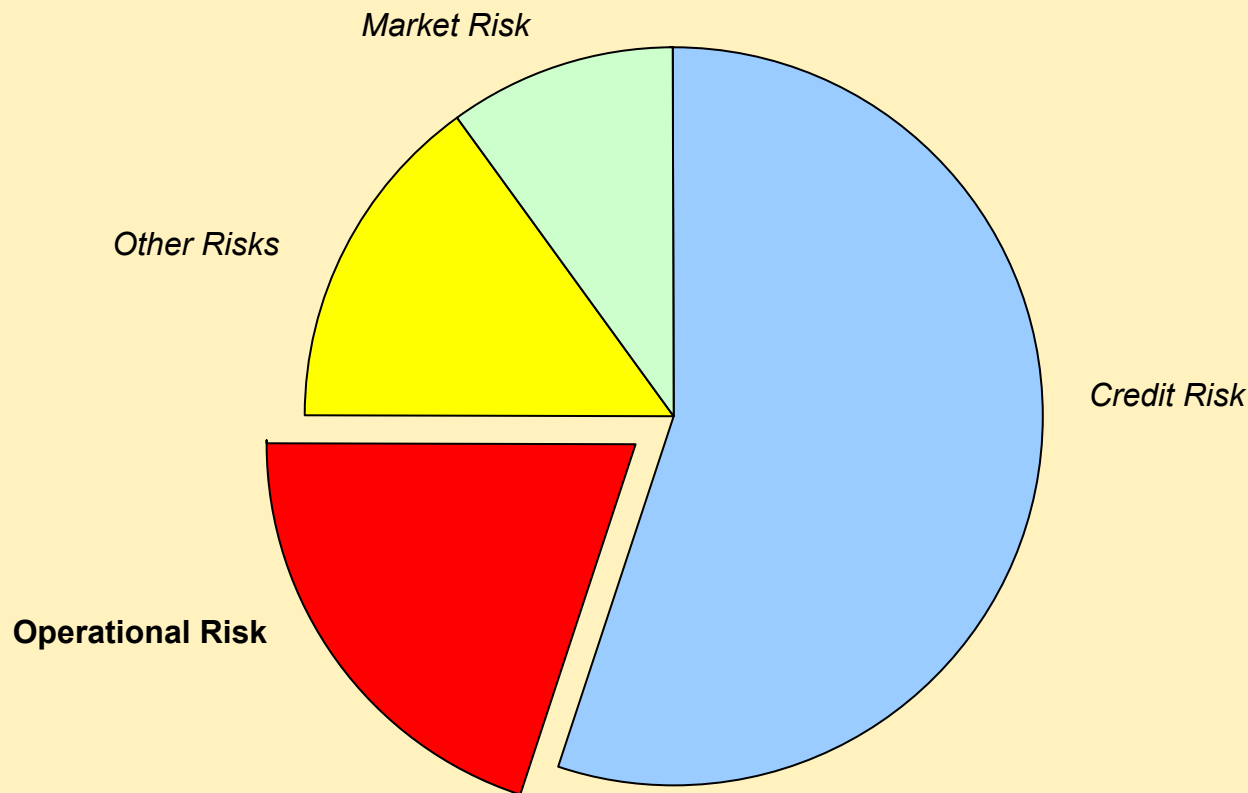
What is operational risk?

“Operational is the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events”

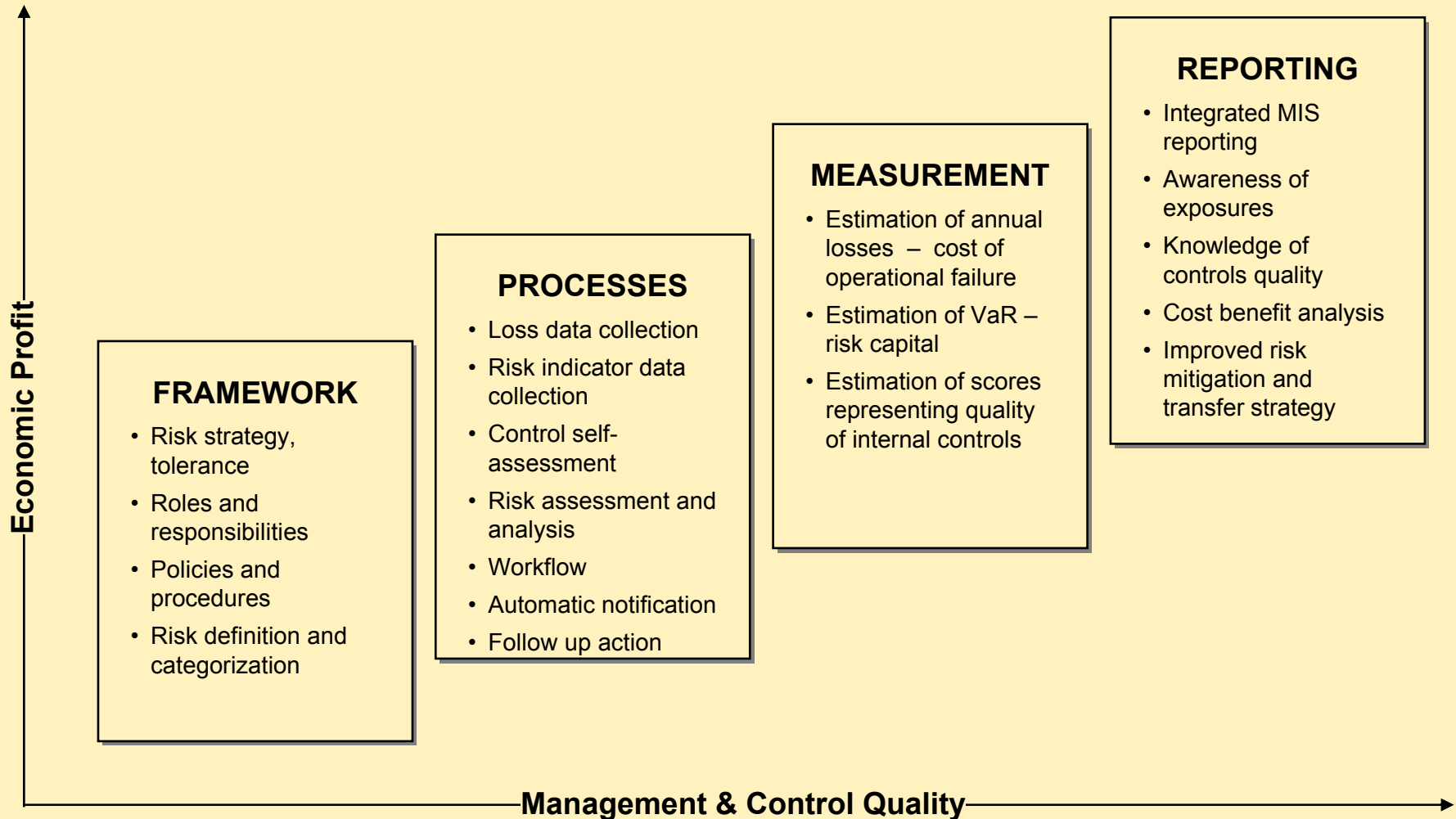
The Basel Committee

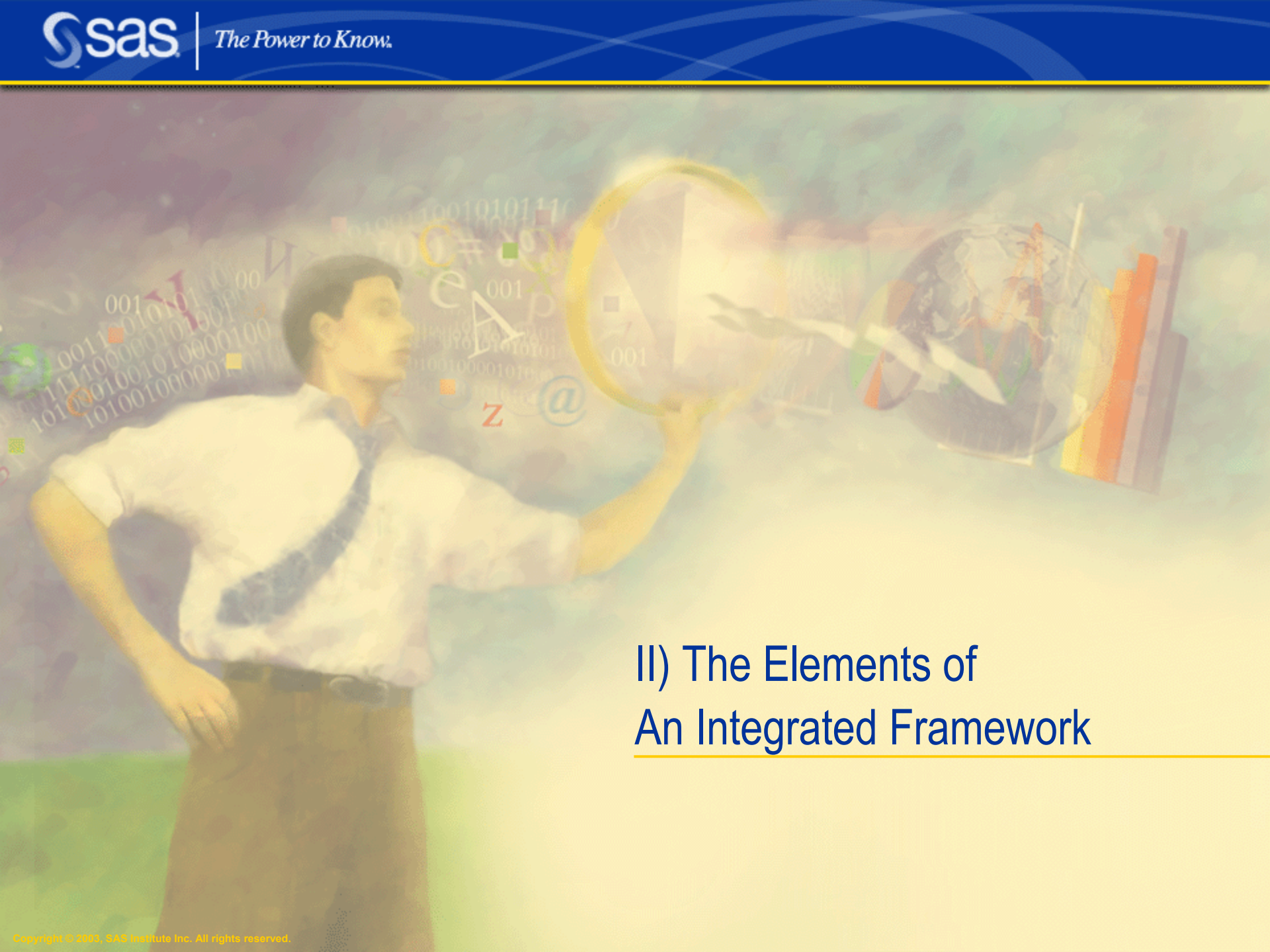
In lay terms: The risks associated with operating a business.

The Banking industry originally defined its risks as Credit risk, Market risk and “Other” risks. As the meaning of risk has been refined, many of these other risks are now characterized as Operational risk.



There are four fundamental steps to managing operational risk, with each step leading to improvements in management & control quality and greater economic profit



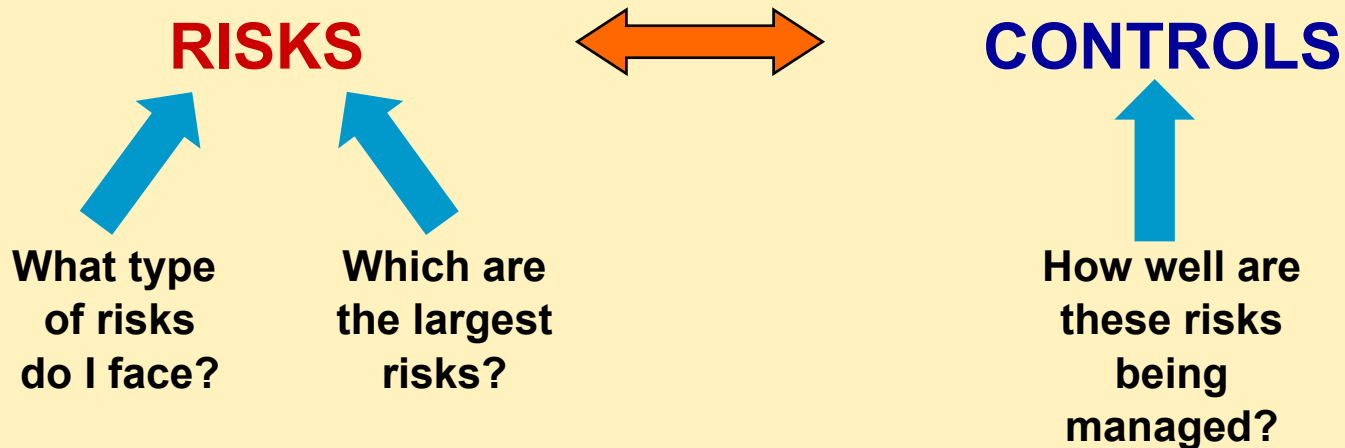


II) The Elements of An Integrated Framework

An integrated operational risk measurement/management program consist of six key elements

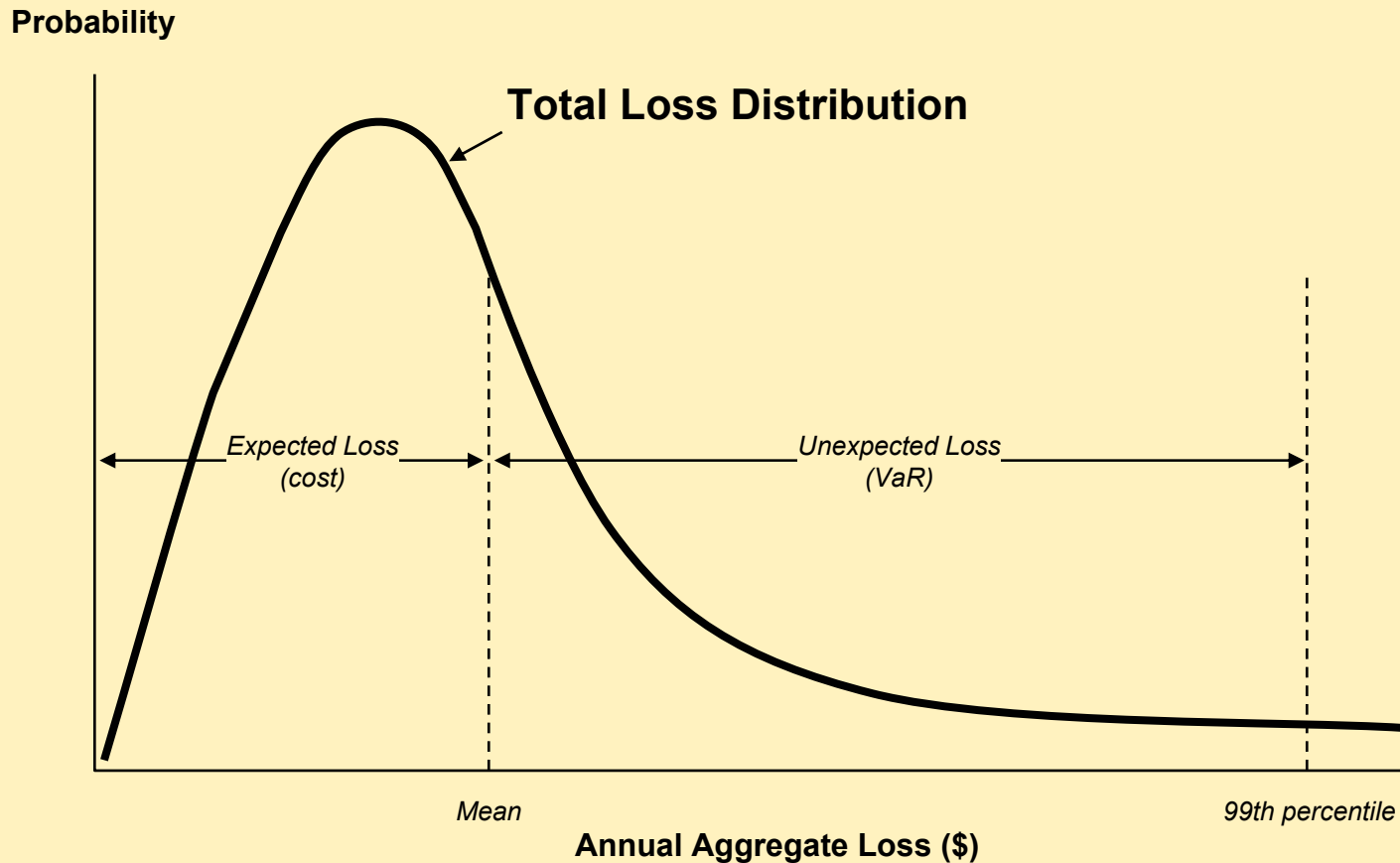
- **Internal and External Loss Data** - actual loss events that have taken place
- **Value at Risk Figures** - monetary estimates of risk capital based on a quantitative model
- **Risk Assessment Figures** - monetary estimates of risk capital based on disciplined scenario assessment process
- **Indicator Data (Scores)** - measurable variable that are believed to be correlated with performance, losses, or loss variability
 - Key performance indicators
 - Loss (risk) indicators
 - Exposure (scale) indicators
- **Control Assessment Data (Scores)** - assessments based on pre-specified criteria believed to be indicative of control quality

Managers need a set of tools to help them accurately measure/assess their operational risks and the quality of their corresponding internal controls



Controls are Optimized Through Cost Benefit Analysis

Definitions: The expected loss is the mean annual aggregate loss and unexpected loss represents the volatility above this mean at a specified confidence level



The results of many risk assessment processes may not be consistent with VaR calculation

Frequency	High			High Cost
	Medium			
	Low			High Risk
		Low	Medium	High

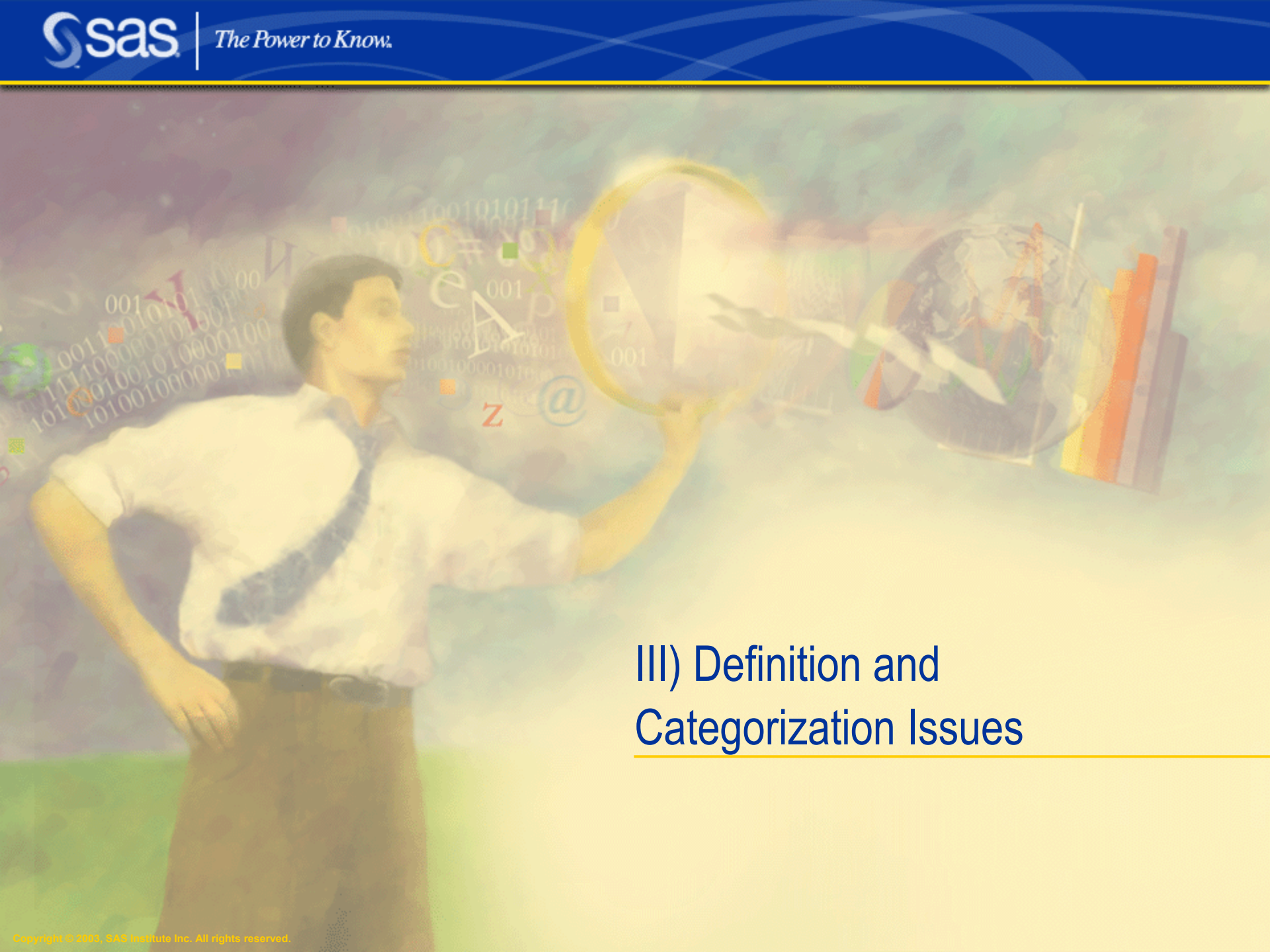
Severity

Placing loss data within a Business Line/Risk matrix helps reveal the risk profile of each business

		INTERNAL FRAUD	EXTERNAL FRAUD	EMPLOYMENT PRACTICES & WORKPLACE SAFETY	CLIENTS, PRODUCTS & BUSINESS PRACTICES	DAMAGE TO PHYSICAL ASSETS	EXECUTION, DELIVERY & PROCESS MANAGEMENT	BUSINESS DISRUPTION AND SYSTEM FAILURES	TOTAL
Corporate Finance	Number	362	123	25	36	33	150	2	731
	Mean	35,459	52,056	3,456	56,890	56,734	1,246	89,678	44,215
	Standard Deviation	5,694	8,975	3,845	7,890	3,456	245	23,543	6,976
Trading & Sales	Number	50	4	35	50	46	210	3	398
	Mean	53,189	78,084	5,184	85,335	85,101	1,869	134,517	66,322
	Standard Deviation	8,541	13,463	5,768	11,835	5,184	368	35,315	10,464
Retail Banking	Number	45	4	32	45	42	189	3	360
	Mean	47,870	70,276	4,666	76,802	76,591	1,682	121,065	59,690
	Standard Deviation	7,687	12,116	5,191	10,652	4,666	331	31,783	9,417
Commercial Banking	Number	41	3	28	41	37	170	2	322
	Mean	43,083	63,248	4,199	69,121	68,932	1,514	108,959	53,721
	Standard Deviation	6,918	10,905	4,672	9,586	4,199	298	28,605	8,476
Payment & Settlements	Number	37	3	26	37	34	153	2	292
	Mean	38,774	56,923	3,779	62,209	62,039	1,363	98,063	48,349
	Standard Deviation	6,226	9,814	4,205	8,628	3,779	268	25,744	7,628
Agency Services	Number	44	4	31	44	40	184	2	349
	Mean	46,529	68,308	4,535	74,651	74,446	1,635	117,675	58,018
	Standard Deviation	7,472	11,777	5,045	10,353	4,535	321	30,893	9,154
Asset Management	Number	40	3	28	40	36	165	2	314
	Mean	41,876	61,477	4,081	67,186	67,002	1,472	105,908	52,217
	Standard Deviation	6,725	10,599	4,541	9,318	4,081	289	27,804	8,238
Retail Brokerage	Number	48	4	33	48	44	198	3	378
	Mean	50,252	73,773	4,898	80,623	80,402	1,766	127,090	62,660
	Standard Deviation	8069	12719	5449	11182	4898	347	33365	9886
Insurance	Number	43	4	30	43	39	179	2	340
	Mean	45,226	66,395	4,408	72,561	72,362	1,589	114,381	56,394
	Standard Deviation	7,262	11,447	4,904	10,063	4,408	312	30,028	8,897
Total	Number	710	152	268	384	351	1,598	21	3,484
	Mean	45,653	67,021	4,450	73,245	73,044	1,604	115,459	56,926
	Standard Deviation	7,331	11,555	4,950	10,158	4,450	315	30,311	8,981

All the key elements of an integrated operational risk management program must be analyzed and reported within the context of a single, consistent risk matrix: Control Assessment Scores (0-100)

		INTERNAL FRAUD	EXTERNAL FRAUD	EMPLOYMENT PRACTICES & WORKPLACE SAFETY	CLIENTS, PRODUCTS & BUSINESS PRACTICES	DAMAGE TO PHYSICAL ASSETS	EXECUTION, DELIVERY & PROCESS MANAGEMENT	BUSINESS DISRUPTION AND SYSTEM FAILURES	TOTAL
Corporate Finance	Score	55	56	75	56	33	50	23	56
Trading & Sales	Score	50	45	53	50	46	21	32	39
Retail Banking	Score	45	47	66	45	42	18	36	36
Commercial Banking	Score	41	32	78	41	37	17	25	32
Payment & Settlements	Score	37	39	76	37	34	15	29	29
Agency Services	Score	44	48	56	44	40	18	22	34
Asset Management	Score	40	61	68	40	36	16	21	31
Retail Brokerage	Score	48	56	74	48	44	19	31	37
Insurance	Score	43	42	65	43	39	17	29	34
Total	Score	45	45	68	48	35	18	28	38



III) Definition and Categorization Issues

What does operational risk include?

Transaction

Execution

Settlement

Technological

Inadequate Supervision

Information

Key Man

Lack of Resources

Reputation

Relationship

Theft

Criminal

Insufficient Training

People

Fraud

Rogue Trader

Compliance

Legal/Regulatory

Fiduciary

Physical Assets

Poor Management

Fixed Cost Structures

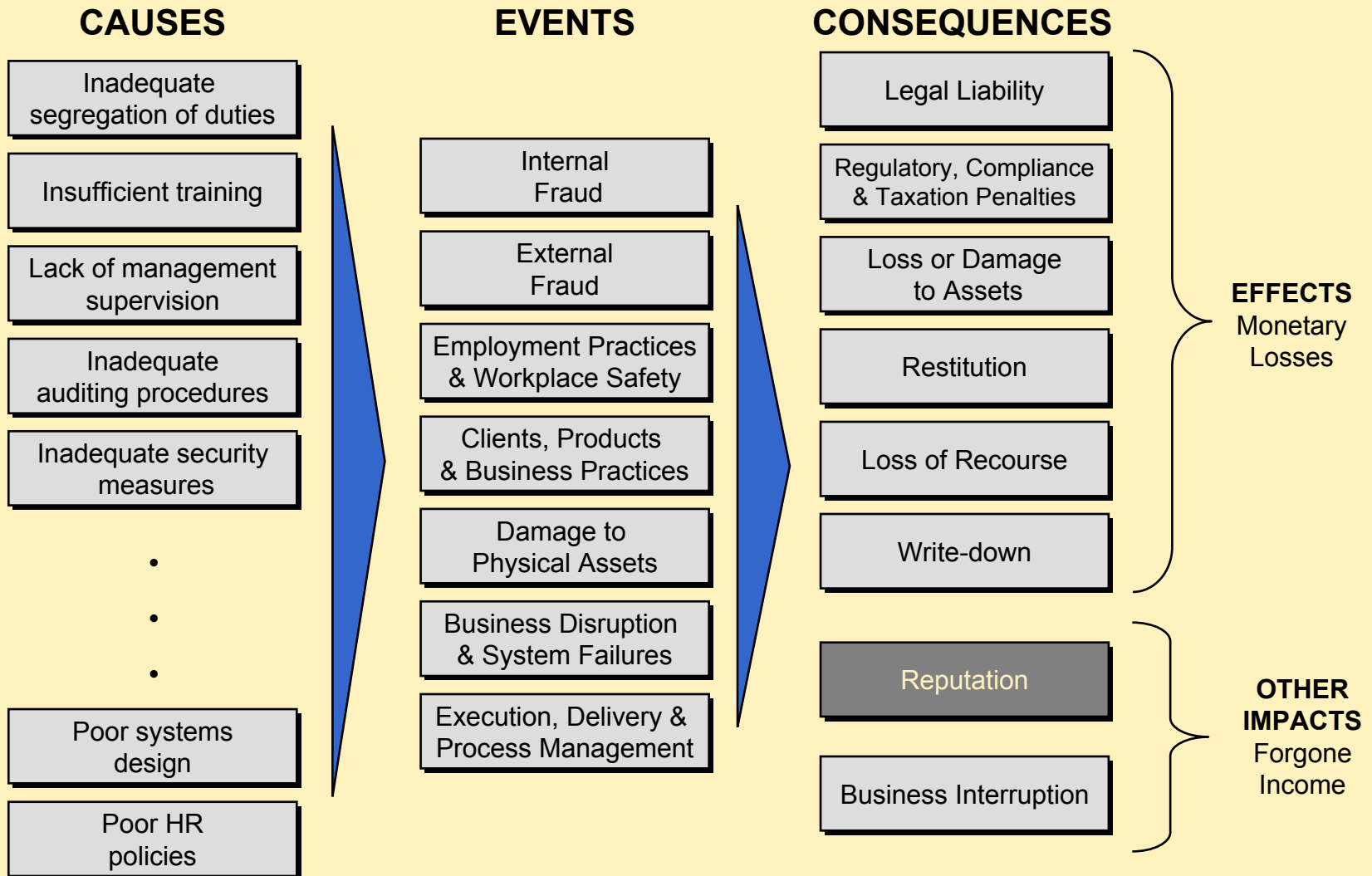
Customer

Business

Business Interruption

Strategic

The universe of operational risks spans causes, events and consequences



What are the standards for defining and categorizing operational risk?

- **Management information** - Grouping of like items (homogenous risk types) to facilitate the management of risk and assignment of controls on the basis of natural boundaries
- **Statistical Consistency** - Mutually exclusive (uncorrelated) and exhaustive (comprehensive), homogenous distributions
- **Logical Consistency** - Examples must be consistent with definitions

Event risk categories are represented in a three tier hierarchy

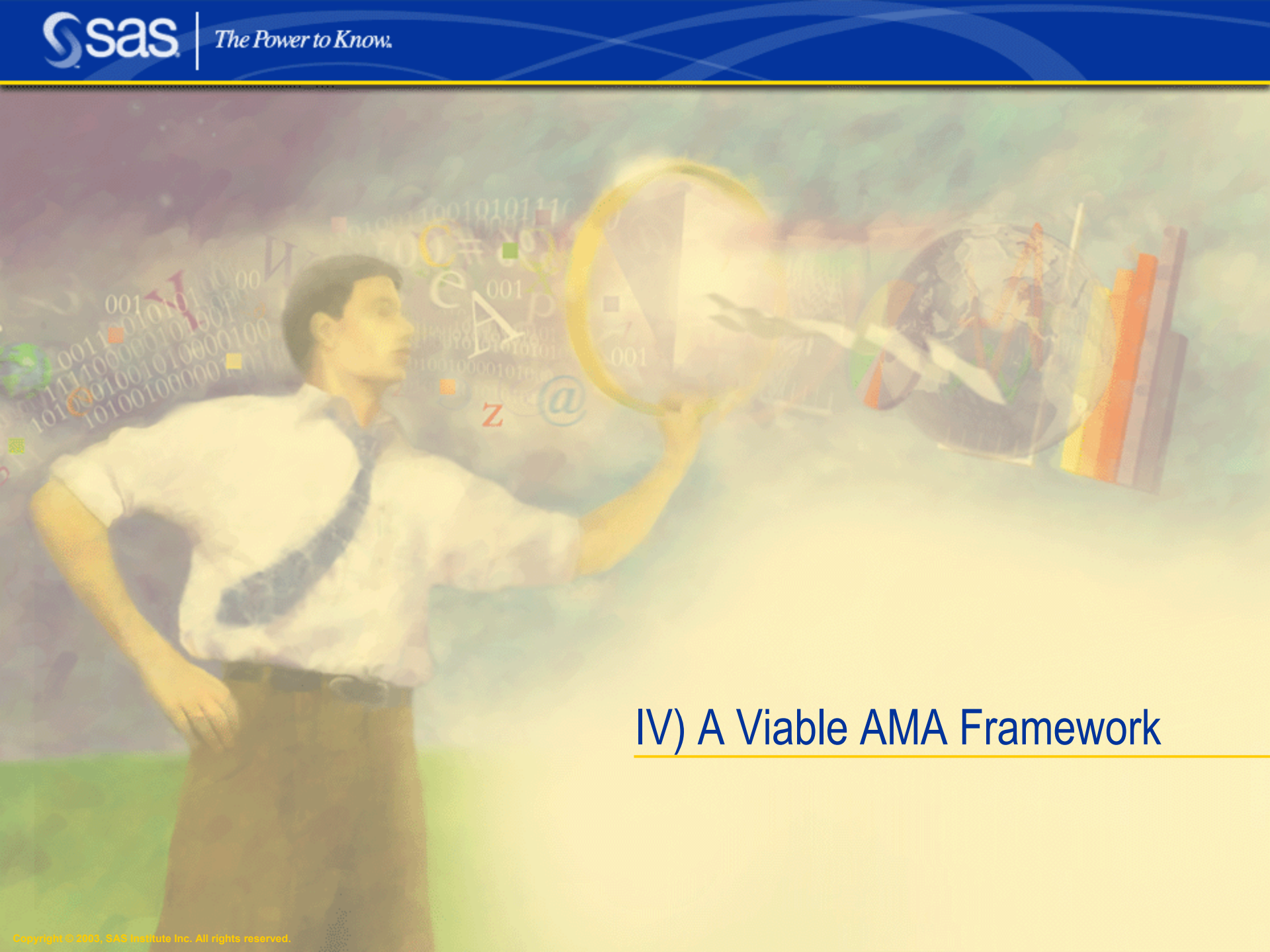
Primary	Secondary	Activity Examples
Internal Fraud <i>Losses due to acts of type intended to defraud misappropriate property, or circumvent regulations, the law or company policy, excluding diversity/discrimination events, which involve at least one internal party</i>	Unauthorized Activities	Transactions not reported (intentional), Transaction type unauthorized (w/monetary loss), Mismarking of position (intentional)
	Theft & Fraud	Fraud/credit fraud, worthless deposits, Theft, extortion, embezzlement, robbery, Misappropriation of assets, Malicious destruction of assets, Forgery, Check kiting, Smuggling, Accountant takeover, impersonation, Tax noncompliance, evasion (willful), Bribes/Kickbacks, Insider trading (not on firm's account)
External Fraud <i>Losses due to acts of type intended to defraud misappropriate property, or circumvent regulations, or the law by a third party</i>	Theft & Fraud	Theft/Robbery Forgery Check kiting
	Systems Security	Hacking damage, Theft of information (w/monetary loss)
Employment Practices and Workplace Safety <i>Losses arising from acts inconsistent with employment health or safety laws, or agreements, from payment of personal injury claims, or from diversity/discrimination events.</i>	Employee Relations	Compensation, benefit, termination issues, Organized labor activity, Poaching
	Safe Environment	General liability (slip and fall, etc), Employee health & safety rules events, Workers' compensation
	Diversity and Discrimination	All forms of discrimination

Event risk categories are represented in a three tier hierarchy

Primary	Secondary	Activity Examples
<p>Clients, Products & Business Practices</p> <p><i>Losses arising from an unintentional or negligent failure to meet a professional obligation to specific clients including fiduciary and suitability requirements), or from the nature or design of a product.</i></p>	<p>Suitability, Disclosure & Fiduciary</p>	<p>Fiduciary breaches - guideline violations, Suitability - disclosure issues (know your customer etc.), Retail consumer disclosure violations, Breach of privacy, Aggressive sales, Account churning, Misuse of confidential information, Lender liability,</p>
	<p>Selection, Sponsorship & Exposure</p>	<p>Failure to investigate client per guidelines, Exceeding client exposure limits</p>
	<p>Advisory Activities</p>	<p>Disputes over performance of advisory activities</p>
	<p>Improper Business or Market Practices</p>	<p>Antitrust, Improper trade/market practices, Market manipulation, Insider trading (on firm's account), Unlicensed activity, Money Laundering</p>
	<p>Product Flaws</p>	<p>Product defects (unauthorized), Model errors</p>
<p>Damage to Physical Assets</p> <p><i>Losses arising from loss or damage to physical assets from natural disaster or other events.</i></p>	<p>Disasters and other events</p>	<p>Natural disaster losses, Human losses from external sources (terrorism, vandalism)</p>
<p>Business Disruption and System Failures</p> <p><i>Losses arising from disruption of business or systems failures</i></p>	<p>Systems</p>	<p>Hardware, Software, Telecommunications Utility outage/disruptions</p>

Event risk categories are represented in a three tier hierarchy

Primary	Secondary	Activity Examples
<p>Execution, Delivery & Process Management</p> <p><i>Losses from failed transaction processing or process management, from relations with trade counter parties and vendors or from systems failures.</i></p>	<p>Transaction Capture, Execution & Maintenance</p>	<p>Miscommunication, Data entry, maintenance, or loading error, Missed deadline or responsibility, Model/system misoperation, Accounting error, entity attribution error, Other task misperformance, Delivery failure, Collateral management failure, Reference data maintenance</p>
	<p>Monitoring and Reporting</p>	<p>Failed mandatory reporting obligation, Inadequate oversight, Inaccurate external report (loss incurred)</p>
	<p>Customer Intake and Documentation</p>	<p>Client permissions, disclaimers missing, Legal documents missing, incomplete</p>
	<p>Customer/Client Account Management</p>	<p>Unapproved access given to accounts (includes inadvertent access to one party on a joint account) Incorrect client records (loss incurred), Negligent loss or damage of client assets</p>
	<p>Trade Counter parties</p>	<p>Nonclient counter party misperformance, Misc. nonclient counter party disputes</p>
	<p>Vendors and Suppliers</p>	<p>Outsourcing, Vendor disputes</p>



IV) A Viable AMA Framework

Using internal and external loss data can calculate Value at Risk

INDIVIDUAL LOSS EVENTS

RISK MATRIX FOR LOSS DATA

LOSS DISTRIBUTIONS

VAR CALCULATION

TOTAL LOSS DISTRIBUTION



74,712,345
74,603,709
74,457,745
74,345,957
74,344,576

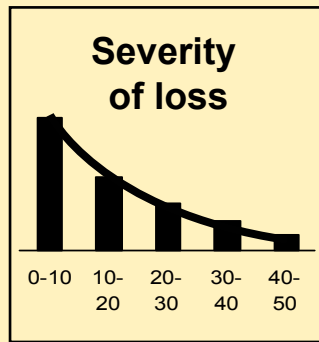
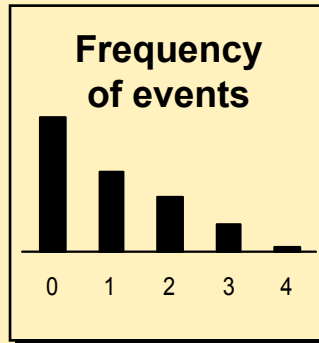
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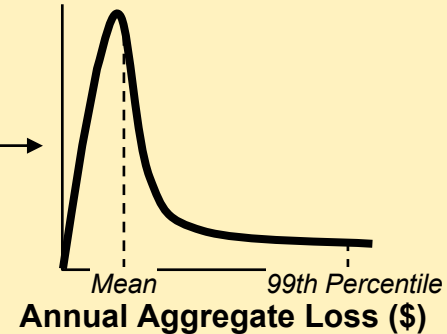
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167,245
142,456
123,345
113,342
94,458

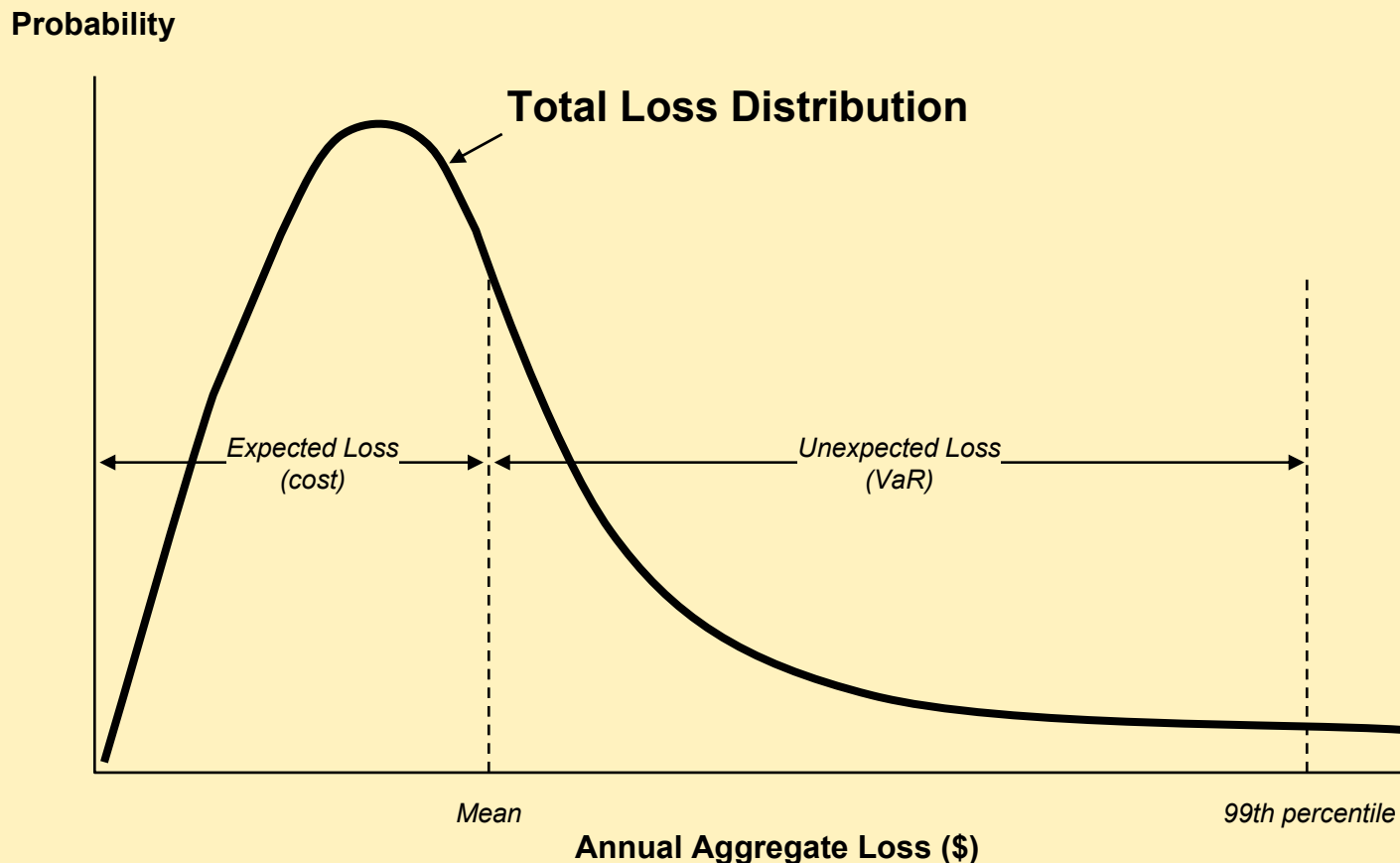
		INTERNAL EVENTS	EXTERNAL EVENTS	EMPLOYMENT INVESTORS & RENTAL INVESTORS	CLIENTS PROPERTY & BUSINESS PRACTICES	DAMAGE TO PHYSICAL ASSETS	SECURITY BREACHS & INFORMATION MANAGEMENT	BUSINESS REPUTATION RISK	TOTAL
Corporate Finance	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Corporate Director	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Trading & Sales	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Investment Banking	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Commercial Banking	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Capital & Infrastructure	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Agency Services	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Risk Management	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Other/Unassigned	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Total	Number	10	10	10	10	10	10	10	10
	Mean	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000



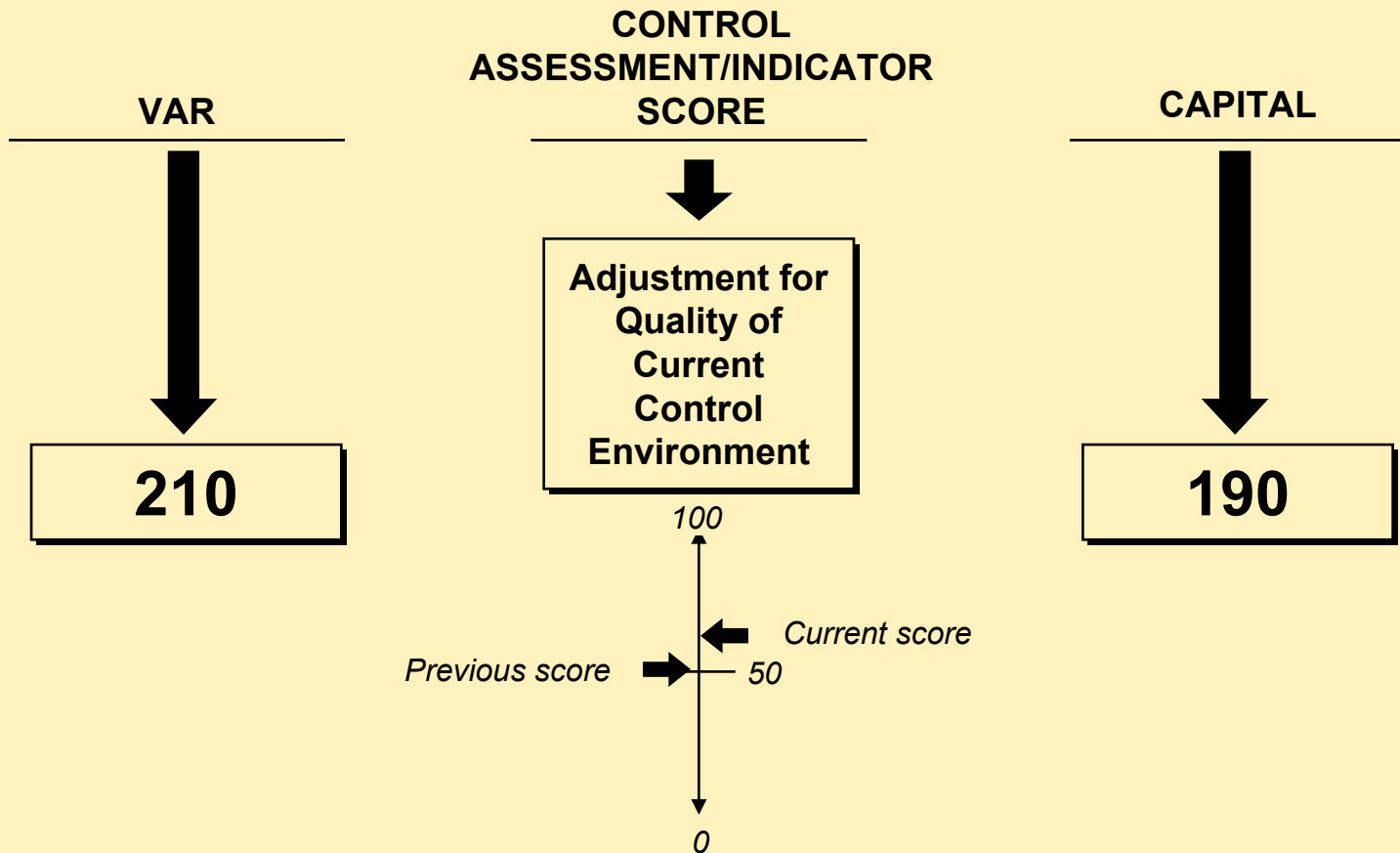
VaR Calculator
e.g.,
Monte Carlo
Simulation
Engine



Definitions: The expected loss is the mean annual aggregate loss and unexpected loss represents the volatility above this mean at a specified confidence level



Composite control assessment/indicator scores can be used to modify capital figures

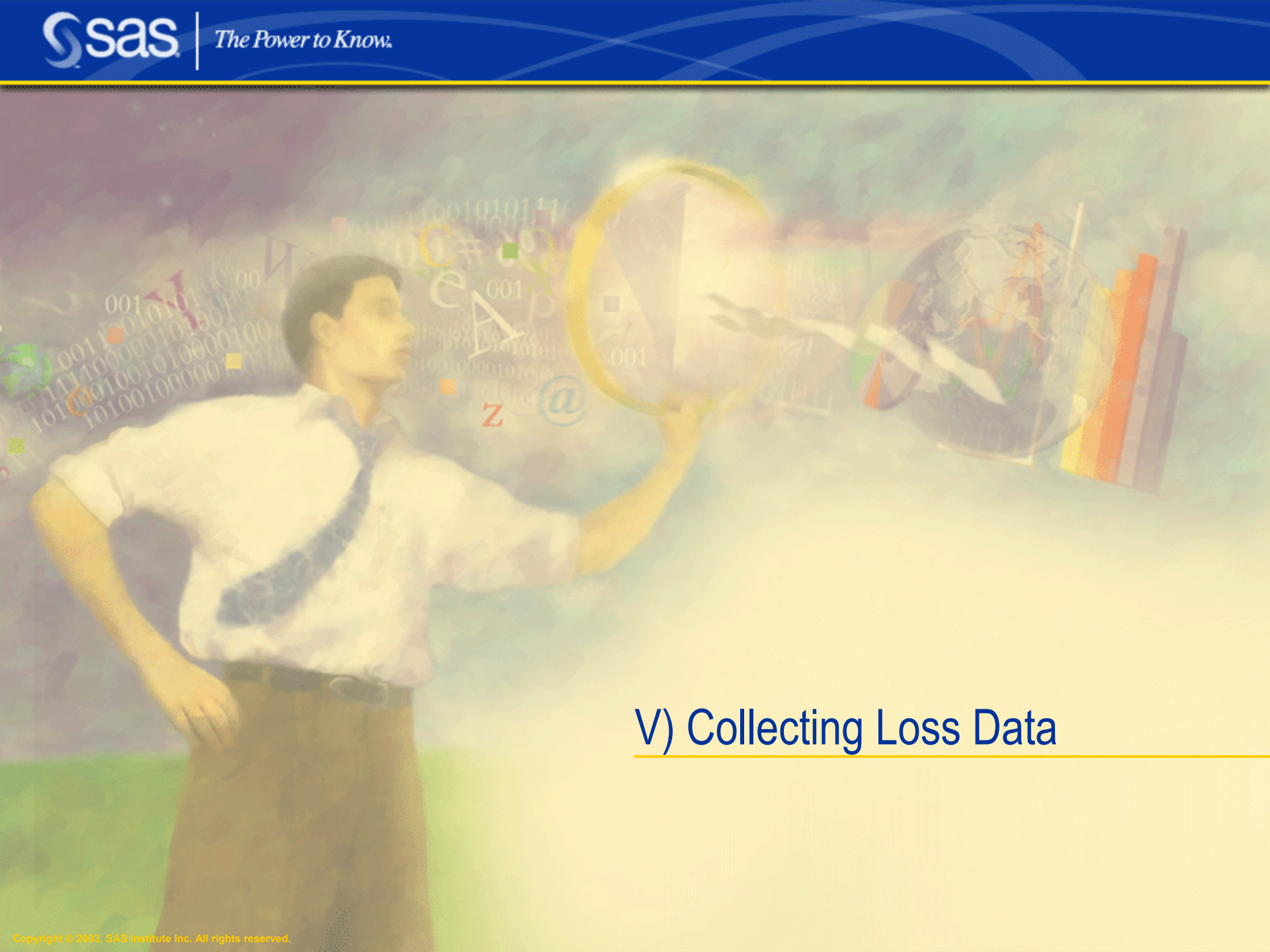


Linking capital to changes in the quality of internal controls provides an incentive for desired behavioral change

Adjustments to capital take place at the cell level, based on the change in composite control scores

RISK MATRIX FOR CAPITAL

		INTERNAL FRAUD	EXTERNAL FRAUD	EMPLOYMENT PRACTICES & WORKPLACE SAFETY	CLIENTS, PRODUCTS & BUSINESS PRACTICES	DAMAGE TO PHYSICAL ASSETS	EXECUTION, DELIVERY & PROCESS MANAGEMENT	BUSINESS DISRUPTION AND SYSTEM FAILURES	TOTAL
Corporate Finance	Previous VaR	21,000,000	36,000,000	62,000,000	75,000,000	124,000,000	86,000,000	36,000,000	362,000,000
	Prev/Current Score	50 55	60 58	75 71	61 61	45 55	50 52	50 55	50 55
	Final Capital	19,000,000	35,000,000	65,000,000	75,000,000	104,000,000	83,000,000	32,000,000	326,000,000



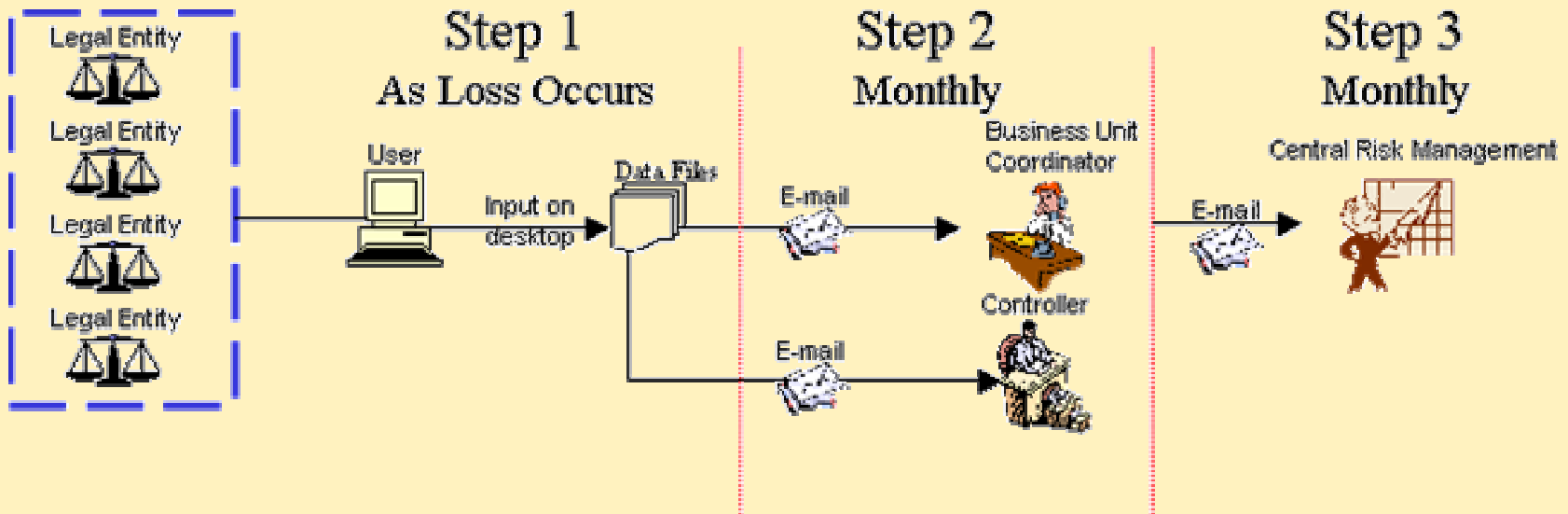
V) Collecting Loss Data

Three sources of loss data may be considered

- **Internal Data** – data drawn directly from the entity whose risk is being measured; this is the most relevant data set, but such data is generally insufficient for most modeling and statistical analysis purposes because of the small sample size
- **External Pooled Data** – public and non-public data drawn from a loss data sharing consortium; this data is less relevant than internal data, but offers larger sample allowing for more accurate modeling/statistical analysis
- **External Public Data** – data drawn from public sources; less relevant than internal data, contains a larger set of “tail events,” but subject to numerous biases – so cannot be used directly for modeling.

While one would expect that consortium data will eventually prove to be more useful than external public data, this will only be true if these initiatives reach critical mass and the data is honestly reported and consistently categorized

A formal process for collecting loss event data must be implemented



Loss data needs to be adjusted for inflation and scaled for size

Inflation adjustment:

\$10 million loss in 1990 = \$12.4 million loss in 2001

Scale Adjustment:

\$10 million loss when a \$2 billion (revenue) bank = \$13.2 million loss when a \$6 billion bank¹

$$ScaledLoss = L_{DB} \left(\frac{R_{cur}}{R_{pre}} \right)^n$$

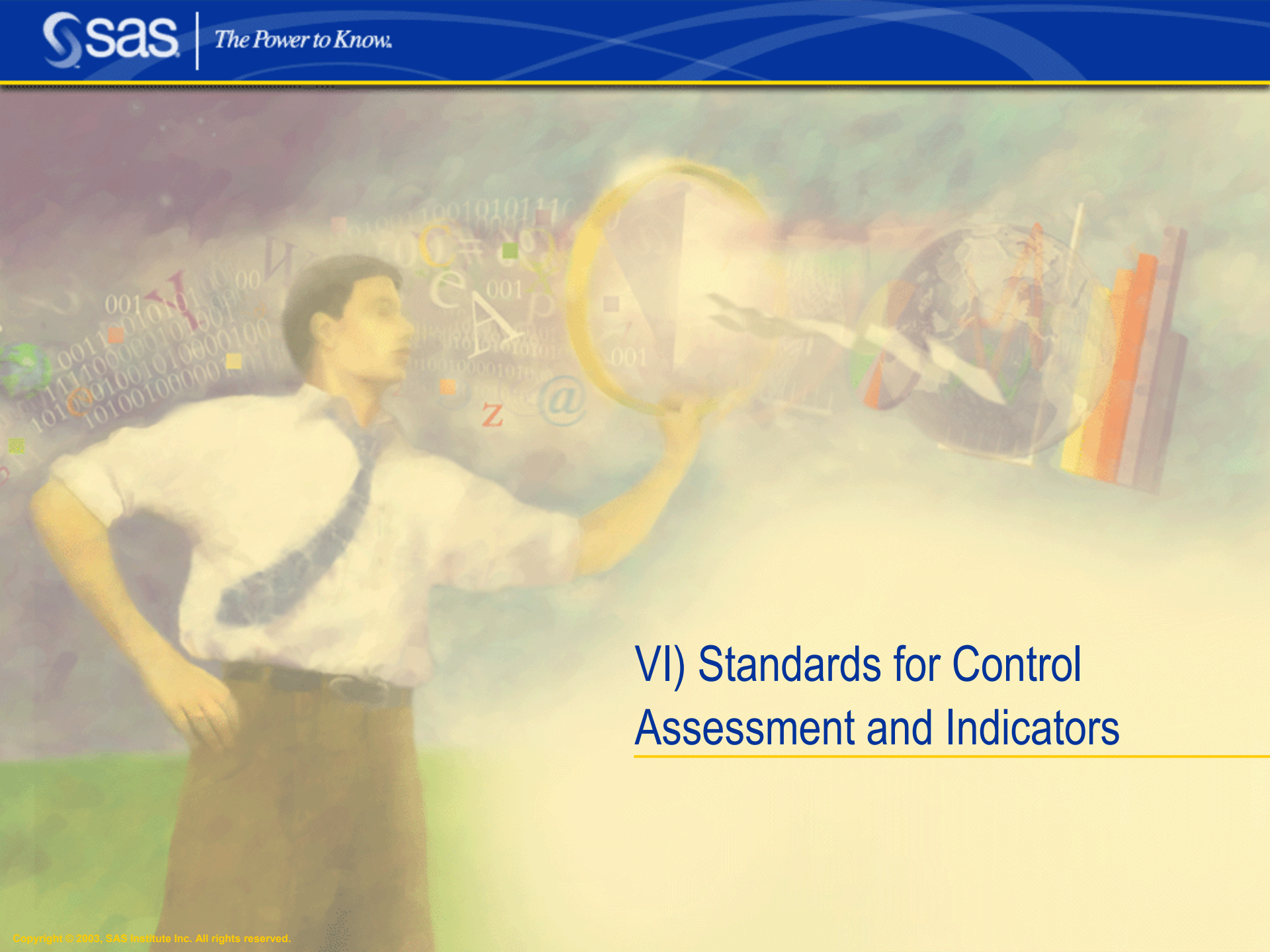
L_{DB} = Actual Loss experienced by bank

R_{cur} = Current Revenue of bank

R_{pre} = Previous Revenue of bank

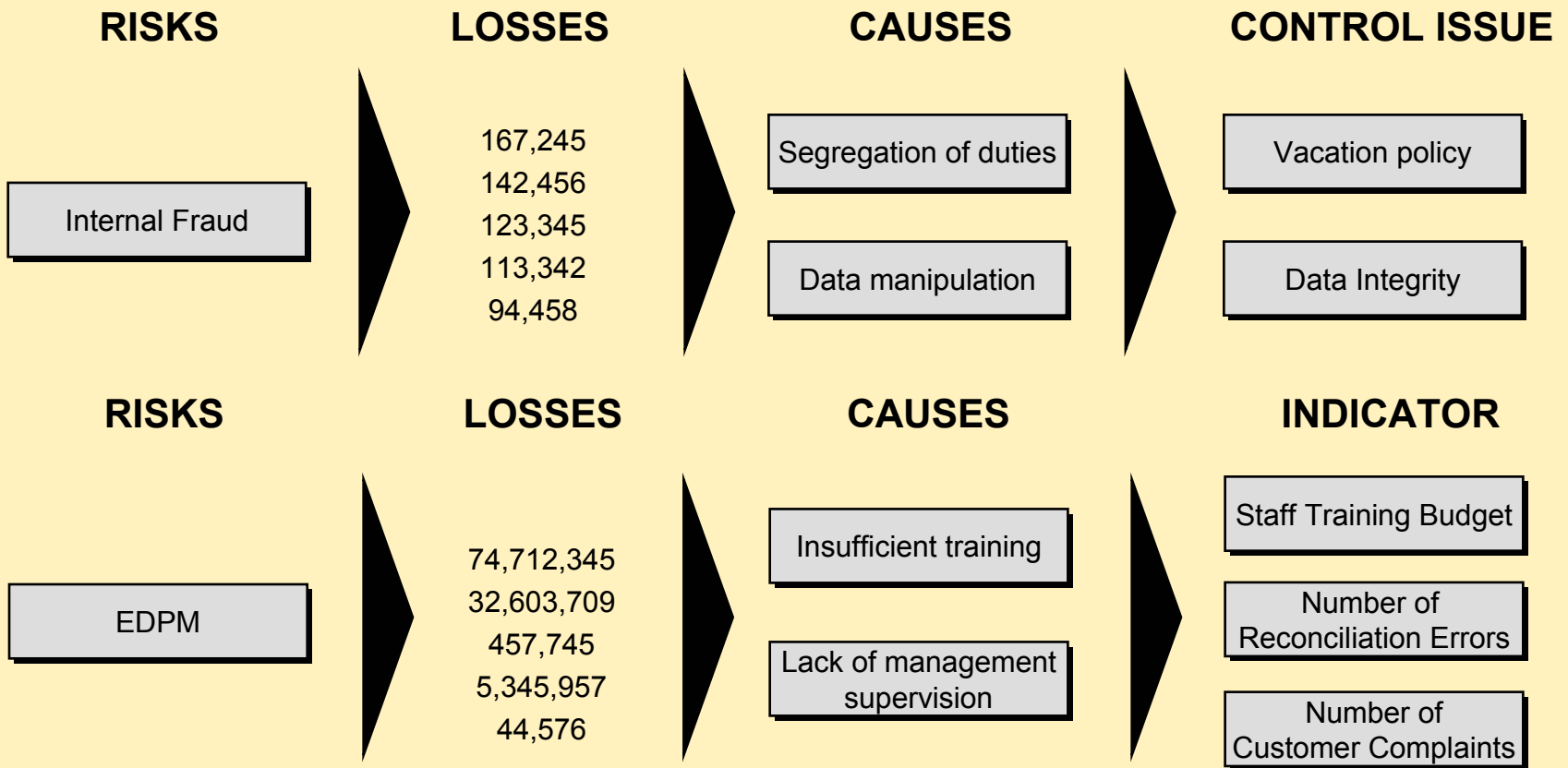
n = Scaling co-efficient determined by regression analysis

³Shih, J., A. Samad-Khan and P. Medapa, "Is the Size of an Operational Loss Related to Firm Size," *Operational Risk* (January 2000)

A man in a white shirt and blue tie stands in a field, holding a glowing orb. The background is a collage of digital and data-themed graphics, including binary code, a globe, a bar chart, and various symbols like '@', 'z', and 'e'.

VI) Standards for Control Assessment and Indicators

Identifying relevant control issues and indicators requires a disciplined process that begins with identifying losses and their underlying causes



Risks are manifested in losses

A control assessment scorecard system must be relevant, consistent and objective

- **Relevance** - The control issues must be relevant to a business line and risk
- **Answer choices** - The answer choices should be consistent
- **Weighting** - The control issues must be weighted according to relevance
- **Scale** - All scores must be converted to a consistent scale, e.g., 0 to 100
- **Normalization** - The process for normalizing scores must be theoretically valid
- **Transparency** - The process must be transparent to allow for buy in and to identify opportunities for improvement
- **Validation** - Responses must be validated to avoid “gaming” the system

Risk indicators must be validated through empirical analysis

Issue	Indicator	Description
Systems	System Downtime	Number of minutes per month system is offline
Data Quality	Processing Errors	% of transactions with errors
Scale	Employees	Number of Employees
Scale	Transactions	Number of Transactions
Level of Employee Knowledge	Employee Experience	Average months of experience per employee

$$Y_t = \alpha_t + \beta_{1_t} X_{1_t} + \dots + \beta_{n_t} X_{n_t} + \varepsilon_t$$

In order for an indicator to be a true risk indicator, there must be empirical evidence (from econometric analysis) supporting a relationship between the indicator and loss frequency or loss severity

Biographical Information

Ali Samad-Khan is Global Head of Operational Risk Strategy at SAS, Inc. (New York, NY) He has seven years experience in operational risk measurement and management and approximately twenty years of professional experience. His areas of expertise include: establishing an operational risk department, internal loss database design and implementation, data collection and reporting (including: loss events, key performance indicators and control assessment scores), data assessment and analysis, causal/predictive modeling, advanced VaR measurement techniques and economic capital allocation.

Mr. Samad-Khan has presented his ideas on operational risk measurement and management at seminars and on an individual basis to a large number of major banking institutions around the world. His significant practical experience in this field comes from managing the implementation of ten operational risk measurement and management projects at leading institutions in North America, Europe and Australia.

Immediately prior to joining SAS Mr. Samad-Khan was CEO of OpRisk Analytics. (SAS acquired OpRisk Analytics in June of 2003.) Before that he was with PricewaterhouseCoopers (PwC) in New York, where he headed the Operational Risk Group within the Financial Risk Management Practice. Prior to joining PwC he worked in the Operational Risk Management Department at Bankers Trust. He has also worked at the Federal Reserve Bank of New York and the World Bank.

Mr. Samad-Khan holds a B.A. in Quantitative Economics from Stanford University and an M.B.A. in Finance from Yale University.

Articles include: “*Is the Size of an Operational Loss Related to Firm Size,*” with Jimmy Shih and Pat Medapa, Operational Risk, January 2000; “*Measuring and Managing Operational Risk,*” with David Gittleston, Global Trading, Fourth Quarter, 1998.

Working papers include: “*How to Categorize Operational Losses – Applying Principals as Opposed to Rules.*” March 2002 and “*Categorization Analysis,*” January 2003.



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