Presenting:

Enterprise Strategic Risk Modeling: Linking ERM to Financial Performance Management

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Enterprise Strategic Risk Modeling: Linking ERM to Financial Performance Management

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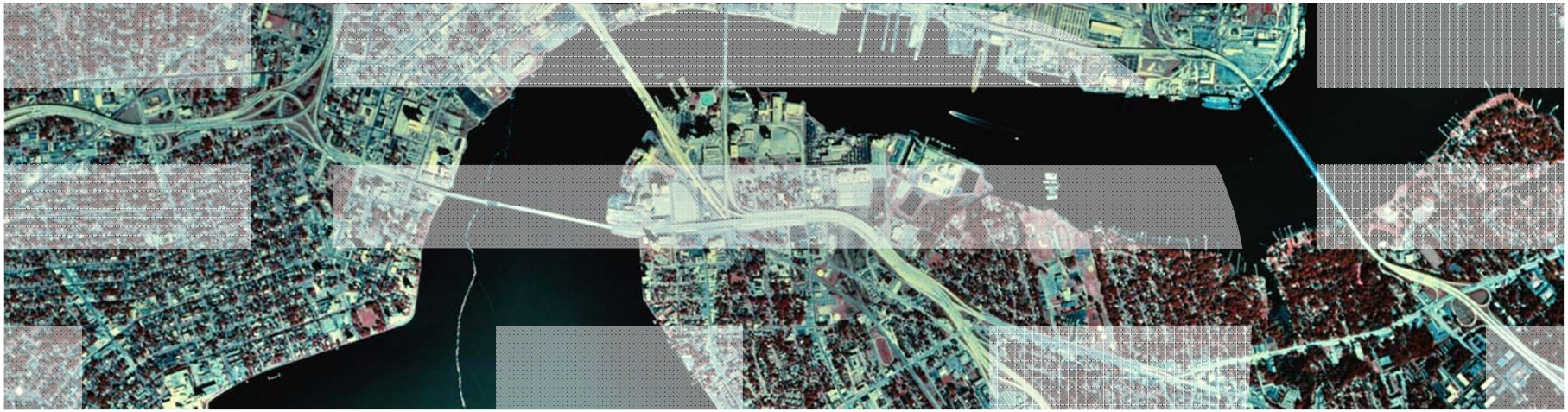
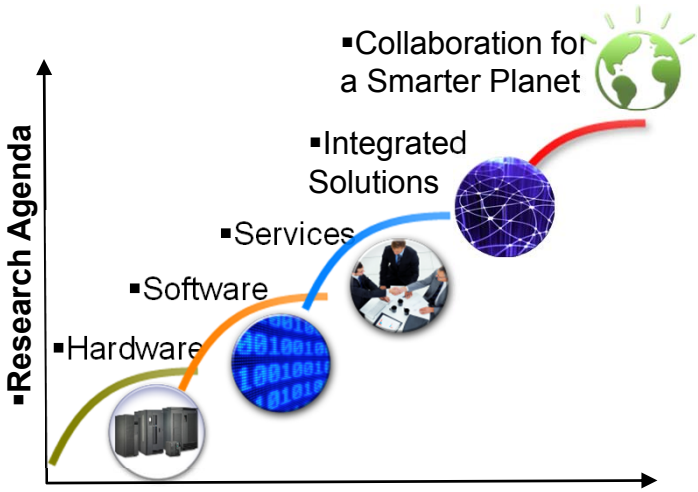
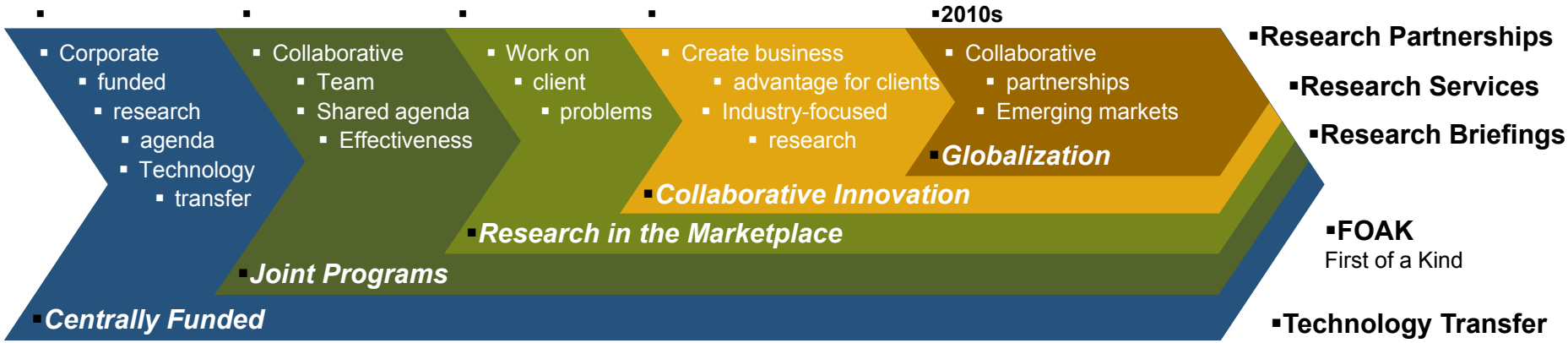


IBM Research Overview

Be famous for our science and technology and vital to IBM





Inter disciplinary collaboration in the market and across the globe

IBM Research Business Analytics & Mathematical Sciences

50 years of significant contributions to the field of mathematical sciences

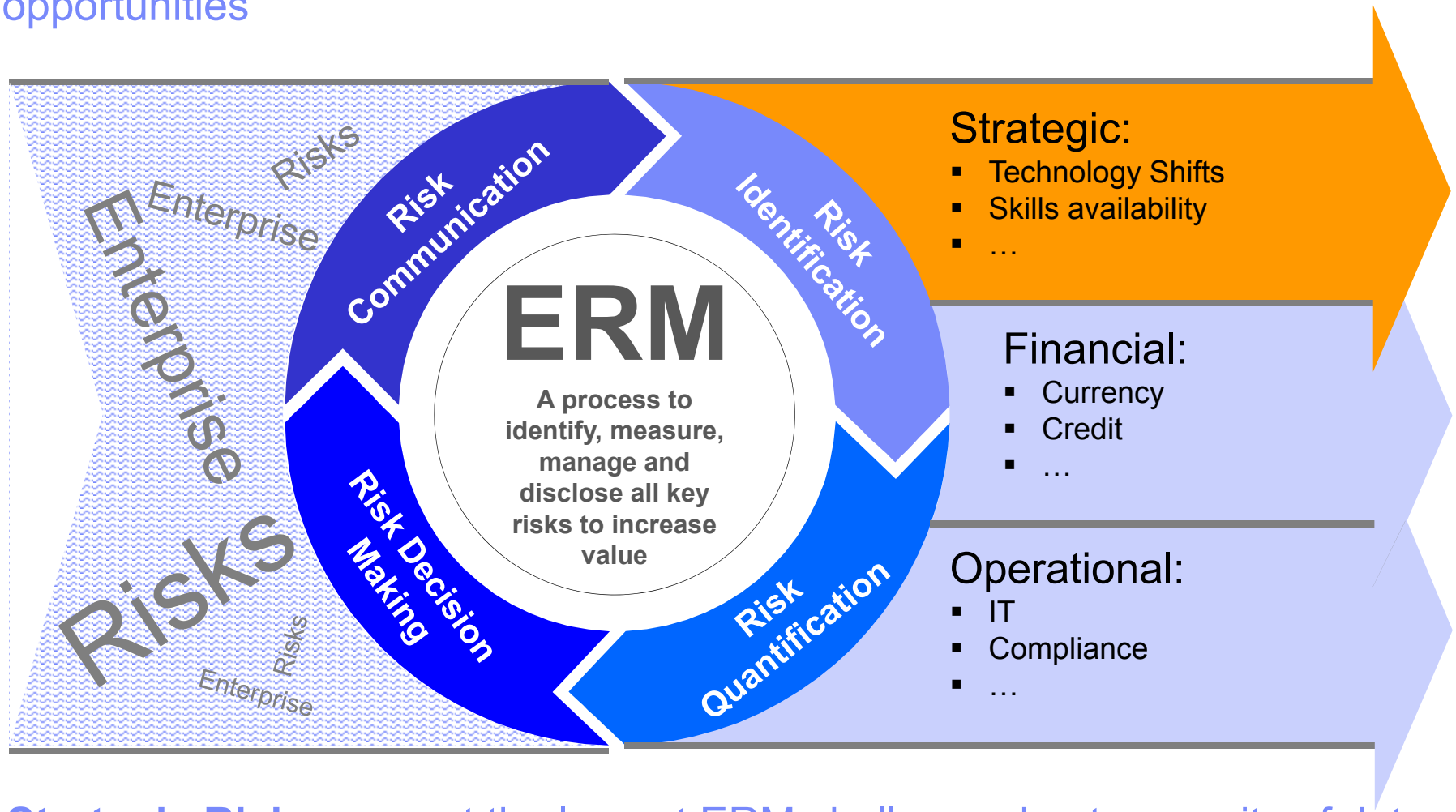
- Parallel Computing
- Fast Fourier Transform
- Integer Programming
- Fast Matrix Multiplication
- Fractals
- Foundations of Complexity
- Combinatorial Matrix Theory
- Complexity of Reals
- Lattice Based Cryptography
- Adversarial Queueing
- Algebraic Complexity

Over 350 top scientists solving the most challenging problems for IBM and its customers

- Business Services Modeling and Simulation
- Pharmaceutical Supply Chain Risk
- Air Mail Optimizer
- Traffic Prediction Tool
- Production Planning and Operations Scheduling
- Intelligent Inventory Management for Retail
- Revenue Forecasting
- Demand Conditioning
- Debt/Tax Collection Optimization
- Workforce Capacity Planning
- Passenger-Based Airline No-show Prediction
- Customer Targeting and Sales Force Productivity

Source: IBM Annual Report 2007

Enterprises are affected by uncertainties presenting both risks and business opportunities



Strategic Risks present the largest ERM challenge due to scarcity of data and difficulties in translating from risk to business impact

IBM's Smarter Enterprise Enablement (SEE) Vision is to create an integrated environment for analytics-driven strategic planning and strategic enterprise risk management

Analytic Capabilities

- Sensitivity Analysis
- Uncertainty Analysis
- Goal seek
- Optimization

Risk Analysis & Modeling

- Risk Elicitation
- Risk Assessment
- Risk Mitigation
- Risk Management

Simulation Framework

- Facilitates generation of scenarios covering a range of assumptions and respective outcomes to enable decision making under uncertainty

Scenario Analysis

- Ability to change the operating levers and quantify the impact on the key financial metrics

BI Reports

- Trend Analysis, Correlation Analysis, Contribution Analysis, etc.

Enterprise Planning Model

- Automated bottom-up, consumable, collaborative financial planning
- What-if scenario analysis for operating levers & risk impact analysis
- Integrated and aggregated across lines of business and geographies

Business Insights

- Utilize analytics to improve strategic planning
- Ensure repeatability and accessibility of trusted information
- Instrument processes to monitor execution and outcomes

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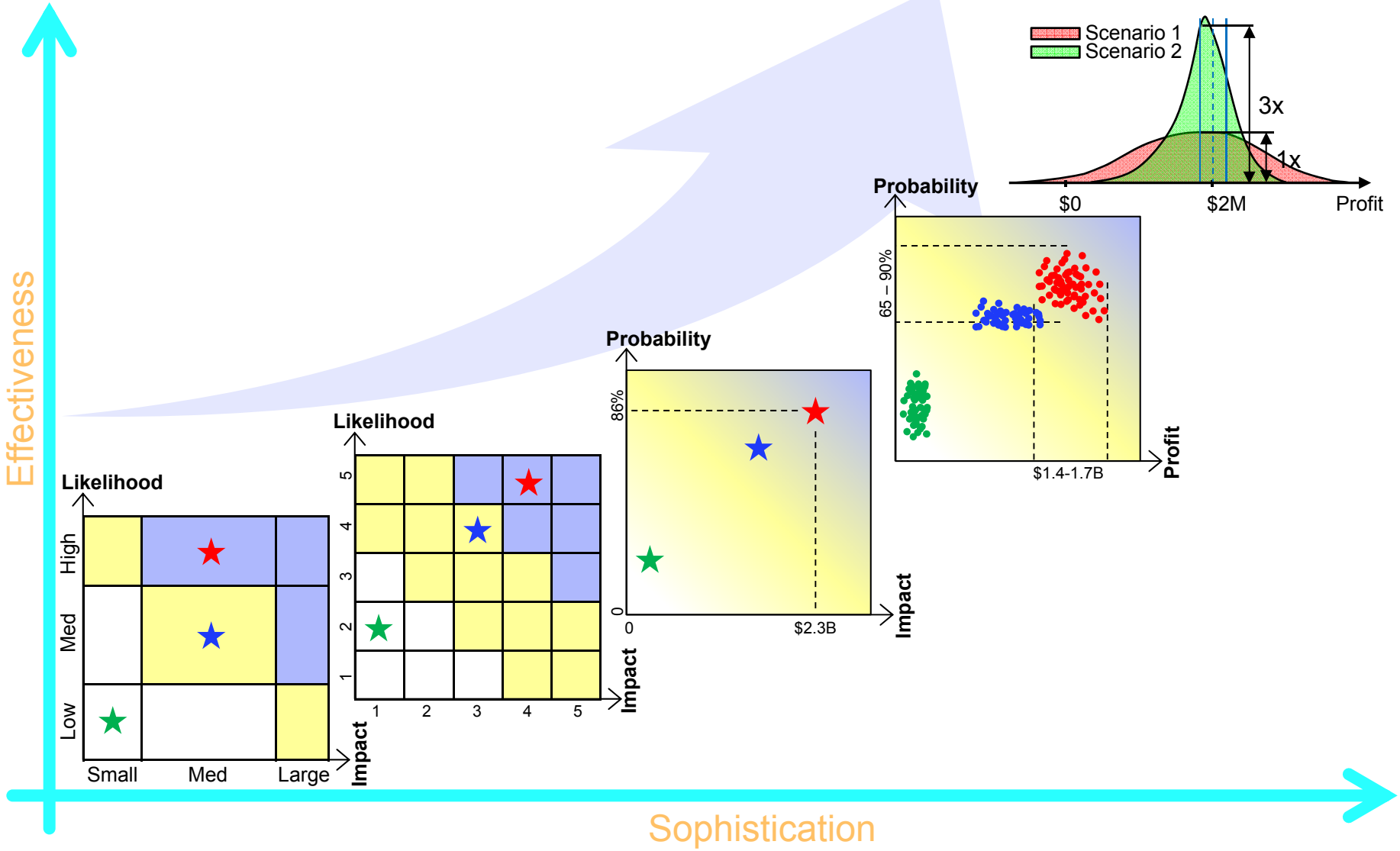
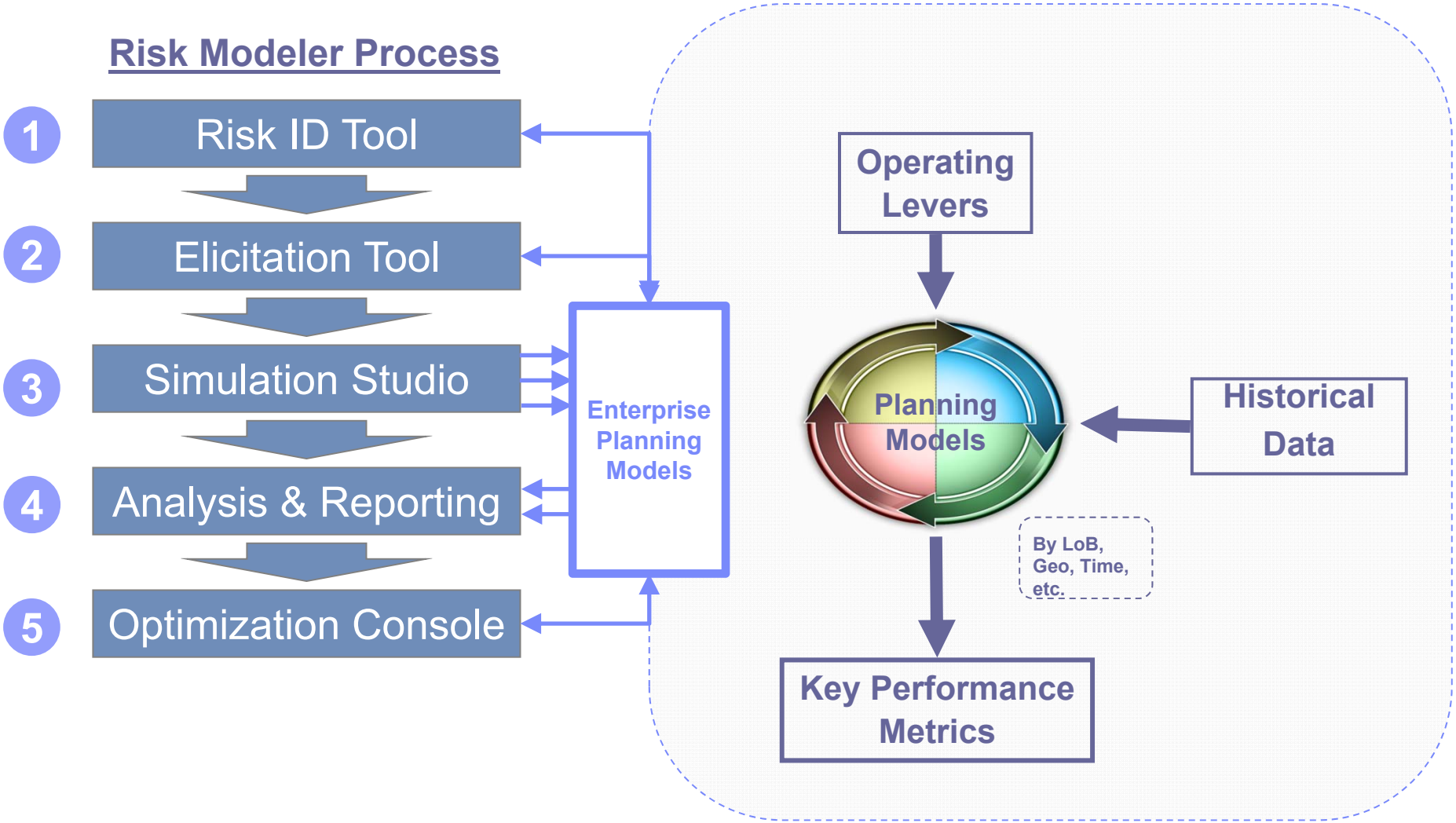
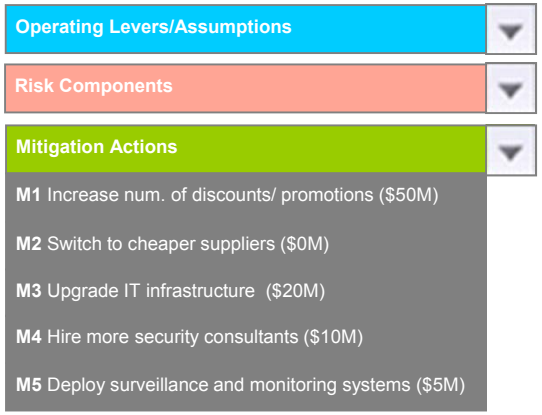
IBM wanted to move ERM from qualitative to quantitative while keeping workload and complexity at bay through tooling and automation



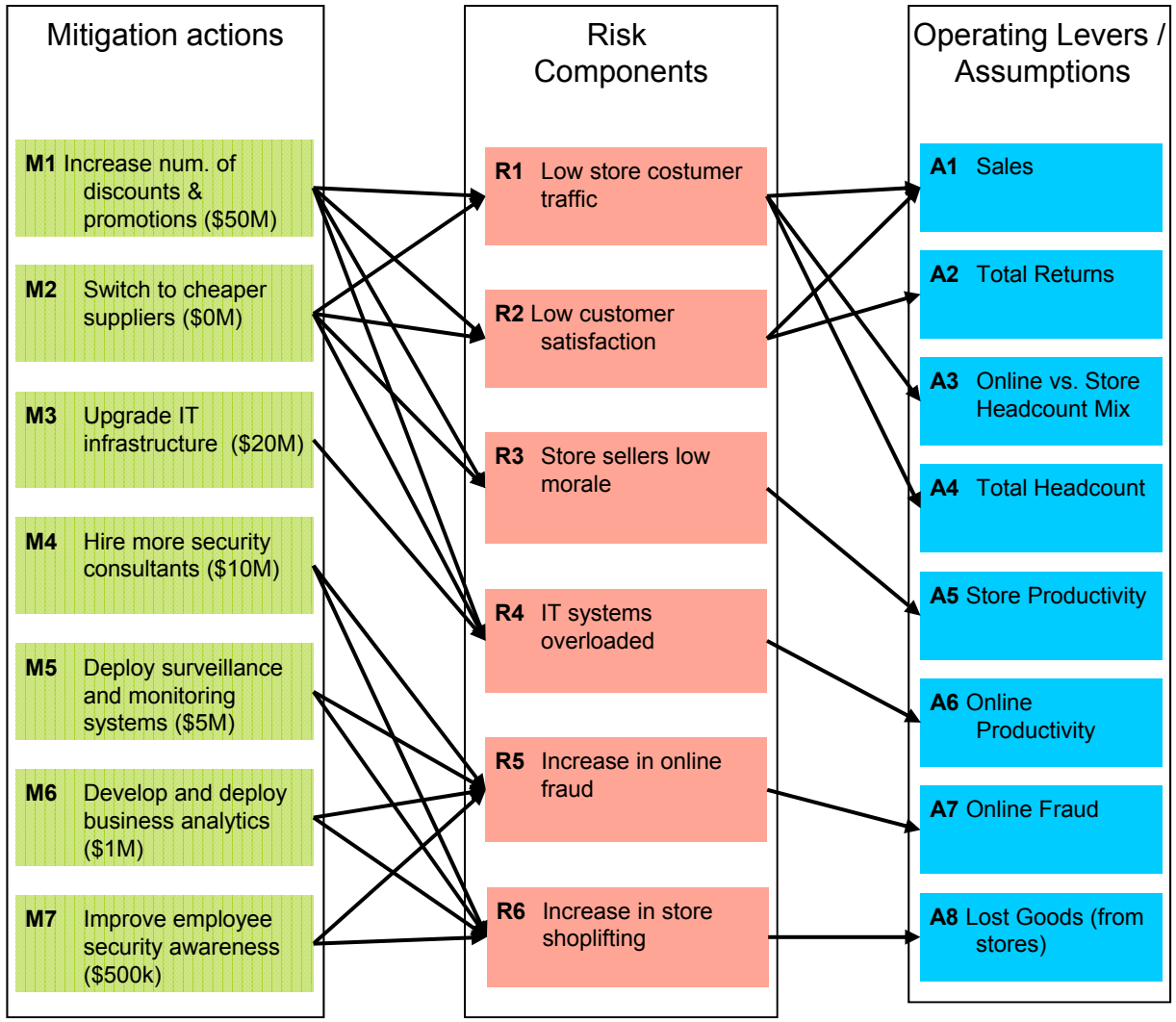
As part of the Smarter Enterprise Enablement framework, Risk Modeler was developed to enable Enterprise Risk Management and link it to Strategic Planning



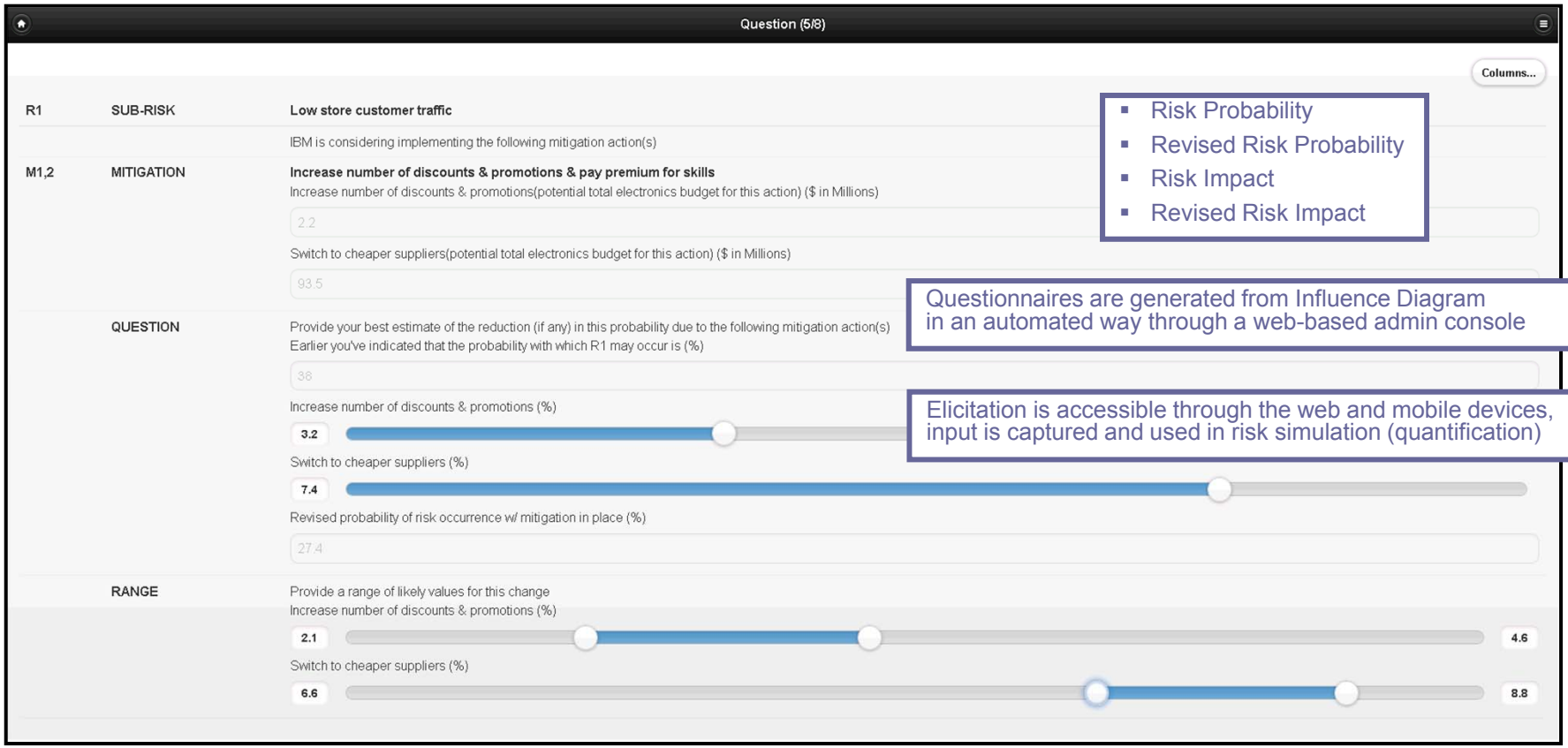
Step 1: Building the Risk Influence Diagram (Risk ID)

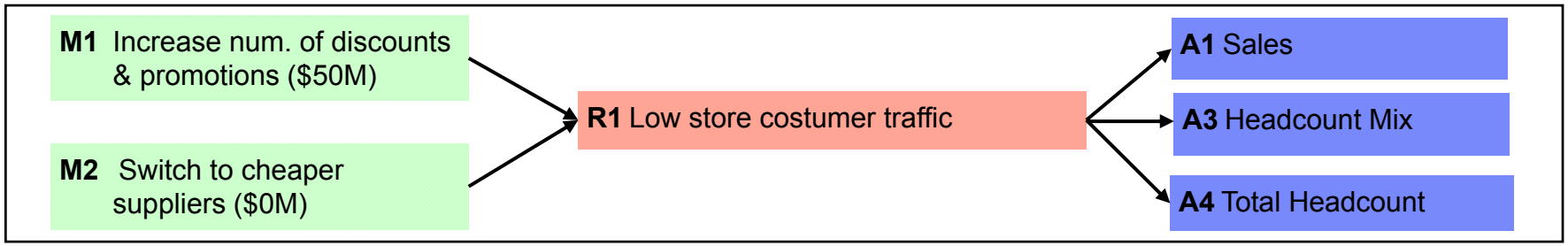


- Risk is defined by through the logic of the Influence Diagram
- The Influence Diagram is constructed in an intuitive, tool-assisted way from a library of (re-usable) building blocks
  - Identify risk components
  - Identify affected levers
  - Identify mitigation actions
  - Establish connections:
    - mitigation → risk
    - risk → lever

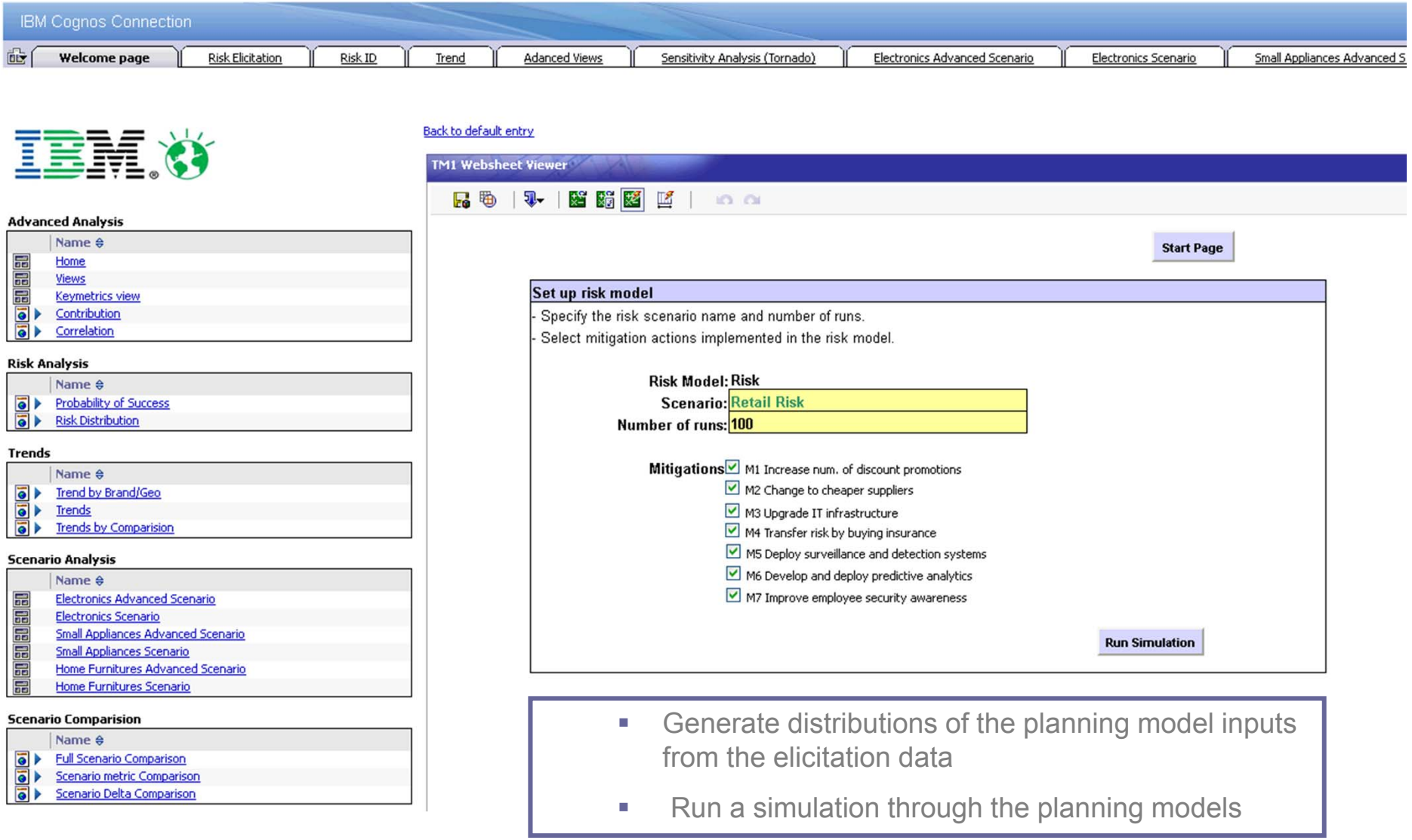


Step 2: Generate questionnaires to collect the necessary information from the risk experts





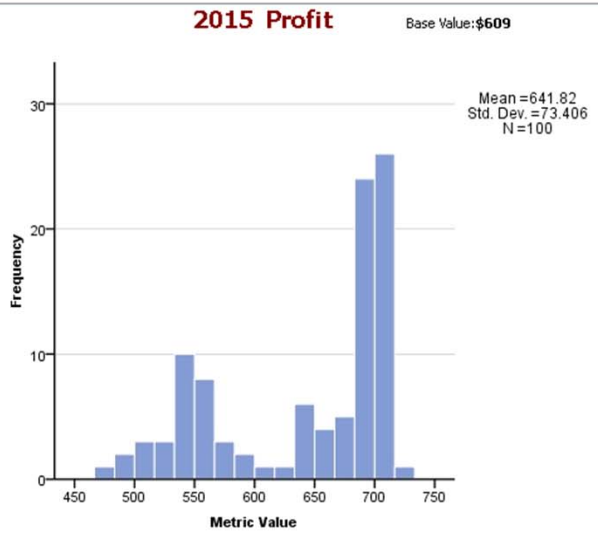
Step 3: Use risk simulation to generate a spectrum of scenarios that show the range of risk and mitigation impacts on the key model metrics



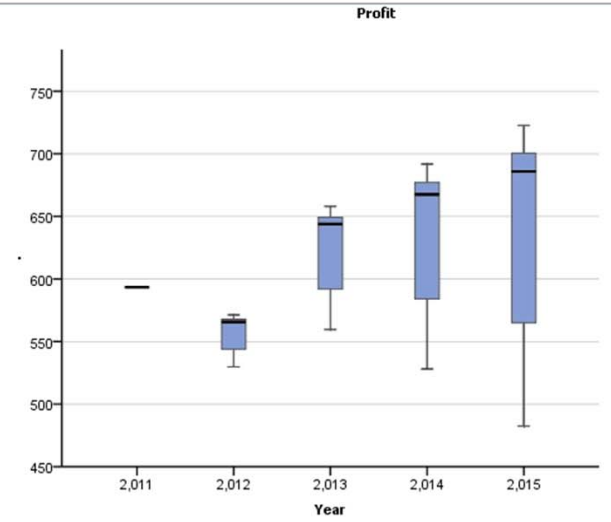
- Generate distributions of the planning model inputs from the elicitation data
- Run a simulation through the planning models

Step 4: Use risk analysis to provide insight into the impacts of risk and mitigation actions on enterprise performance

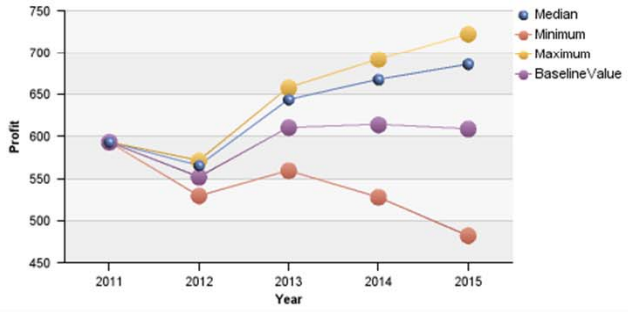
Selected Brand: **Electronics** Selected Geo: **Global** Selected Scenario: **Risk_with_7_mitigations** Selected Metrics:**Profit** Selected Year:**2015**

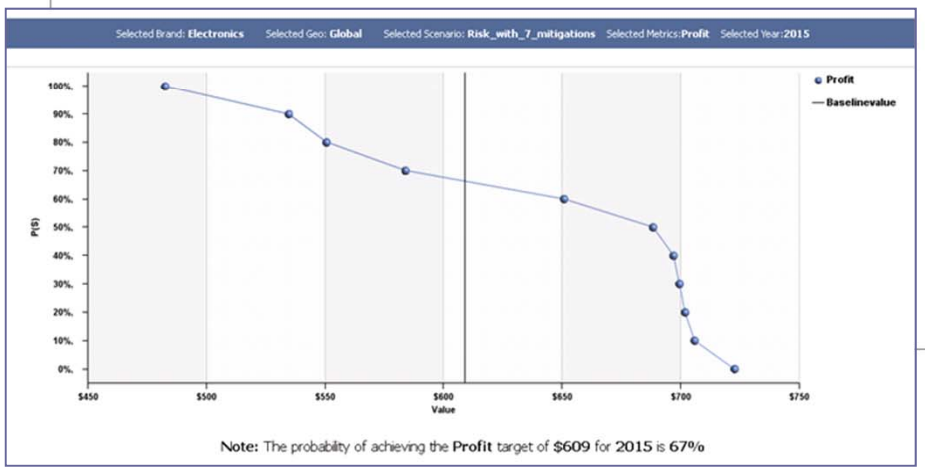


Risk Profile : Probability of achieving the Baseline is 67%



Note: The vertical line shows the min and max range.
The box shows the range between the 25 and 75 percentiles
The horizontal line shows the median value

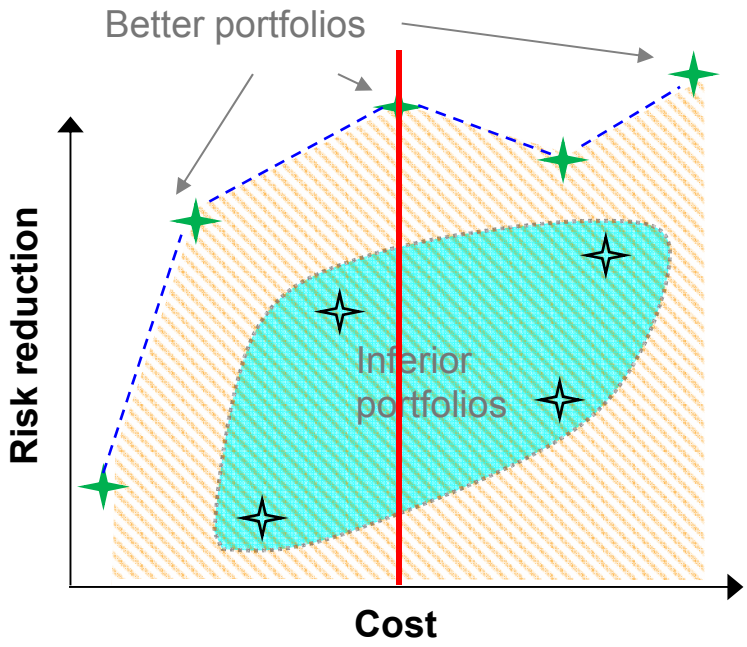




Step 5: Determine the optimal portfolios of mitigation actions and enable better investment decisions and trade-offs

Mitigation portfolio analysis & optimization

- Evaluate mitigation action portfolios
- Select the portfolios that satisfy the budget constraints
- Rank the portfolios according to their expected risk reduction impact
- Determine optimal mitigation action portfolios



Current Status and Lessons Learned

- The Smarter Enterprise Enablement strategic planning tool has been adopted by IBM's WW and Brand Finance teams to provide key input to IBM's Spring and Fall planning processes
- The methodology underlying Risk Modeler was used to assess risk associated with "Skills availability" in 2012
  - Feedback indicated that the process was too complex and time-consuming for wide-scale deployment, leading to current tooling work to maximize ease of use
- With the tooling to support the Risk Modeler methodology, IBM's ERM team is adopting the capability for use by designated Risk Owners and their teams
  - Risk Modeler analysis results are expected to become a required input to IBM's Spring and Fall planning processes
- Current work underway to evaluate requirements to incorporate Risk Modeler capabilities as part of IBM's Open Pages product
  - Open Pages provides data model to link risks to the business processes they impact, which aids in quantification of risk impact

Discussion

- Aim is to incorporation of uncertainty into strategic planning and management of risks a **systematic**, **repeatable** and **collaborative** process
  - Risk ID provides a simple template to represent the risk model and communicate it to experts and decision makers
  - Distributed expert elicitation of probabilistic risk information minimizes burden on any single individual
    - Mining knowledge on risks and mitigations from multiple sources
    - Possibility to combine expert knowledge with data where available
    - Future capability may enable linking/attaching source information used by experts to the captured input
- Our methodology especially appropriate for modeling risks that rely mainly on expert judgment due to scarcity of data
- Risk factors modeled as binary events but our approach is amenable for risk factors that occur with a certain frequency over time, e.g. fraud rate

Discussion

- Collecting risk information in a common repository enables
  - Transparency into the risk assessment and management process
  - Tracking of changes in risk profile over time
  - Easy identification of “outliers” or disagreement

- Implementing risk mitigation and planning decisions require findings monitoring metrics to track that
  - Implementation of decisions is taking place
  - Observed risk levels (risk frequency, KRIs) and business performance metrics (KPIs) are within expected ranges
  - Deviations between observed and expected KPI
    - Launch review of risk model and identification of any new risks
  - Risk assessments and monitoring results to be incorporated into existing planning processes

Step 2: Generate questionnaires to collect the necessary information from the risk experts – Risk Impact

R1 SUB-RISK **Low store customer traffic**

In the event that this risk occurs the following 2020 planning assumption could be affected

A1 ASSUMPTION

The 2020 planning model base value for the Electronics sales CAGR from 2012 to 2020 is (%)

8.25

QUESTION If we have a low store customer traffic, what do you think the impact on this base value will be? Provide your best estimate, including sign, for the change in the base value

Change (%)

1.3

Relative change(amount of change as a fraction of base value) (%)

15.8

Assumption value with risk in effect (%)

9.6

RANGE Provide a range of likely values for this change. (e.g., while most likely CAGR change is expected to be -2.00pp, it may end up being any number between -1.50pp and -2.80pp)

Range of Change (%)

0.8 — 2

Step 2: Generate questionnaires to collect the necessary information from the risk experts – Revised Risk Probability

R1	SUB-RISK	**Low store customer traffic**
		IBM is considering implementing the following mitigation action(s)
M1,2	MITIGATION	**Increase number of discounts & promotions & pay premium for skills**
		Increase number of discounts & promotions(potential total electronics budget for this action) ($ in Millions)
		2.2
		Switch to cheaper suppliers(potential total electronics budget for this action) ($ in Millions)
		93.5
	QUESTION	Provide your best estimate of the reduction (if any) in this probability due to the following mitigation action(s)
		Earlier you've indicated that the probability with which R1 may occur is (%)
		38
		Increase number of discounts & promotions (%)
		2
		Switch to cheaper suppliers (%)
		6
		Revised probability of risk occurrence w/ mitigation in place (%)
		30
	RANGE	Provide a range of likely values for this change
		Increase number of discounts & promotions (%)
		1 — 3.4
		Switch to cheaper suppliers (%)
		5.4 — 8.2