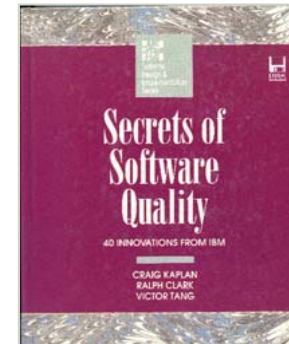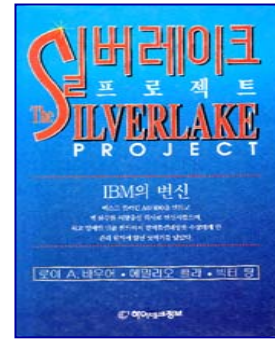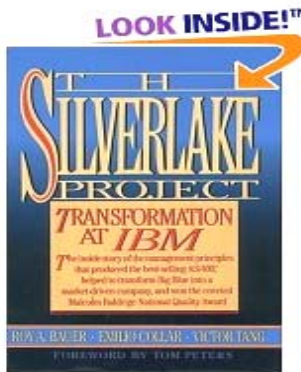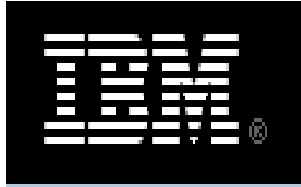# Corporate Decision Analysis:
An Engineering Approach

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Product Lifecycle Team
April 2006

Observations from corporate experience about senior-executive decisions under uncertainty.

Data quality	*largely untested*
Range of alternatives considered	*narrow*
Importance of decision variables	*largely unaddressed*
Uncontrollable variables	*largely unaddressed*
Impact of uncontrollable variables	*largely unaddressed*
Predictive power	*low*

Decision outcome =
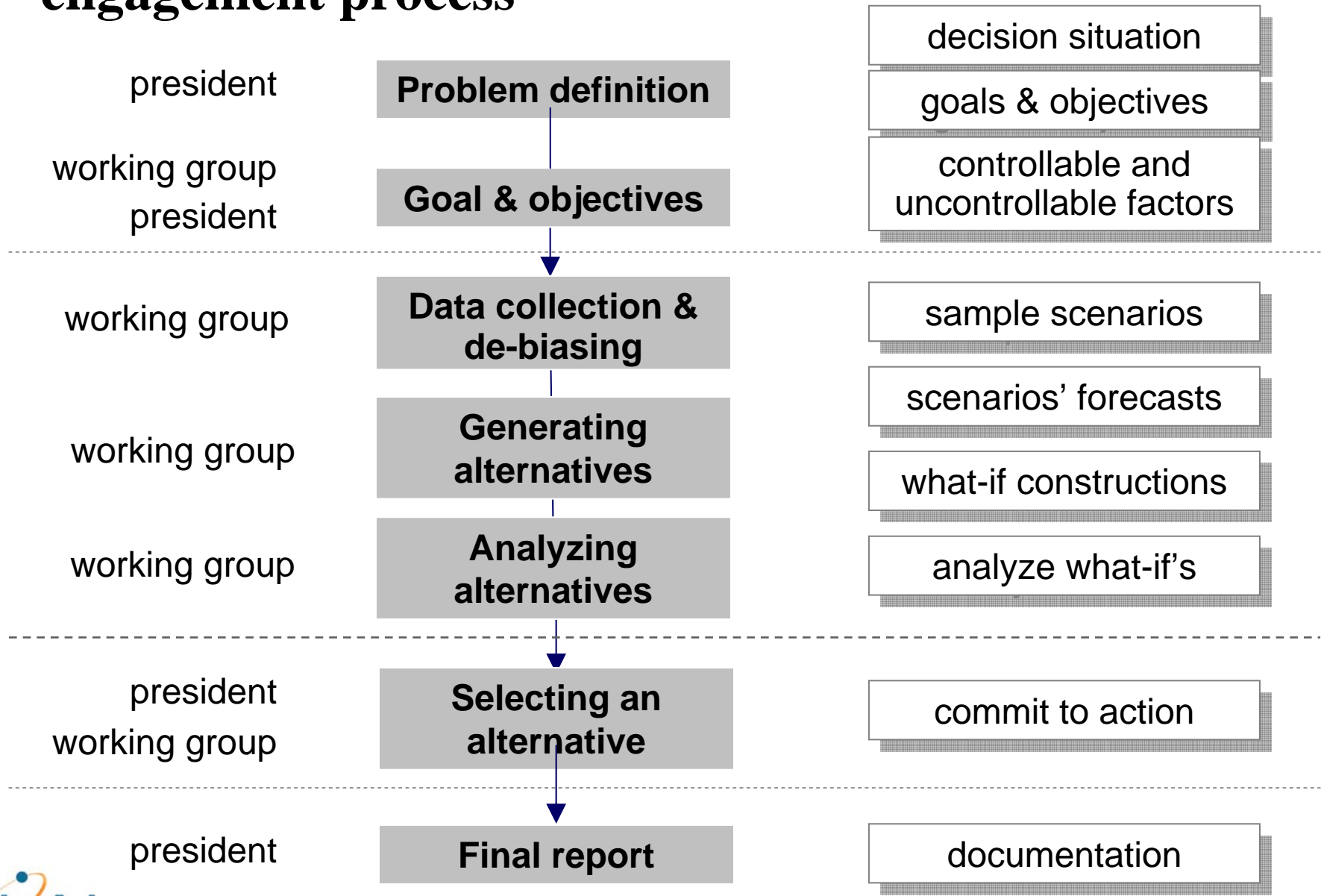# f(what's controllable & uncontrollable)

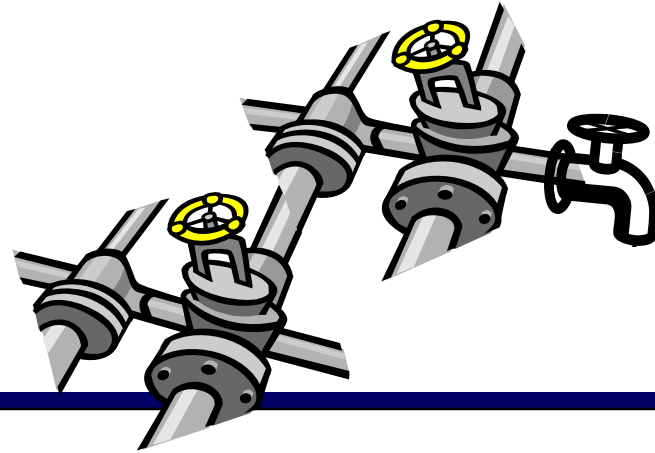# *In situ* experiment #3
High-tech manufacturing company (US)

- $700 M/year global high-tech manufacturer failing to generate profit.

- Company de-listed from stock exchange.

- Board of directors appoints new president.

  Wants an assessment of his turnaround strategy, survey of alternatives and their prospects to generate profit.

engagement process

president	**Problem definition**	decision situation
		goals & objectives
working group president	**Goal & objectives**	controllable and uncontrollable factors
working group	**Data collection & de-biasing**	sample scenarios
working group	**Generating alternatives**	scenarios' forecasts
		what-if constructions
working group	**Analyzing alternatives**	analyze what-if's
president working group	**Selecting an alternative**	commit to action
president	**Final report**	documentation

Frame the problem

problem	Survival
outcomes	Profitability in 6 Months
controllable variables	1. Sales, general & admin expenses, SG&A 2. Cost of goods sold, COGS 3. Capacity utilization 4. Customer portfolio structure 5. Sales 6. Financing
uncontrollable variables	1. Customer base changes 2. Senior management interaction 3. Banker actions 4. Loss of critical skill

Boundaries of the solution and uncertainty space ➜ 729 alternatives and 54 uncontrollable environments

| Controllable	level 1	level 2	level 3
1. SG&A	+10 %	$ 54 M	-10 %
2. COGS	+2 %	$ 651 M	-2 %
3. plant capacity	40 %	60 %	80 %
4. customer portfolio mix	current mix	dev<10%, a/t<6%, mfg.<4%	dev<20%, a/t<12%, mfg.<8%
5. sales	-5 %	$ 690M	+5 %
6. financing	$10M short	Mexico action, + $12 M annualized	China action, + $25 M annualized

BAU

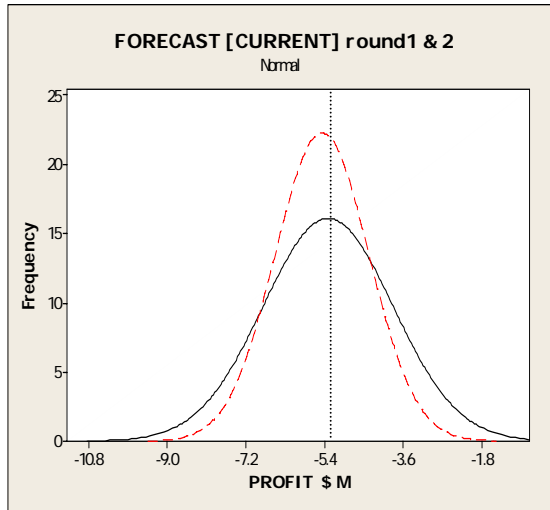| Uncontrollable	worse	current	best
1. cust. base change	net loss >5% GM	no change	net gain >5%GM
2. senior executives' interactions	= current	weak management unity	strong management unity
3. banker actions	US banks drop	no change	US banks relax terms
4. critical skills	lose 3 skills	no change	gain 1 or 2 skills

controllable factors						uncontrollable factor levels		
SG&A	COGS	capacity	portfolio	sales	financing	level 2	level 1	level 3
						level 2	level 2	level 3
						level 2	level 1	level 3
						level 2	level 1	level 3
						current	**worst**	**best**
BAU 2	2	2	1	2	1			
1	1	1	1	1	1			
1	2	2	2	2	2			
1	3	3	3	3	3			
2	1	1	2	2	3			
2	2	2	3	3	1			
2	3	3	1	1	2			
3	1	2	1	3	2			
3	2	3	2	1	3			
3	3	1	3	2	1			
1	1	3	3	2	2			
1	2	1	1	3	3			
1	3	2	2	1	1			
2	1	2	3	1	3			
2	2	3	1	2	1			
2	3	1	2	3	2			
3	1	3	2	3	1			
3	2	1	3	1	2			
3	3	2	1	2	3			
3	1	3	1	1	3			
1	3	1	3	3	3			
1	3	3	1	1	3			
3	2	3	3	1	1			

Collect and analyze the data.
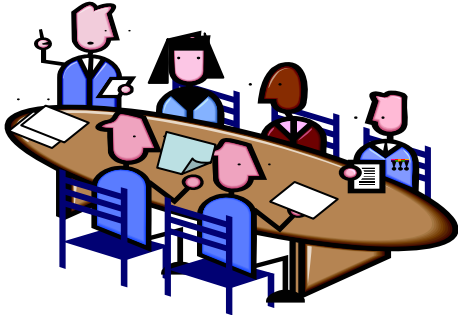
Debiasing ➜ dispersions decline and confidence rises

FORECAST [CURRENT] round1 & 2
Normal

forecasts =
stdev ↓

FORECAST [WORST] round 1 & 2
Normal

forecasts ↑
stdev ↓

FORECAST [BEST] round 1 & 2
Normal

forecasts ↓
stdev ↓

CONFDENCE (1-5) round 1 & 2
Normal
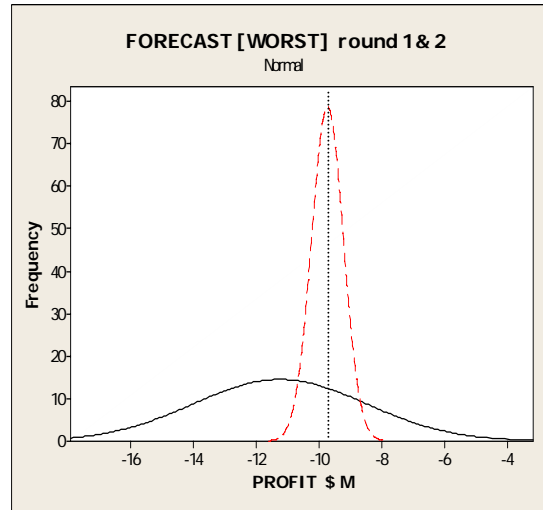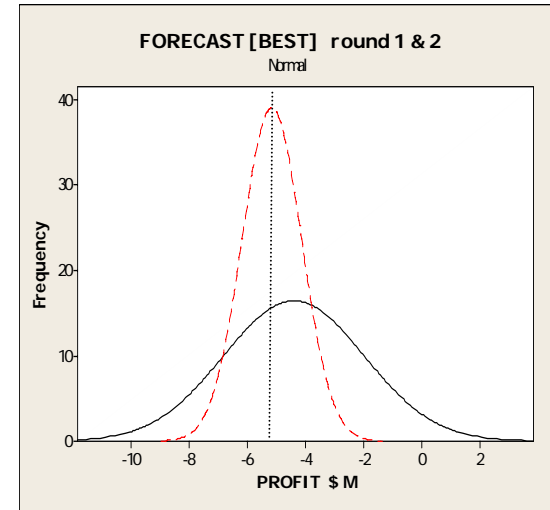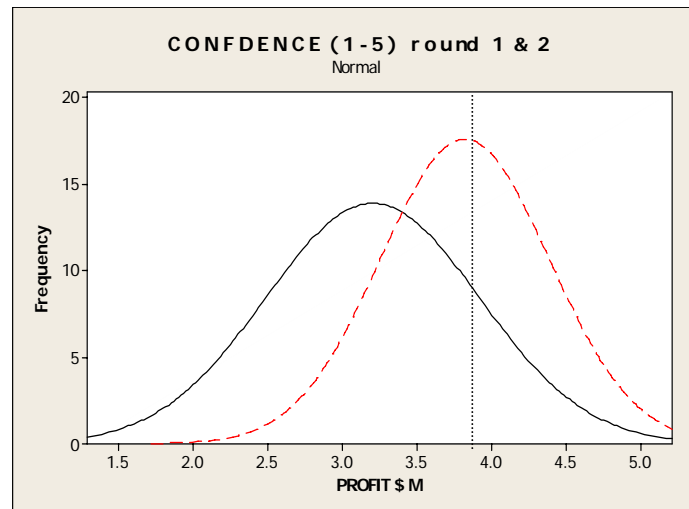
confidence rises
stdev ↓

—— round 1
- - - round 2

Unconstrained exploration of what if's

Contribution of each variable to the outcome					
COGS	Cportfolio	SG&A	sales	financing	capacity
72 %	9 %	7 %	7 %	3 %	2 %

What if ?		profit $ M		
		current	worst	best
BAU	*business as usual*	**-5.54**	*-9.40*	*-2.89*
BAU + COGS$^+$		-2.04	-5.90	+0.43
BAU + cust. portfolio$^+$		-3.99	-7.73	-1.15
BAU + SG&A$^+$		-4.35	-8.28	-1.68
BAU + sales$^+$		-4.43	-8.27	-1.90
BAU + financing$^+$		-4.90	-8.17	-2.41
BAU + plant capacity$^+$		-5.16	-8.43	-2.72
BAU + COGS$^+$ + portfolio$^+$		*-0.40*	*-4.24*	*+2.18*

Manufacturing company results: Plan versus actual
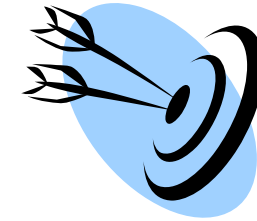
controllable factors	Plan		actual performance		
	level	values (level)	level	values (level)	vs. plan
SG&A	3	$54 M-10%	3	same	=
COGS	2.5	$651 M – 1%	2.5	same	=
plant utilization	2	60 %	2.5	70 %	↑
portfolio actions	2	no change	2.5	improved mix	↑
sales	1.5	$690 M -2.5%	1	$690 M - 5%	↓
financing	1.5	shortfall ~$5 M	1	shortfall ~$10 M	↓
results			reported to SEC $ 1M		
		derived $ -1.13M	derived $ 0.41 M		

- loss of $16 M same quarter last year
- loss of $13 M previous quarter

Services company results: Plan versus actual

controllable factors	Post-BAU plan		agreed result		delivered	
	level	values (level)	level	values (level)	level	values (level)
Project leadership	3	change project leader & program mgr.	3	=	3	=
Project approach	2	3 waves. Focus US & Japan	2	=	2	=
Cost contingency	2	use some contingency	2	=	2	=
Project delivery	3	meet delivery date	3	=	2	slip 2-3 months
derived results		environment		environment		environment
	3.6	worst		-	2.7	worst
	3.8	**current**		-	2.9	current
	4.1	best	4.1	best	3.2	best
actual result ➜			3.5			

Executives were enthusiastic about the method
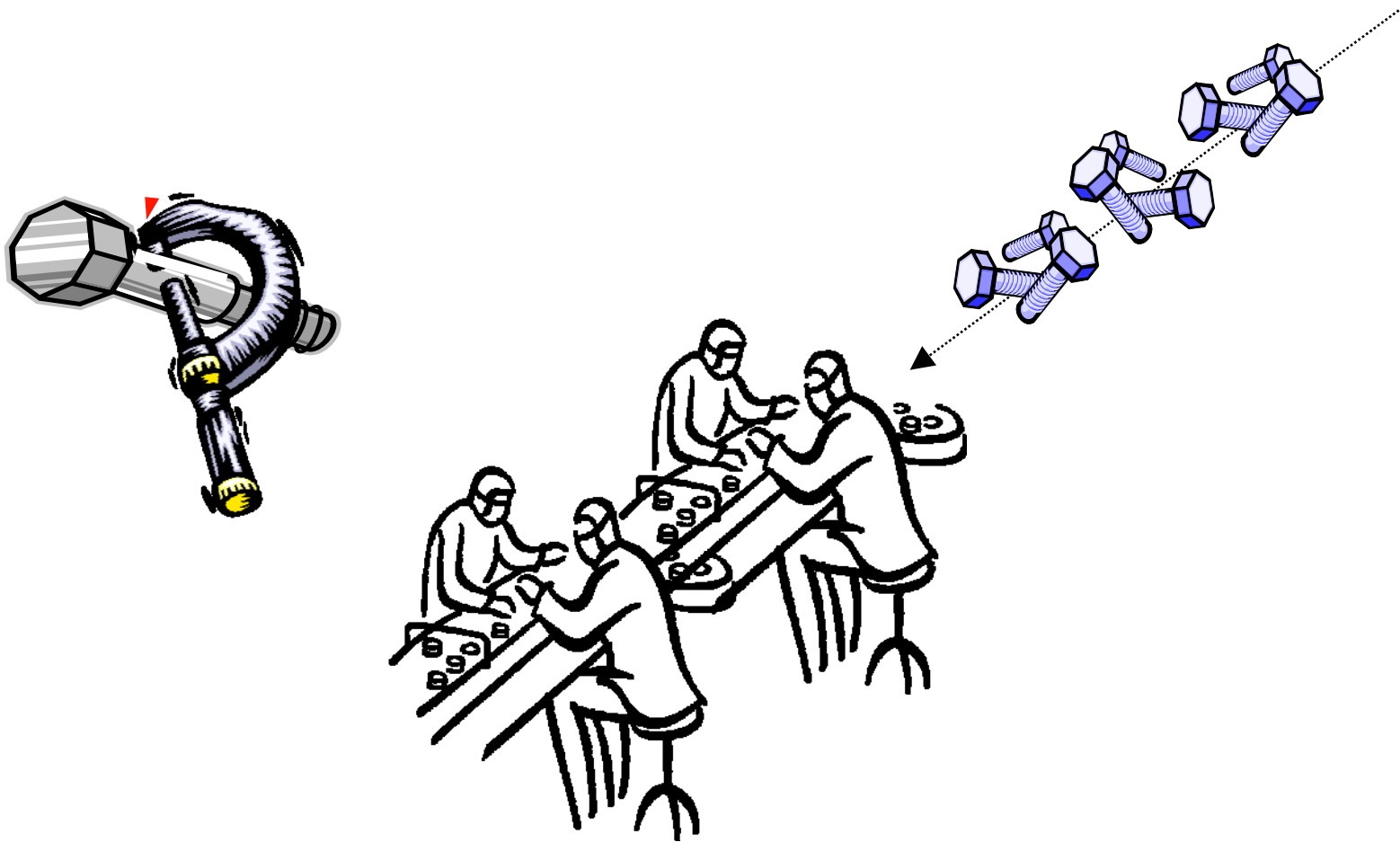
"Let's take this to our board of directors."

"Approach will make better decisions."

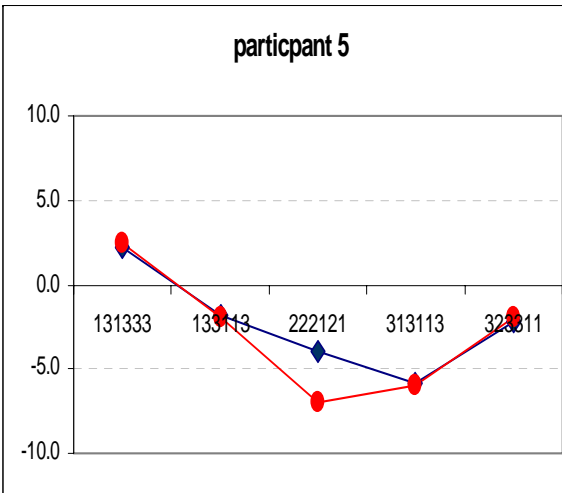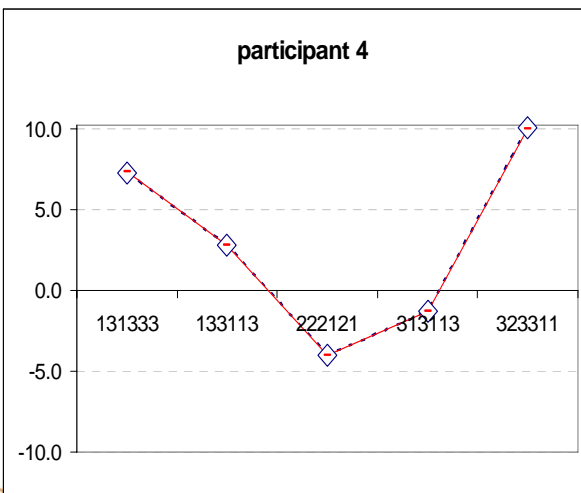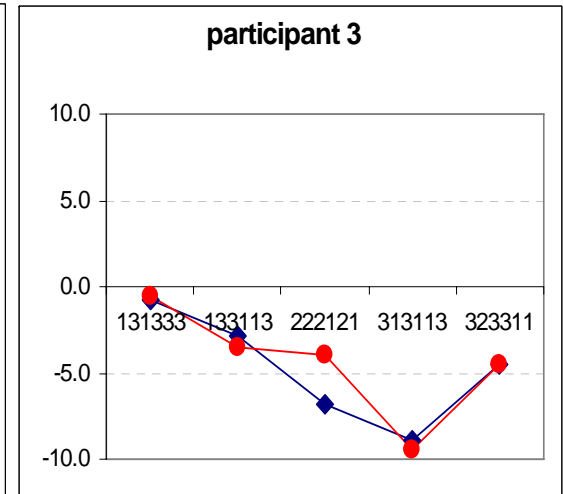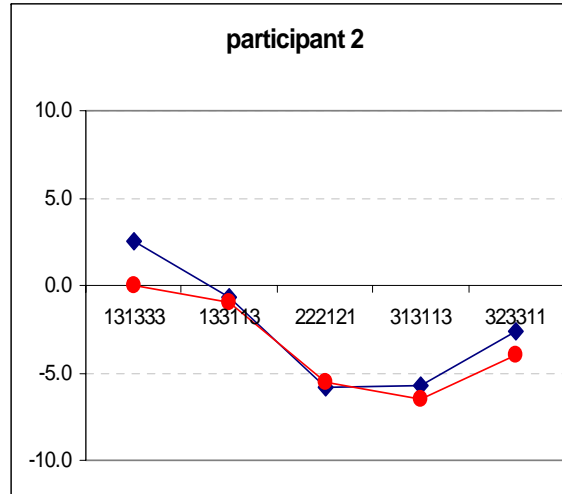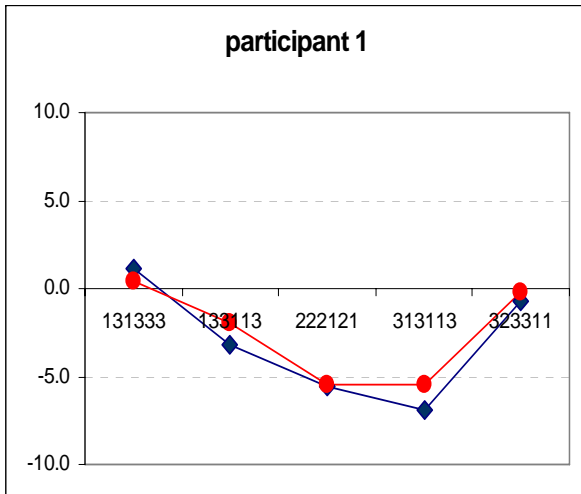"... excellent, rational ...Understand risk with factors cannot control."

"Value of this process is in the process not the conclusions."

"This process visualizes the decision … instead of intuition."

Measurement system analysis

Forecasts vs. derived estimates give an indication of an operator's *repeatability* across forecasts.
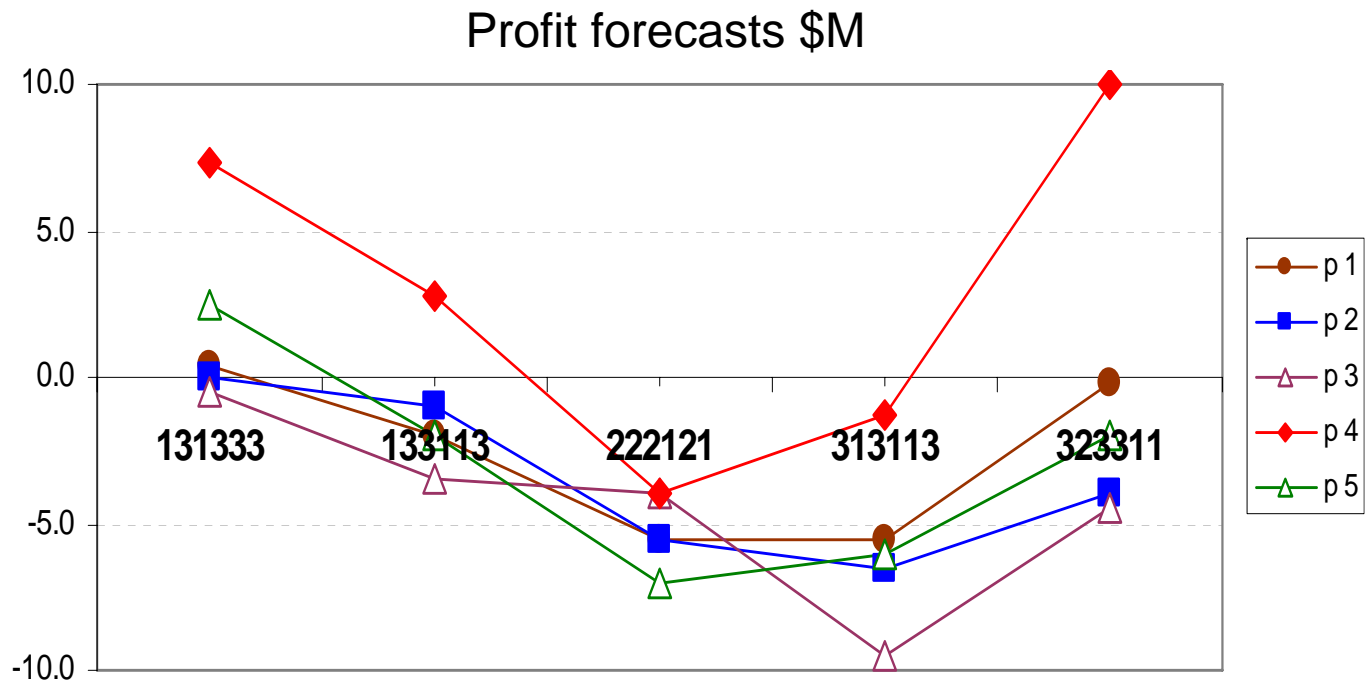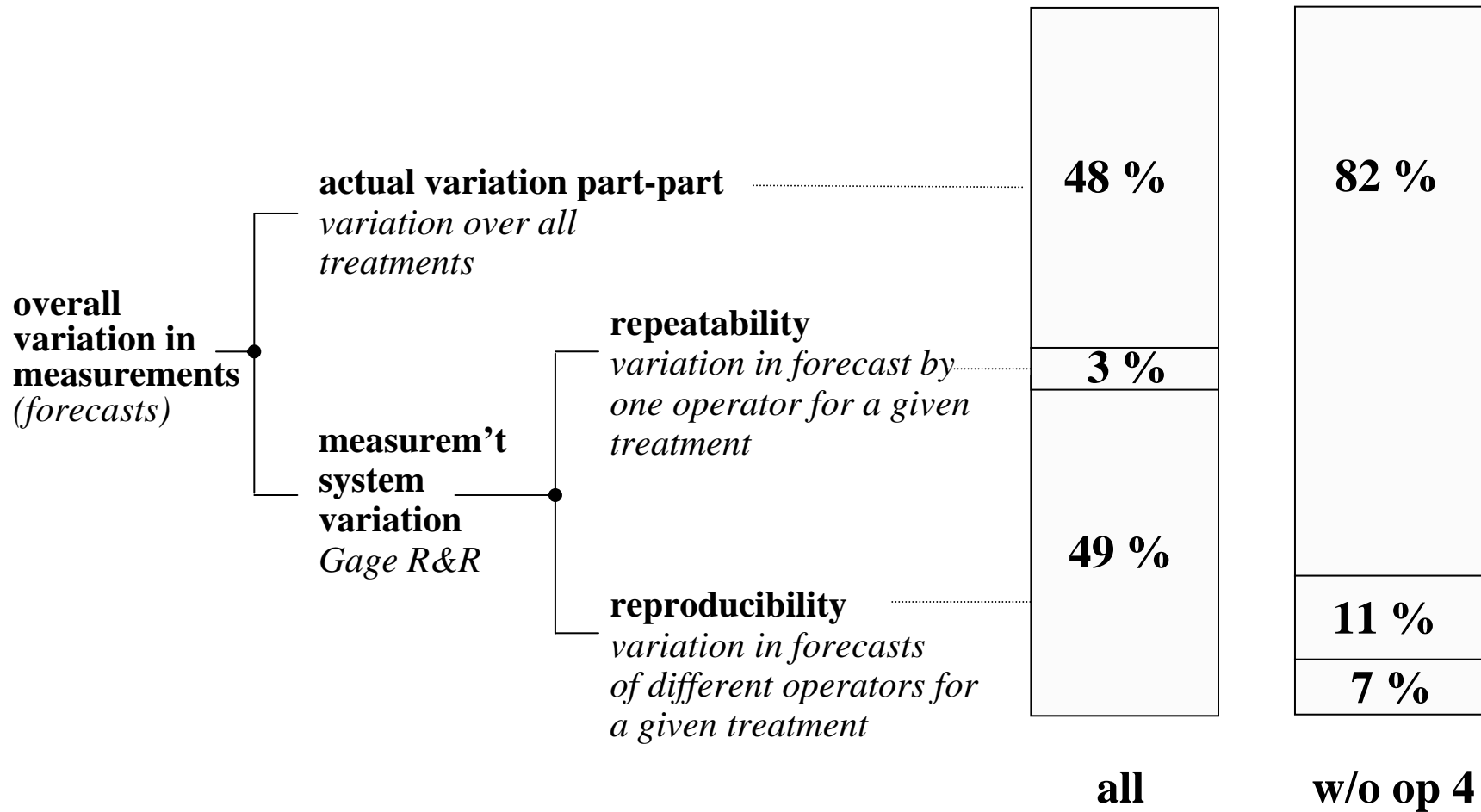
Individual forecasts of 5 (test) treatments gives us an indication of *reproducibility* across "operators"

Profit forecasts $M

Can identify source of low quality data

actual variation part-part
variation over all treatments

overall variation in measurements
(forecasts)

repeatability
variation in forecast by one operator for a given treatment

measurem't system variation
Gage R&R

reproducibility
variation in forecasts of different operators for a given treatment

48 %

3 %

49 %

82 %

11 %

7 %

all   **w/o op 4**

New approach to ...
senior-executive decisions under uncertainty.

Data quality	*can be improved*
Range of alternatives considered	*entire solution space*
Importance of decision variables	*can be determined*
Uncontrollable variables	*can be determined*
Impact of uncontrollable variables	*can be determined*
Predictive power	*higher*

NEW WAY TO ...

- **Analyze corporate decision-making**

  Controllable variables

  Uncontrollable variables
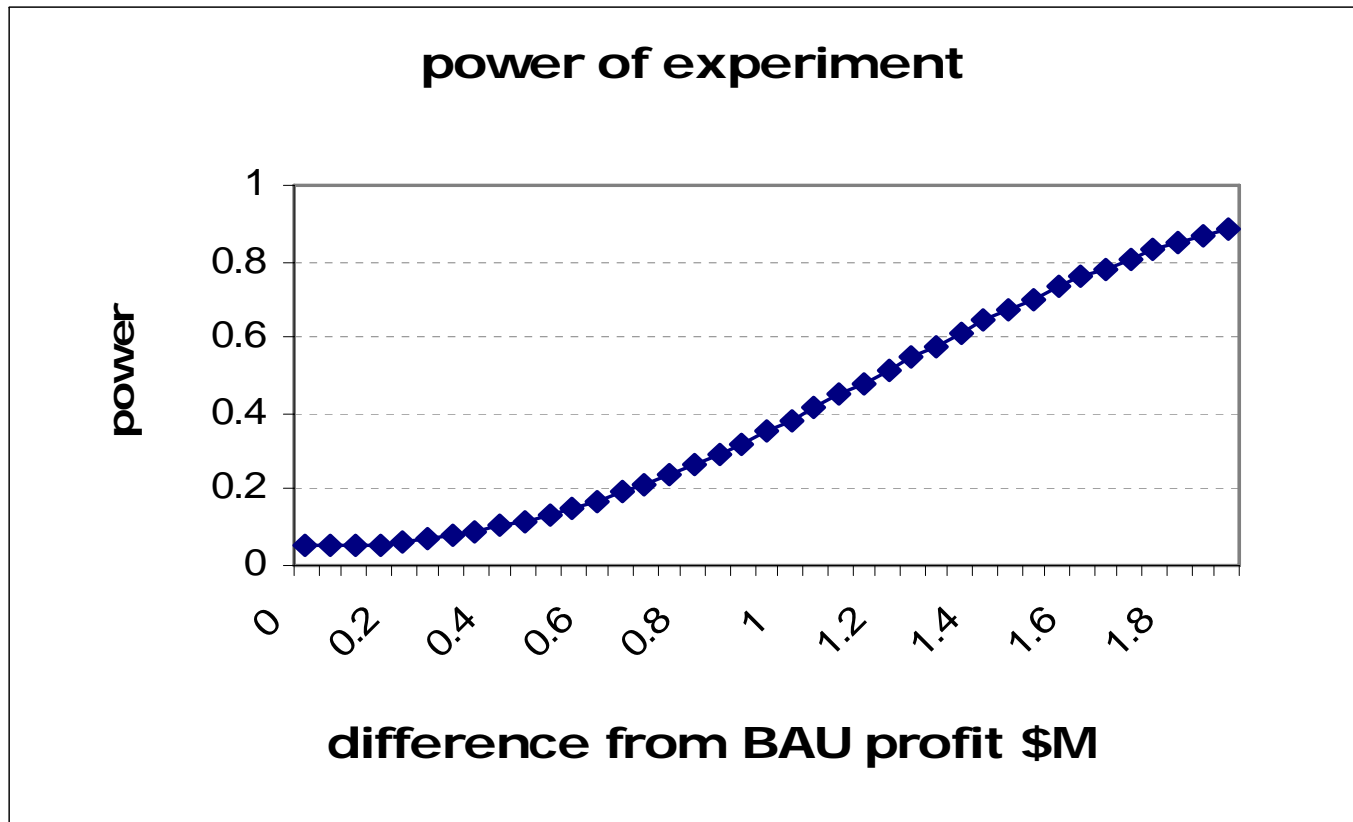
- **Explore the entire solution space**

  Systematically and economically

- **Explore outcomes over entire space of uncertainty**

  Unconstraint range of *what-if* scenarios

Experiment power

- Power is the ability to detect a difference when one exists.
- Power is the probability that you will reject a premise when it should be rejected.