

Risk Budgeting and Risk Adjusted Performance for Investment Management

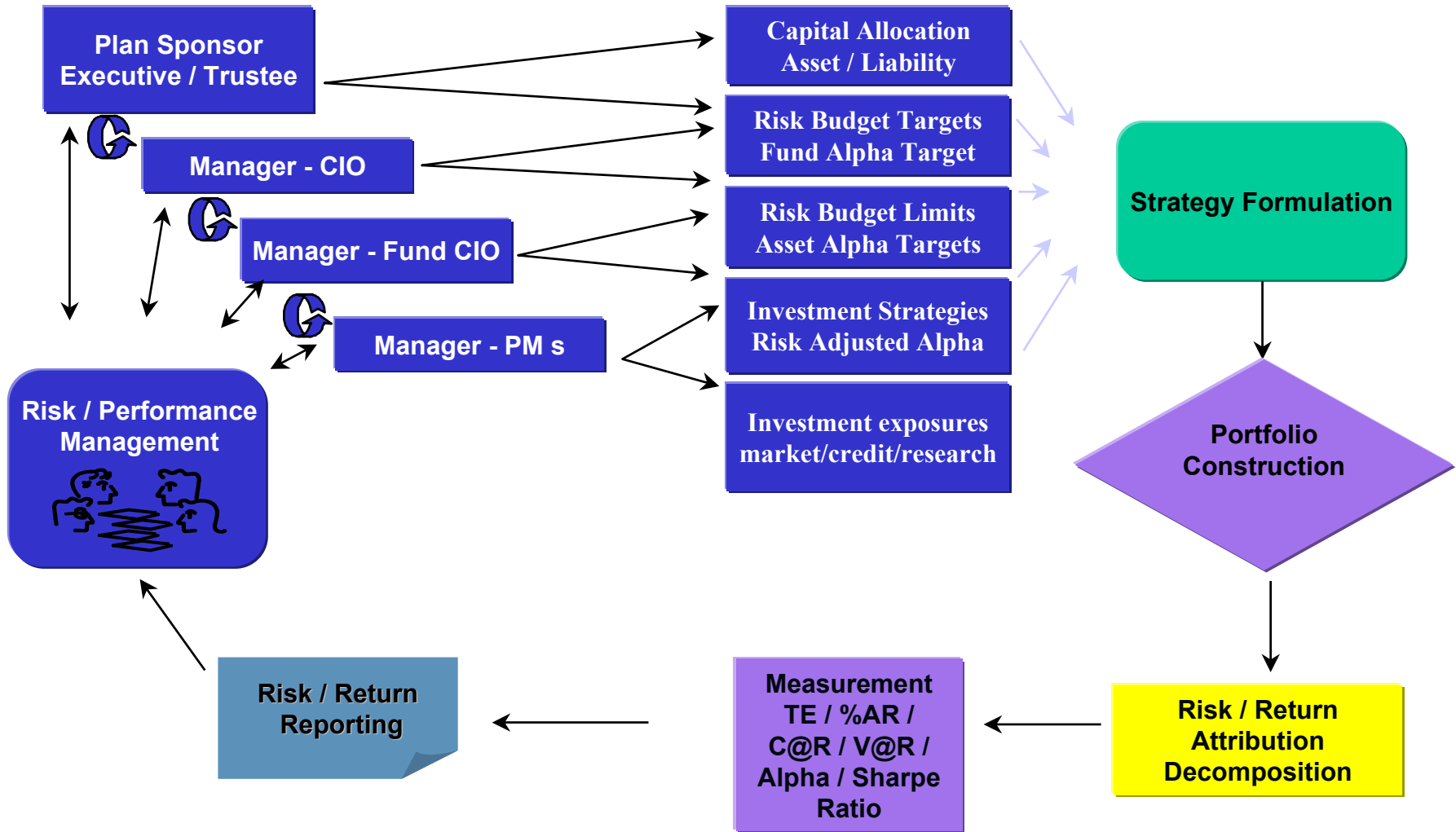
Erwin Martens



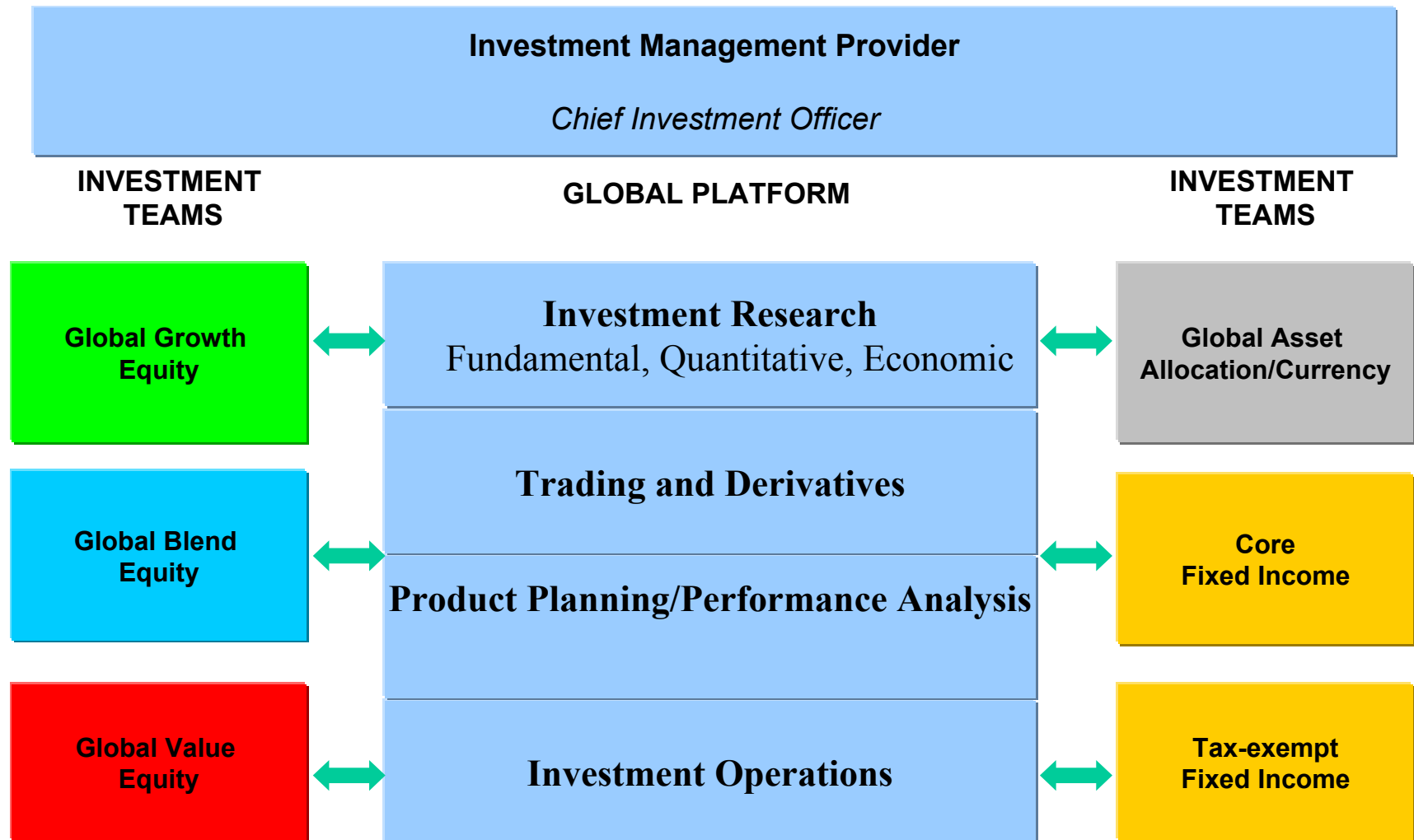
Risk (Budgeting) and Performance Measurement within the Investment Process Agenda

- Big Picture - The Process
- Conceptual Framework
- Tools & Techniques - Implementation
- Platform
- Summary

Risk (Budgeting) and Performance Measurement within the Investment Process



Risk (Budgeting) and Performance Measurement within the Investment Process

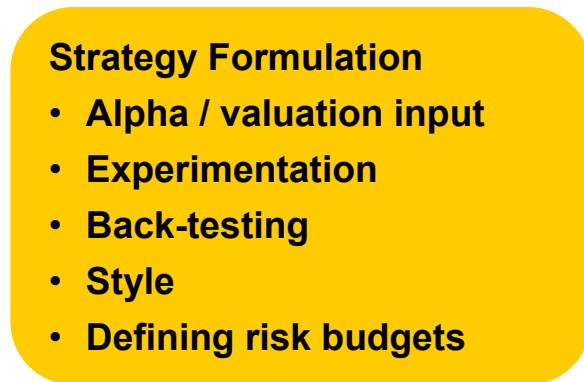


Risk (Budgeting) and Performance Measurement within the Investment Process

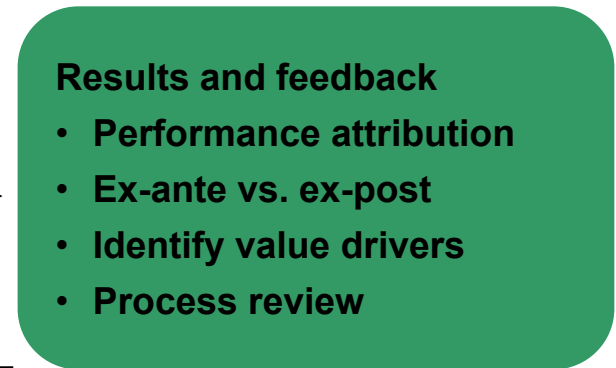
Portfolio Construction

Implementation

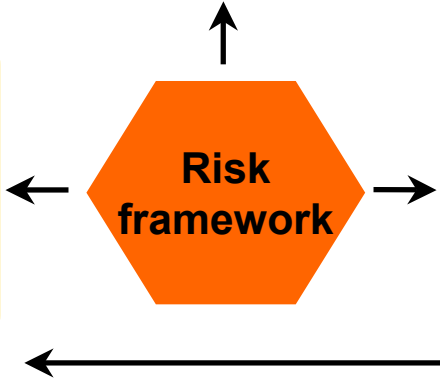
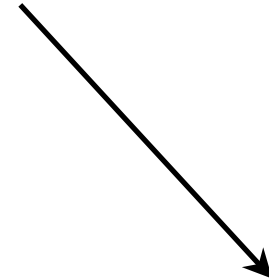
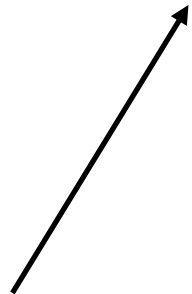
- Optimal portfolio
- What if?
- Strategic positioning
- Tactical positioning
- Spending the risk budget



Research platform



Risk / Return Attribution engine



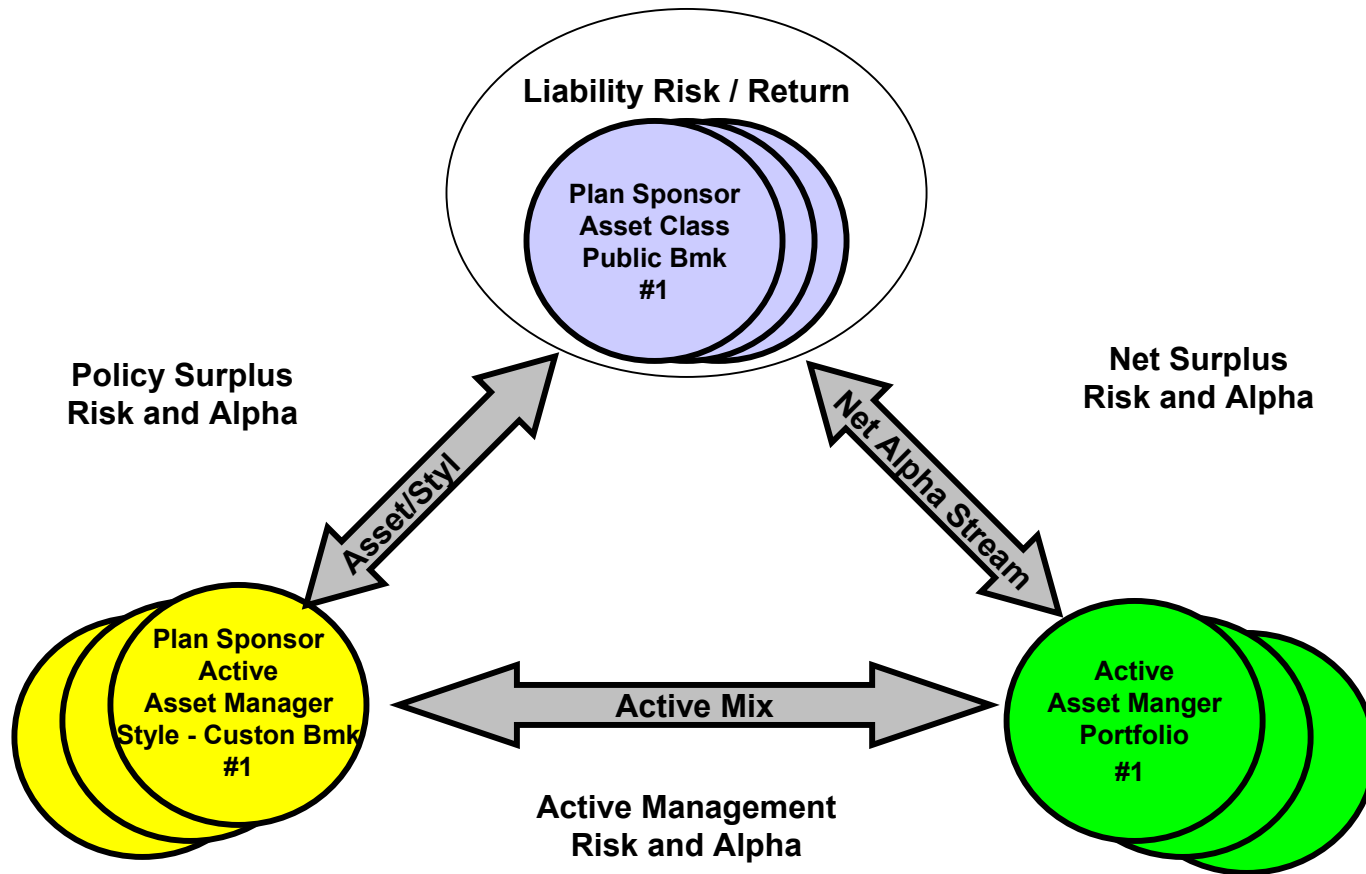
Risk Budgeting and Performance Measurement within the Investment Process

Conceptual Framework

Measurement Tools & Techniques

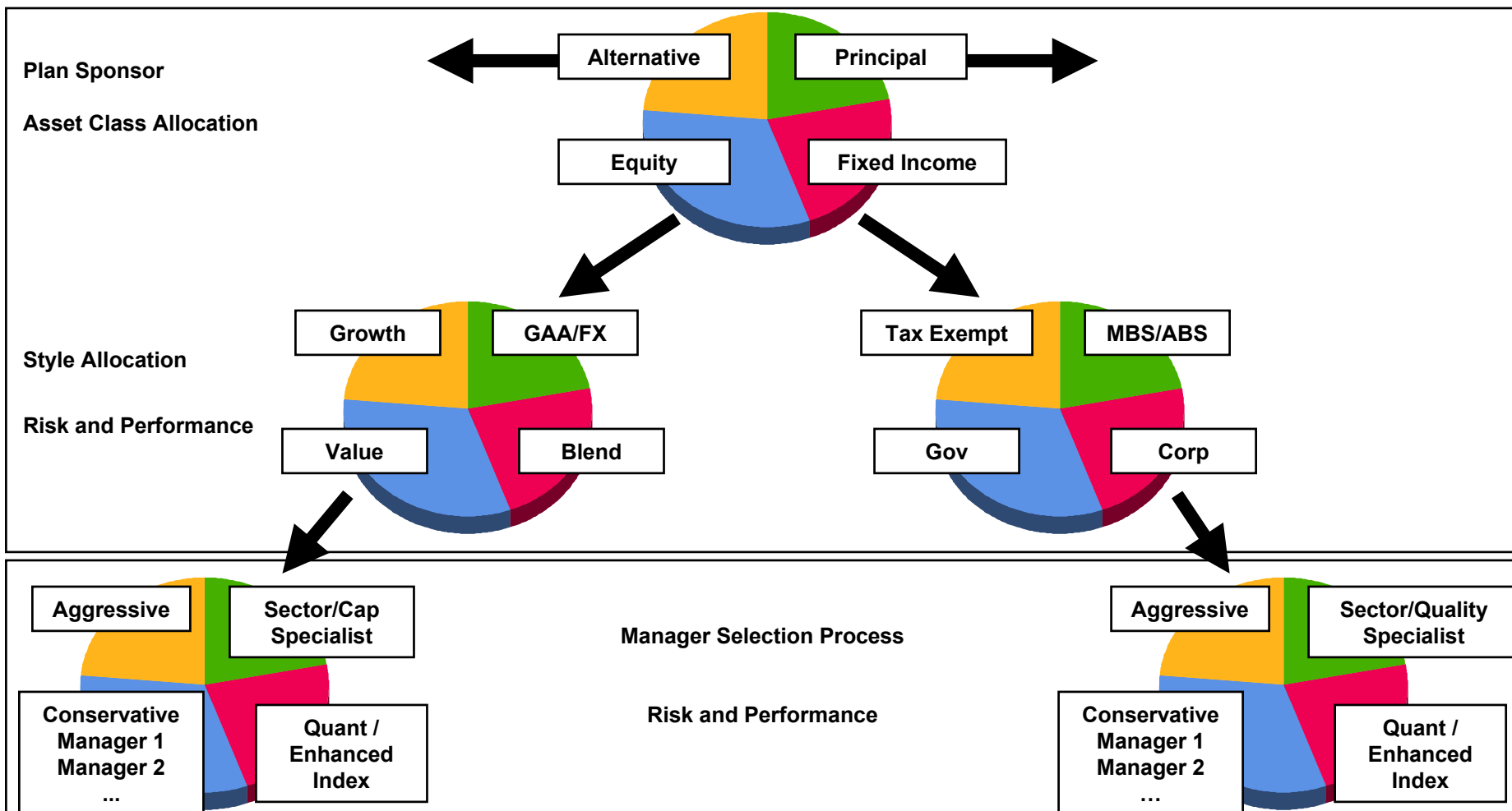
Linking Risk, Return, Placement and Competitiveness

Multi-Manager Investment Process Measurement



Risk (Budgeting) and Performance Measurement within the Investment Process

Asset Class Allocation / Style Objective / Manager Selection



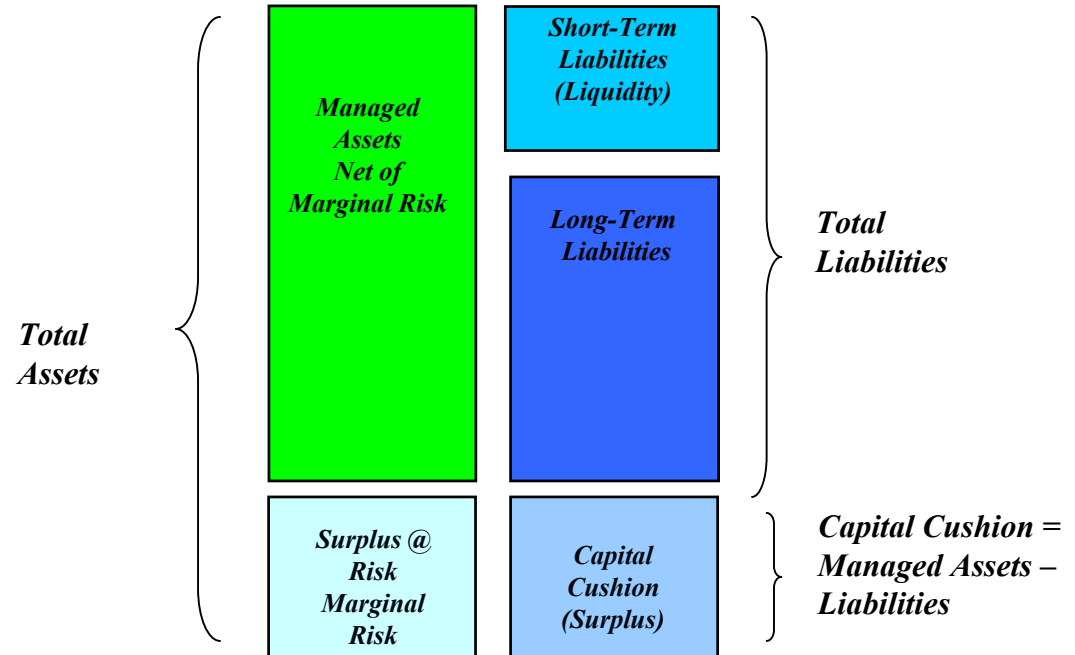
Conceptual Framework

Capital Allocation Objective

Dynamic Surplus (α or \$) Management – Fund Surplus

Investment Management Mix

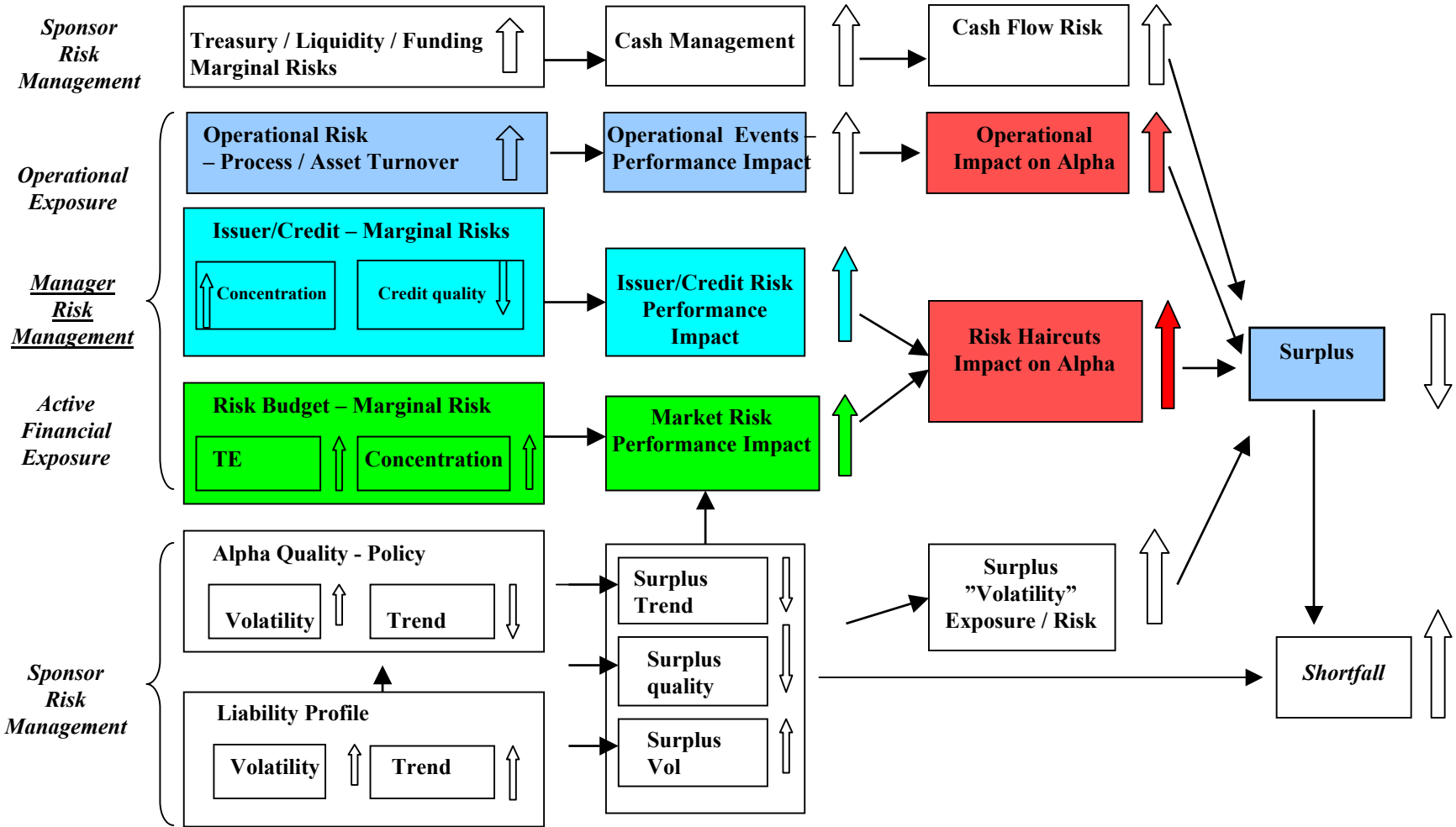
- **Client's Asset / Liability Mix**
 - **Quality of Assets**
 - **Liability Structure**
- **Certainty of capital structure**
 - **Capital preservation**
- **Risk Capital**
 - **Aggregate Marginal Risk**
- **Risk Budget**
 - **Managing Marginal Risk**



Conceptual Framework

Capital Allocation Objective

Dynamic Surplus (α or \$) Management – Process Risk



Conceptual Framework

Risk Budgeting - Linking Risk and Return

Risk/Reward Measurement – Information Ratio

Quality of Returns

- Information Ratio, $IR = \alpha/\omega$
- Where α is the residual return earned in excess of a benchmark return.
- And ω is a measure of the residual or active risk taken by the portfolio manager.
- Another way to define the IR is excess return divided by tracking error.
- Quality of returns – units of return per unit of risk

Objective

- Maximize Value Add to the Portfolio = $\alpha_p - \lambda\omega_p^2$
- λ is a measure of an investor's risk aversion; it links active risk into a potential loss of alpha.
- λ (risk aversion) is investor specific
but in more general terms usually grouped as aggressive, moderate and conservative risk takers

Source of IR

- IR can be looked at another way $IR = IC * \sqrt{\text{Breadth}} = \alpha/\omega$
- IC is short hand for Information Coefficient (think of this as risk adjusted alpha per bet)
- $\sqrt{\text{Breadth}}$ represents how many independent risk adjusted alpha bets are made per investment period

Conceptual Framework

Risk Budgeting - Linking Risk and Return

Practical Meaning

Building towards a fund's IR

- A large AUM fund manager will get breadth by striving to get modest alpha per bet from a large number of firms (with relatively low number of bets per year)
- A more concentrated fund manager will get breadth by looking to get more alpha over fewer names by making many bets per year per name
- An IR of in the range of 0.5 to 0.7 is realistic (~70% percentile performance) ... if the two funds have 225 and 64 names respectively and make one bet per name per period ... their ICs would be
 $IC(225) = 0.03$ where $IC(64)$ would be 0.0625 ... over double per bet! It turns out that this can be linked to a win/loss percentage ... funds with large number of bets do well with 52% average win/loss ratio while more concentrated funds may need win/loss ratios as much as 60% to do well.
- Skill is therefore in the details and risk budgets help match investor alpha expectations and risk tolerance with manager skill and portfolio/product choice

Conceptual Framework

Risk (Budgeting) and Performance

Tracking Error Range by Style / Manager

Ex Ante Tracking Error Range	Value	Core	Growth	Sector/GAA
1 - 2.5%	Conservative Product	Conservative Product	Conservative Product	Conservative Product
1.5 - 3%				
2 - 4%	Moderate Product	Moderate Product	Moderate Product	Moderate Product
3 - 6%				
4 - 7%				
5 - 8%	Aggressive Product	Aggressive Product	Aggressive Product	Aggressive Product

Conceptual Framework

Risk (Budgeting) and Performance

Alpha Expectation by Style / Manager

Gross
Alpha Target
Range (BP)

Value

Core

Growth

Sector/GAA

50 - 100

Conservative
Product

Conservative
Product

Conservative
Product

Conservative
Product

100 - 200

150 - 250

Moderate
Product

Moderate
Product

Moderate
Product

Moderate
Product

200 - 400

300 - 500

500 - 800

Aggressive
Product

Aggressive
Product

Aggressive
Product

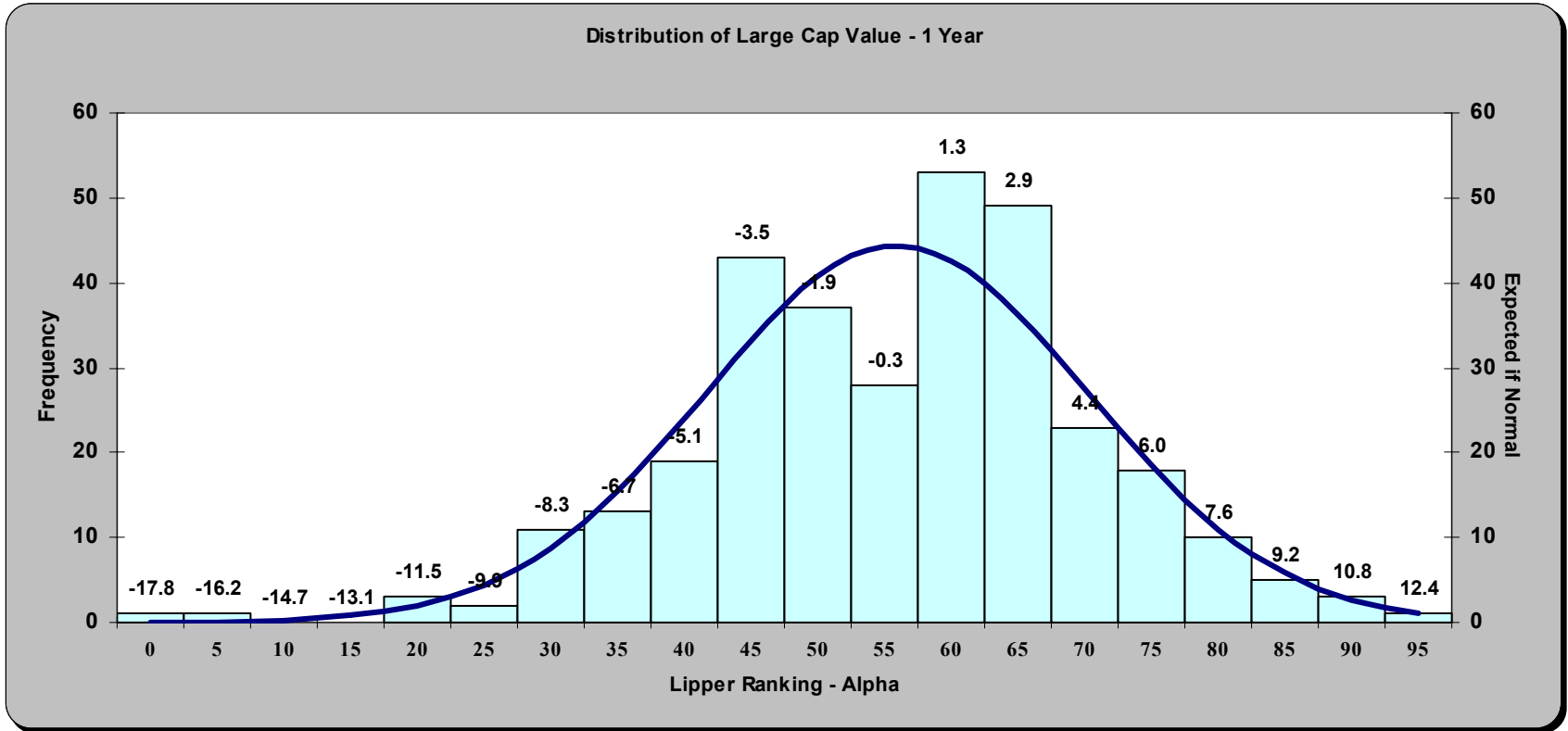
Aggressive
Product

50 - 100	Conservative Product	Conservative Product	Conservative Product	Conservative Product
100 - 200				
150 - 250	Moderate Product	Moderate Product	Moderate Product	Moderate Product
200 - 400				
300 - 500				
500 - 800	Aggressive Product	Aggressive Product	Aggressive Product	Aggressive Product

Conceptual Framework

Risk Budgeting - Linking Risk and Return

Large Cap Value – All Managers



Conceptual Framework

Risk (Budgeting) and Performance

Implied IR by Style / Manager

Implied IR (Midpoint)	Value	Core	Growth	Sector/GAA
0.2 – 0.3	Conservative Product	Conservative Product	Conservative Product	Conservative Product
0.3 – 0.4				
0.4 – 0.5	Moderate Product	Moderate Product	Moderate Product	Moderate Product
0.5 – 0.6				
0.6 – 0.7				
0.6 – 0.8	Aggressive Product	Aggressive Product	Aggressive Product	Aggressive Product

Risk Budgeting and Performance Measurement

Tools & Techniques

Implementation

Active Management Process

Risk Budgeting

What we are looking for

- Risk Budget Decomposition (Marginal Risk)
 - Tracking Error
 - Additional Risk Measures
 - Integrating Information: Risk Management and Investment Research
- Active Risk Measurement
(full analysis of the Portfolio and Benchmark)
- Capture positive and negatives bets
(relative risk with respect to the benchmark)
- Forecast risk (ex-ante) vs actual risk (ex-post)
- Tracking Error Decomposition
(common factor risks vs specific risks)

Active Management Process

Risk Budgeting

What we need to accomplish

- Managing Tracking Error (TE) at the margin
- Setting realistic TE ranges (per fund and within style groups)
- Analyzing opportunities (TE vs. Alpha)
- Monitor the benchmark's characteristics continually – risk decomposition in common as well as specific space
- Continually review positive and negative bets as sources of diversification (concentration of bets)
- Convey and review “Risk Signatures” over time

Active Risk Budgets

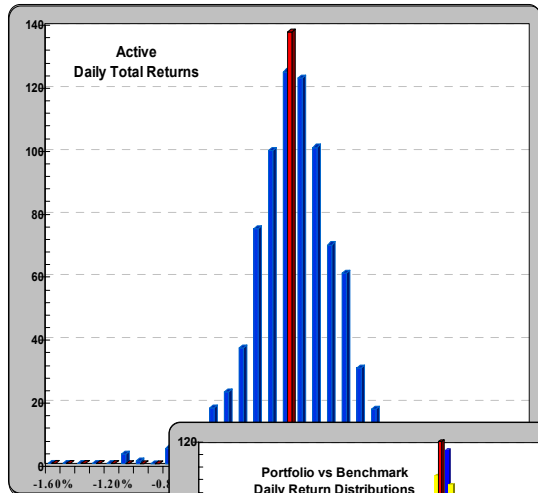
Risk Reporting – Tracking Error Limits

FUND	BENCHMARK	AUM	Current Tracking Error Usage	CURRENT FORECASTEC			Annual Average TE	FORECASTED TE - PREVIOUS 6 MONTHS							
				MIN TE	MAX TE	TE		Feb-02	Jan-02	Dec-01	Nov-01	Oct-01	Sep-01	Aug-01	
CIO / PM / Fund Style / Product															
Fund #1	SP500	\$ 3,914,763		3.23	3.00	6.00	3.97	3.23	3.46	3.72	4.23	4.38	4.10	4.04	
Fund #2	SP500	\$ 20,269,573		3.27	3.00	6.00	3.90	3.27	3.56	3.78	4.32	4.47	4.16		
Fund #3	SP500	\$ 68,006,725		3.29	3.00	6.00	4.07	3.29	3.60	3.85	4.29	4.45	4.12	4.19	
Fund #4	SP500	\$ 300,996,295		3.25	3.00	6.00	4.11	3.25	3.54	3.74	4.17	4.38	4.18	4.10	
Fund #5	SP500	\$ 2,164,900,871		3.27	3.00	6.00	4.12	3.27	3.55	3.78	4.20	4.38	4.17	4.12	
\$ 2,554,173,464															
CIO / PM / Fund Style / Product															
Fund #1	SBPGWORLD	\$ 1,410,692		6.63	4.00	8.00	6.17	6.63	6.60	6.49	6.70	6.44	5.28	5.52	
Fund #2	SBPGWORLD	\$ 51,835,162		3.73	2	5	4.21	3.73	3.67	3.63	3.63	3.49	3.41	3.60	
Fund #3	SBPGWORLD	\$ 368,458,504		3.74	3	5	4.79	3.74	3.66	3.63	3.61	3.50	3.48	3.64	
Fund #4	SBPGWORLD	\$ 1,126,897,772		3.74	2	5	4.43	3.74	3.67	3.63	3.61	3.48	3.39	3.60	
Fund #5	SBPGWORLD	\$ 3,742,499,087		3.75	2	5	3.65	3.75	3.69	3.64	3.61	3.47	3.38	3.61	
\$ 5,291,101,218															
CIO / PM / Fund Style / Product															
Fund #1	MSACWORLDxUSAFree	\$ 54,027,780		4.41	4.00	6.00	5.36	4.41	4.06	4.44	4.42	4.42	4.42	4.40	
Fund #2	MSACWORLDxUSAFree	\$ 109,934,055		4.43	4.00	6.00	5.95	4.43	4.14	4.43	4.47	4.47	4.47	4.41	
Fund #3	MSEAFEEMFree	\$ 276,287,674		4.46	4.00	6.00	5.38	4.46	4.11	4.46	4.37	4.37	4.37	4.34	
Fund #4	SBGEPAC	\$ 3,994,353		4.41	4.00	6.00	5.58	4.41	4.24	4.12	4.25	4.14	4.11	4.04	
Fund #5	SBGEPAC	\$ 23,191,885		4.40	4.00	6.00	4.42	4.40	4.54	4.44	4.59	3.98	3.87	3.70	
Fund #6	SBPGWORLDxUSA	\$ 306,425,208		4.41	4.00	6.00	4.44	4.41	4.14	4.60	4.34	3.82	3.95	3.95	
Fund #7	SBPGWORLDxUSA	\$ 1,247,052,113		4.41	4.00	6.00	4.37	4.41	4.22	4.67	4.60	4.19	4.34	4.33	
Fund #8	SBPGWORLDxUSAxJPN	\$ 18,447,135		4.52	4	6	4.50	4.52	4.23	4.50	4.22	4.17	4.31	4.70	
\$ 2,039,360,202															
CIO / PM / Fund Style / Product															
Fund #1	CUSTINTGRO	\$ 1,423,424		4.28	2.00	4.00	4.50	4.28	3.78	4.07	4.27	3.92	3.87	4.48	
Fund #2	CUSTINTGRO	\$ 8,171,061		4.19	2.00	4.00	6.58	4.19	3.65	3.97	4.13	6.85	7.58	7.83	
Fund #3	CUSTINTGRO	\$ 15,494,052		4.19	2.00	4.00	6.62	4.19	3.66	3.99	4.16	6.89	7.59	7.81	
Fund #4	CUSTINTGRO	\$ 25,422,830		4.41	2.00	4.00	3.88	4.41	3.48	3.86	4.08	3.55	3.56	4.13	
Fund #5	CUSTINTGRO	\$ 54,085,135		4.49	2.00	4.00	3.89	4.49	3.49	3.84	4.12	3.56	3.58	4.16	
Fund #6	CUSTINTGRO	\$ 77,814,956		4.19	2.00	4.00	3.91	4.19	3.67	3.99	4.16	3.64	3.62	4.14	
Fund #7	CUSTINTGRO	\$ 101,736,447		4.19	2.00	4.00	4.03	4.19	3.66	4.00	4.17	3.86	3.85	4.37	
\$ 284,147,905															
CIO / PM / Fund Style / Product															
Fund #1	SBEGWORLDxUSA	\$ 2,779,471		4.50	4.00	7.00	5.49	4.50	7.13	4.50	4.59	4.69	4.52	4.69	
Fund #2	SBEGWORLDxUSA	\$ 44,026,357		4.25	4.00	7.00	5.63	4.25	7.11	5.98	4.53				
\$ 46,805,827															

Active Risk Budgets – Risk Signatures

Assessing Active Risk

“Active Risk Signature” over time

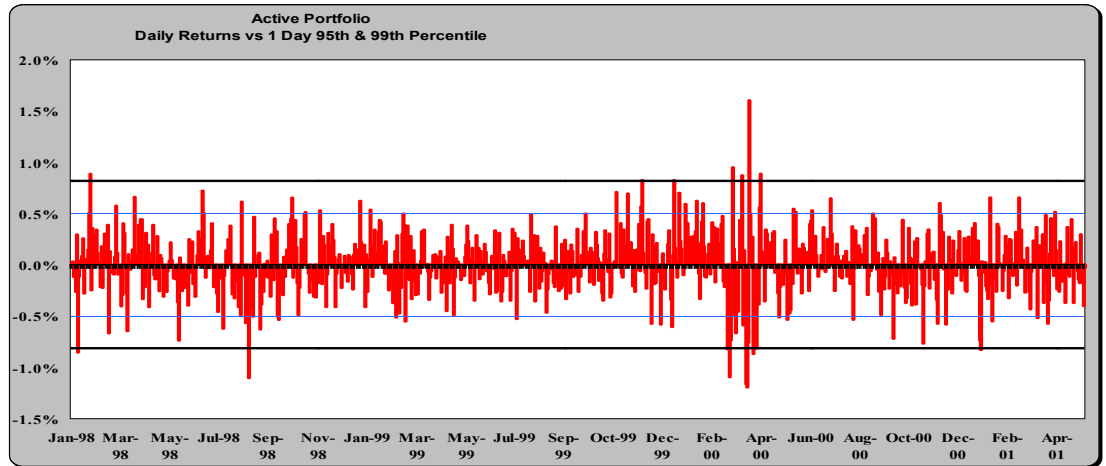
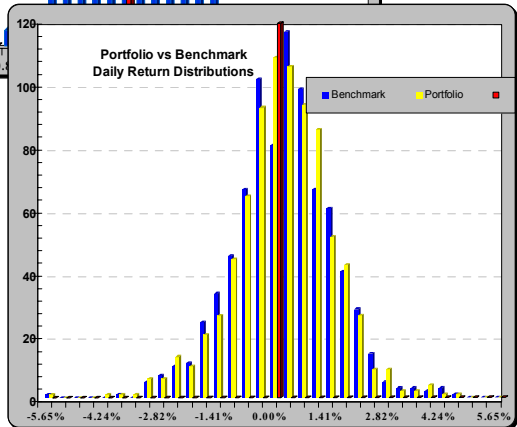


Worst Loss (1 Day)	-1.199%
Volatility StdDev	4.02

Mean (Ann.)
2.382%

StdDev (Ann.)
4.775%

Best Gain (1 Day)	1.600%
Volatility StdDev	5.29



Port Return Loss

Date of Loss	Rank of Loss	SDs	Port Loss Magnitude
3-Apr-00	1	4.02	-1.2%
31-Mar-00	2	3.89	-1.2%
26-Aug-98	3	3.70	-1.1%
14-Mar-00	4	3.66	-1.1%
10-Apr-00	5	2.93	-0.9%

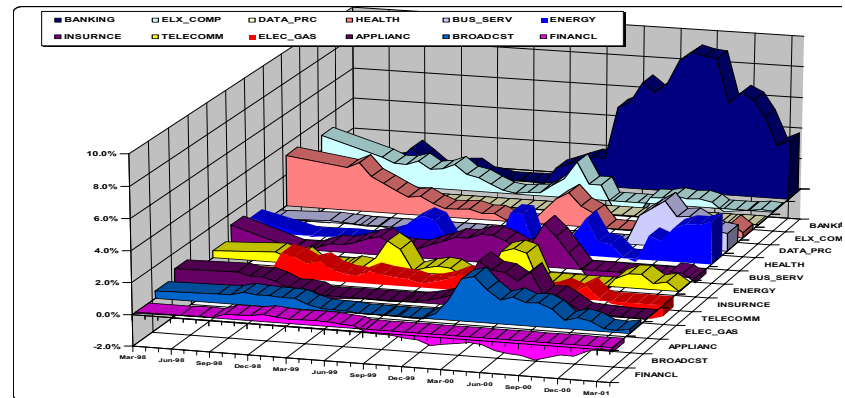
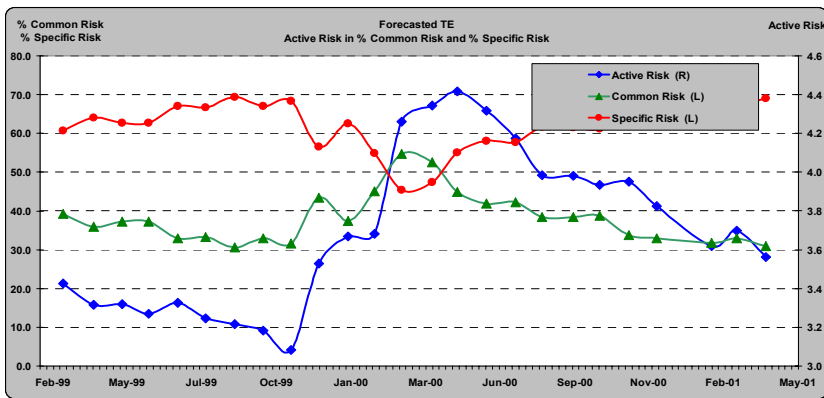
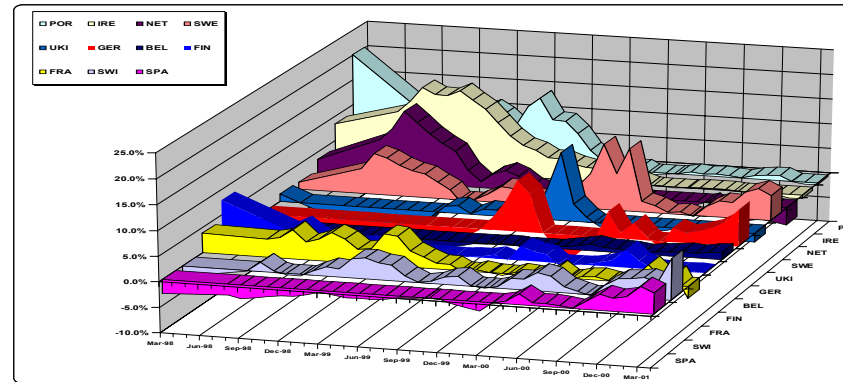
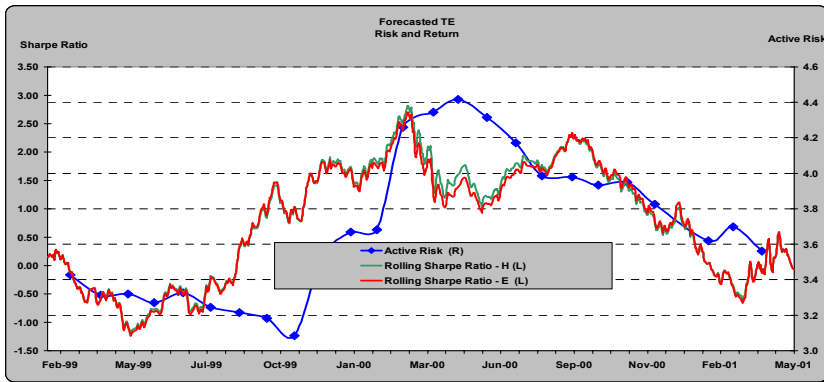
Port Return Gain

Date of Gain	Rank of Gain	SDs	Port Gain Magnitude
5-Apr-00	1	5.29	1.6%
16-Mar-00	2	3.12	0.9%
18-Apr-00	3	2.92	0.9%
23-Feb-98	4	2.91	0.9%
28-Mar-00	5	2.86	0.9%

Active Risk Budgets - Risk Signatures

Assessing Active Risk

“Active Risk Signature” How is the risk budget being spent....



Active Risk Budgets – Risk Signatures

Fund
Benchmark
Style

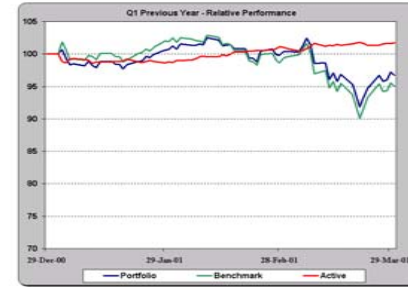
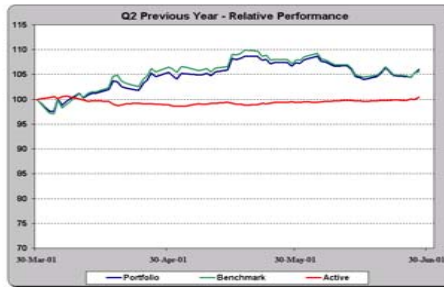
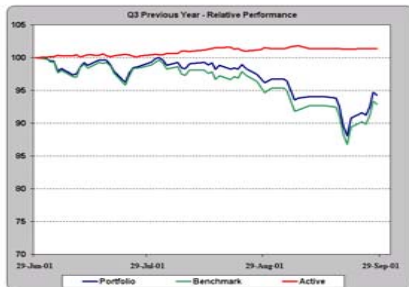
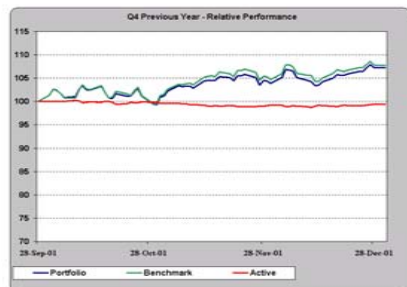
XXX EQUITY FUND
R1000V
Large Cap Value

CIO
Manager
Product

STYLE
PORTFOLIO
US Large Cap Value

Risk / Return		Beta	Return	Risk	IR
Annual	Portfolio		%4.13	%14.47	0.29
	Benchmark		%1.22	%15.88	0.08
	Active	0.90	%2.90	%3.04	0.95
		0.97			

Gain / Loss : Return / Volatility			Gain	Loss	VR
Annual	Active	Days	158	104	1.52
		Return	%19.01	(%15.90)	1.20
		Volatility	%2.62	%2.51	1.04
		IR	7.25	-6.33	

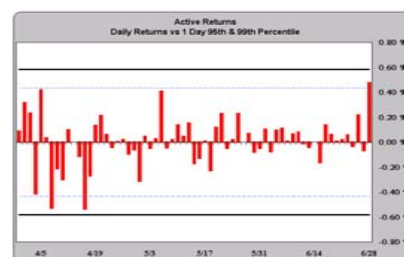
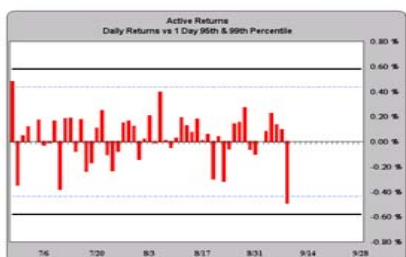
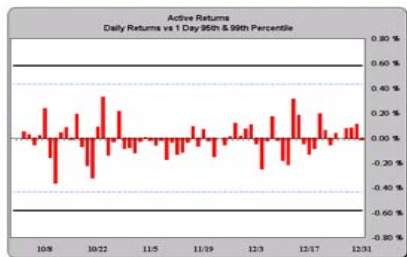


Risk / Return		Beta	Return	Risk	IR
Q4	Portfolio		%7.24	%13.05	0.55
	Benchmark		%7.82	%14.01	0.56
	Active	0.92	(%0.58)	%2.11	-0.28
		0.98			

Risk / Return		Beta	Return	Risk	IR
Q3	Portfolio		(%5.69)	%14.57	-0.39
	Benchmark		(%7.08)	%15.89	-0.45
	Active	0.91	%1.39	%2.80	0.50
		0.97			

Risk / Return		Beta	Return	Risk	IR
Q2	Portfolio		%9.10	%14.73	0.62
	Benchmark		%9.35	%16.52	0.57
	Active	0.87	(%0.25)	%4.03	-0.06
		0.95			

Risk / Return		Beta	Return	Risk	IR
Q1	Portfolio		(%5.63)	%15.22	-0.37
	Benchmark		(%7.60)	%16.61	-0.46
	Active	0.88	%1.97	%4.72	0.42
		0.92			



Gain / Loss : Return / Volatility			Gain	Loss	VR
Q4	Portfolio	Days	35	32	1.09
		Return	%24.05	(%17.85)	1.38
		Volatility	%8.22	%6.98	1.18
		IR	3.00	-2.96	
	Benchmark	Days	34	33	1.03
		Return	%26.61	(%19.24)	1.38
		Volatility	%8.89	%7.36	1.21
		IR	2.99	-2.61	
	Active	Days	31	36	0.86
		Return	%2.95	(%3.52)	0.84
		Volatility	%1.23	%1.27	0.97
		IR	2.39	-2.76	

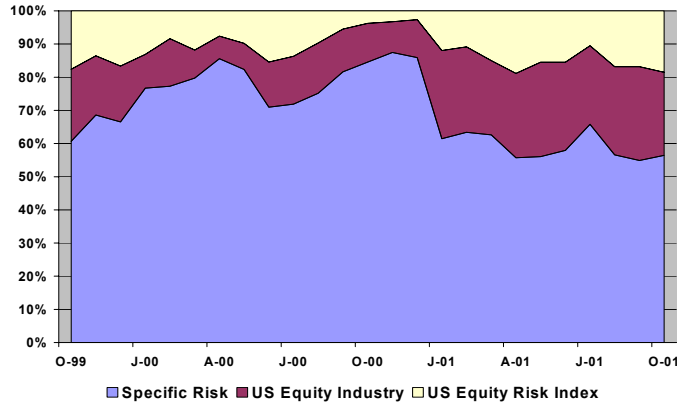
Gain / Loss : Return / Volatility			Gain	Loss	VR
Q3	Portfolio	Days	37	30	1.23
		Return	%20.05	(%24.60)	0.82
		Volatility	%5.84	%6.46	0.93
		IR	2.27	-2.60	
	Benchmark	Days	35	32	1.09
		Return	%21.37	(%27.49)	0.78
		Volatility	%9.29	%10.12	0.92
		IR	2.30	-2.72	
	Active	Days	48	19	2.53
		Return	%4.73	(%3.15)	1.50
		Volatility	%1.62	%1.68	0.97
		IR	2.91	-1.88	

Gain / Loss : Return / Volatility			Gain	Loss	VR
Q2	Portfolio	Days	34	31	1.10
		Return	%24.07	(%18.55)	1.30
		Volatility	%8.97	%7.23	1.24
		IR	2.68	-2.56	
	Benchmark	Days	33	32	1.03
		Return	%25.48	(%20.42)	1.25
		Volatility	%10.29	%7.98	1.29
		IR	2.48	-2.56	
	Active	Days	40	25	1.60
		Return	%4.56	(%4.09)	1.11
		Volatility	%1.75	%1.95	0.89
		IR	2.61	-2.10	

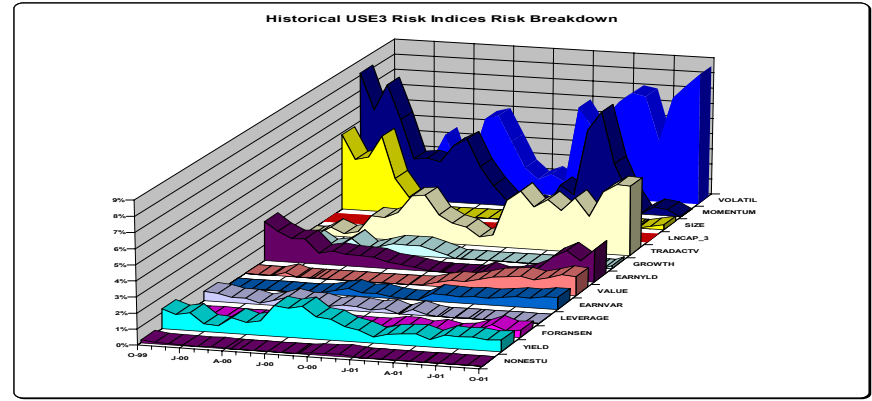
Gain / Loss : Return / Volatility			Gain	Loss	VR
Q1	Portfolio	Days	35	31	1.13
		Return	%22.46	(%26.46)	0.85
		Volatility	%8.29	%10.34	0.80
		IR	2.71	-2.96	
	Benchmark	Days	32	34	0.94
		Return	%24.89	(%31.09)	0.80
		Volatility	%6.22	%11.65	0.79
		IR	2.70	-2.67	
	Active	Days	42	24	1.75
		Return	%7.34	(%5.14)	1.43
		Volatility	%2.05	%2.86	0.72
		IR	3.57	-1.79	

Active Risk Budgets – Risk Signatures

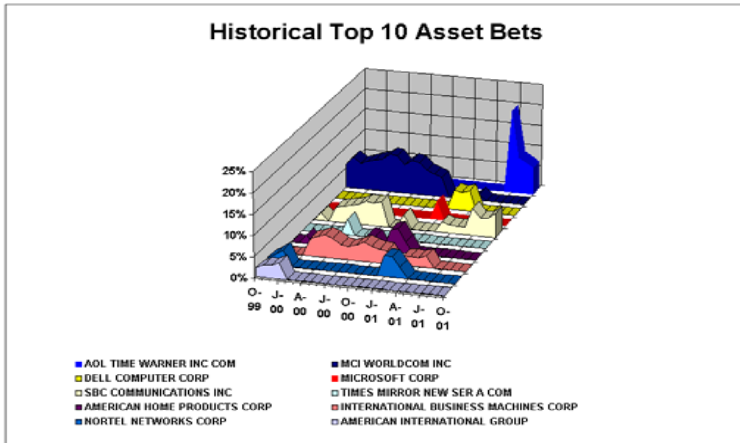
Risk Decomposition by Class of Risk



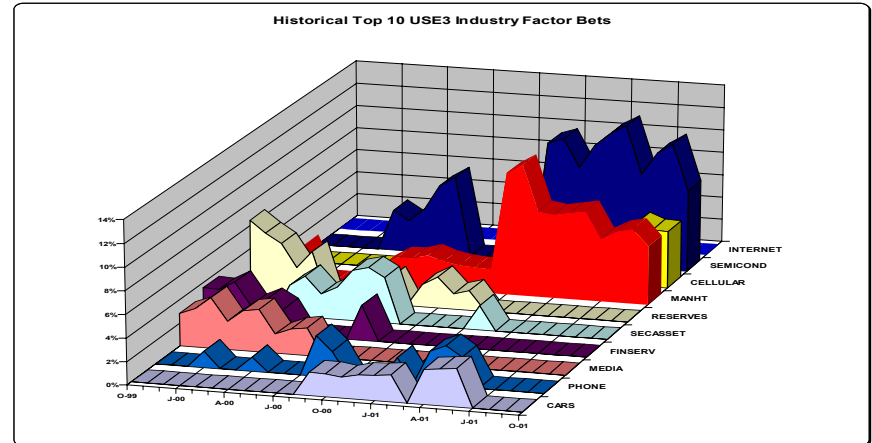
Risk Decomposition by Factor



Risk Decomposition by Asset



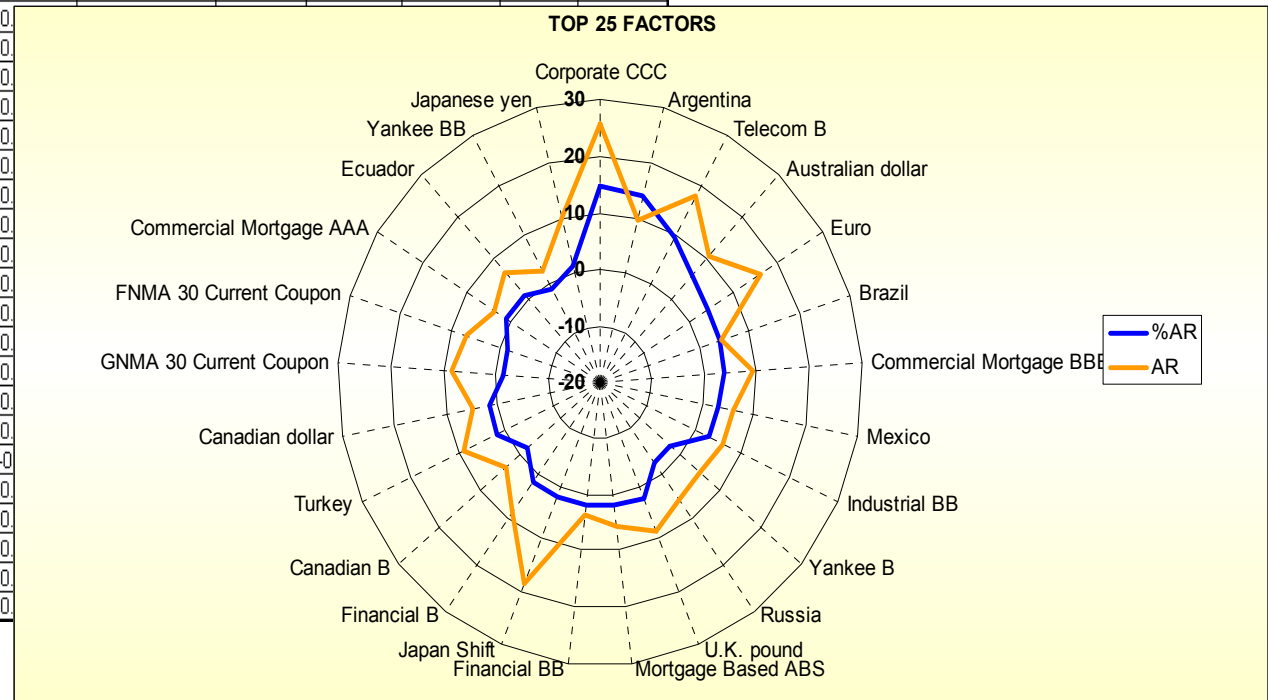
Risk Decomposition by Sector



Active Risk Budgets – Risk Signatures

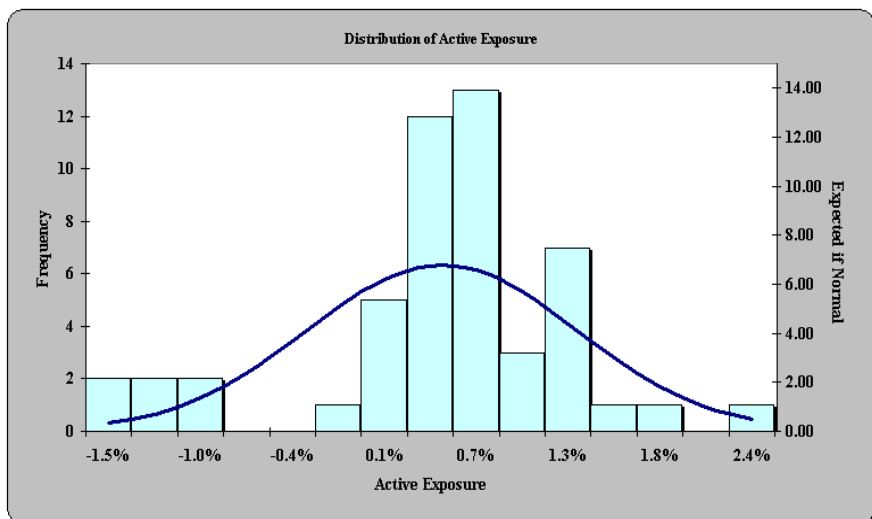
Fixed Income and FX - Risk Decomposition – Exposure and Risk

Top 25 Exposures								
Rank	By Risk Factor	Portfolio	Benchmark	Active Exposure	MCAR	CAR	%AR	Active Risk
1	Corporate CCC	0.23	0.14	0.09	1.50	0.14	14.77%	26
2	Argentina	0.04	0.09	-0.04	-3.11	0.13	13.93%	10
3	Telecom B	0.46	0.36	0.10	0.94	0.09	9.41%	18
4	Australian dollar	0.01	0.00	0.01	5.50	0.06	5.80%	10
5	Euro	0.01	0.00	0.01	0.00	0.00	0.00%	0
6	Brazil	0.01	0.00	0.01	0.00	0.00	0.00%	0
7	Commercial Mortgage BBB	0.01	0.00	0.01	0.00	0.00	0.00%	0
8	Mexico	0.01	0.00	0.01	0.00	0.00	0.00%	0
9	Industrial BB	0.01	0.00	0.01	0.00	0.00	0.00%	0
10	Yankee B	0.01	0.00	0.01	0.00	0.00	0.00%	0
11	Russia	0.01	0.00	0.01	0.00	0.00	0.00%	0
12	U.K. pound	0.01	0.00	0.01	0.00	0.00	0.00%	0
13	Mortgage Based ABS	0.01	0.00	0.01	0.00	0.00	0.00%	0
14	Financial BB	0.01	0.00	0.01	0.00	0.00	0.00%	0
15	Japan Shift	0.01	0.00	0.01	0.00	0.00	0.00%	0
16	Financial B	0.01	0.00	0.01	0.00	0.00	0.00%	0
17	Canadian B	0.01	0.00	0.01	0.00	0.00	0.00%	0
18	Turkey	0.01	0.00	0.01	0.00	0.00	0.00%	0
19	Canadian dollar	0.01	0.00	0.01	0.00	0.00	0.00%	0
20	GNMA 30 Current Coupon	-0.01	0.00	-0.01	0.00	0.00	0.00%	0
21	FNMA 30 Current Coupon	0.01	0.00	0.01	0.00	0.00	0.00%	0
22	Commercial Mortgage AAA	0.01	0.00	0.01	0.00	0.00	0.00%	0
23	Ecuador	0.01	0.00	0.01	0.00	0.00	0.00%	0
24	Yankee BB	0.01	0.00	0.01	0.00	0.00	0.00%	0
25	Japanese yen	0.01	0.00	0.01	0.00	0.00	0.00%	0



Active Risk Budgets – Risk Concentration Analysis

Active Weights and Contribution to Tracking Error (Factors/Sectors/Names)



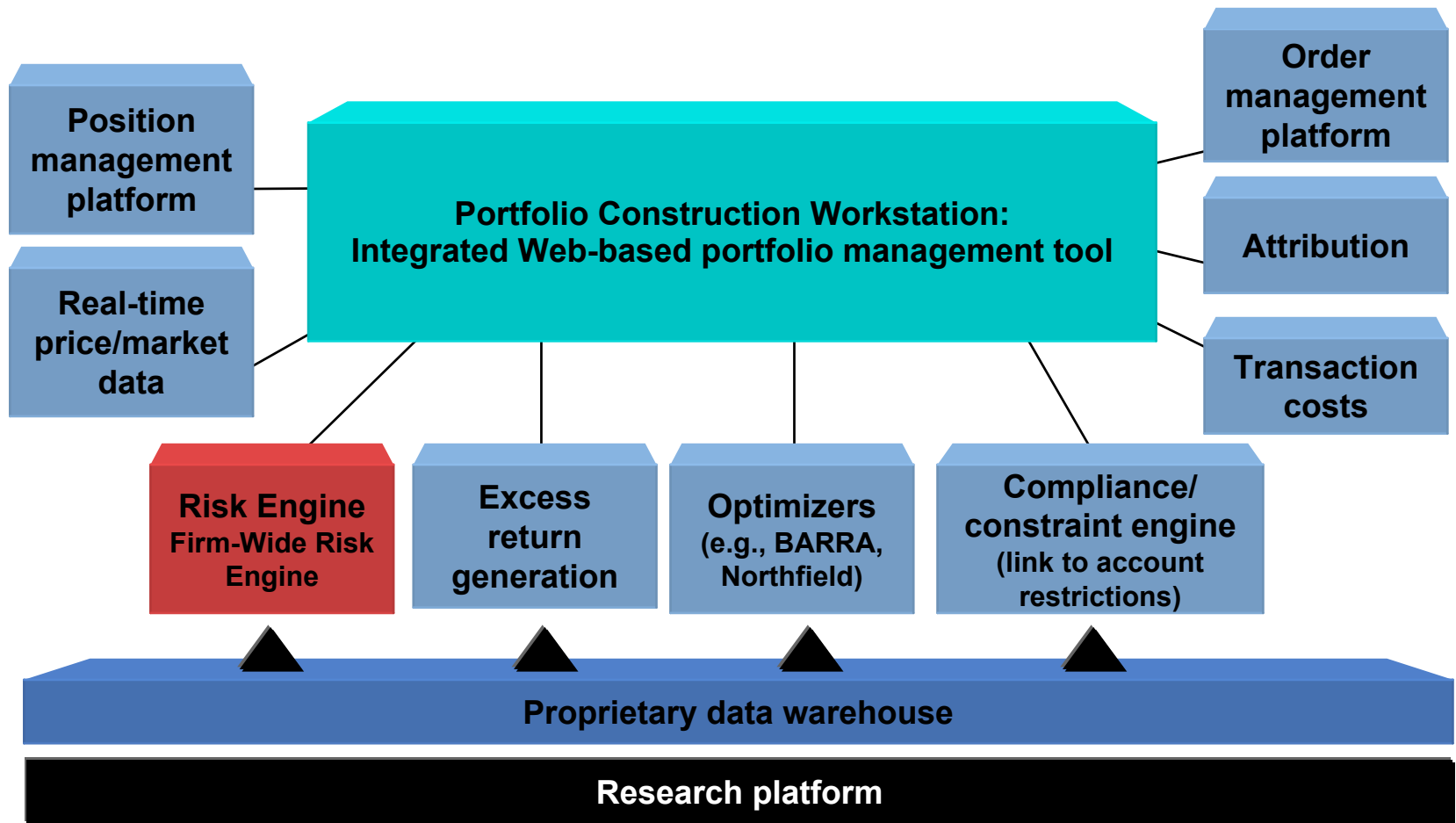
1 S&P 500 INDEX FUTURE (SP)	2.51%	50 COCA COLA COMPANY	-1.66%
2 FREDDIE MAC	1.92%	49 GENERAL ELECTRIC COMPANY	-1.54%
3 CITIGROUP INC	1.61%	48 WAL MART STORES INC	-1.33%
4 US BANCORP	1.31%	47 INTERNATIONAL BUSINESS MACHINES (-1.30%
5 AUTOZONE	1.25%	46 MERCK AND COMPANY INC	-0.95%

Security/Factor Name	% Of Overall Tracking Error	Active Exposure
Momentum	6.52%	0.105
Computer Software	6.41%	2.556 %
Size	4.67%	-0.127
Volatility	3.92%	0.065
FREDDIE MAC	3.77%	1.924 %
THE TJX COMPANIES INC	3.03%	1.237 %
INTERNATIONAL BUSINESS MACHINES CORP	2.93%	-1.302 %
AUTOZONE	2.60%	1.245 %
Trading Activity	2.57%	0.138
CISCO SYSTEMS	2.49%	-0.942 %
GENERAL ELECTRIC COMPANY	2.45%	-1.539 %
Specialty Retail	2.33%	1.971 %
Drugs	2.32%	1.911 %
CITIGROUP INC	2.23%	1.607 %

Risk Budgeting and Performance

Platform

Risk Management shares the same platform as Portfolio Construction



Summary

- Clear set of Fund of Fund objectives and mandates
- Risk Budgets based upon the identification of marginal risks
Liability, Policy and Active Levels
- Sound analysis of Fund of Funds based upon detailed decomposition of sources of Policy and Active risk (historical risk signatures, tracking error budget spending, etc.)
- Complete coverage of Asset type (Equity, Fixed Income and FX), Style and Manager coverage across multiple funds using the risk / reward decomposition to assess the individual funds relative to the entire groups of funds (aggregate Liability profile).
- Risk adjusted metrics moving through time
- Minimize the unintended, uncompensated risks (concentration risks)

Reading

Budgeting and Monitoring the Risk of Defined Benefit Pension Funds

William F. Sharpe*
STANCO 25 Professor of Finance, Emeritus, Stanford University
Chairman, Financial Engines Inc.
September, 2001

Reading

Portfolio Construction and Risk Budgeting

Bernd Scherer
Deutsche Bank Asset Management
Risk Books, 2002