GUY CARPENTER

Institute and Faculty of Actuaries

Capital (Cost) Allocation Leading Practices
A brief tour

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Capital Cost Allocation Best Practices

- Design-Driven Approach
- Core Elements:
  - Realistic framework of insurer capital usage
  - Explicit risk preferences and reward appetite
  - Key sensitivities: the Three R's
- Operational buffer

Capital (Cost) Allocation
Leading Practice Process

Leading Practice Step	Rationale
1) Design driven approach	Decide what to reflect and ignore Employ sensitivity testing
2) Realistic capital usage costs	Insurer capital is a shared asset with two distinct types of usage, Rental and Consumption Allocate the costs of its true usage to contributing lines
3) Consumption Costs via Risk Preference function	Every risk metric has an implicit risk preference function underlying it Assess capital consumption costs using risk preference function
4) Key sensitivity tests: the Three R's	Reserves, reinsurance and return periods
5) Create an operational buffer between the capital model and the field	Use a sophisticated method to produce percentage allocations which are then applicable to any total Only allocate cost of capital as far down in the organization as necessary Translate cost of capital into familiar terms – e.g., % load in target combined ratios

1) Design-Driven Approach (Six Sigma)

Capital Cost Allocation System Design
Begin with the End in Mind

- The CFO is operating an internal capital market
  - An unconstrained market of one capital supplier and numerous consumers
- Price access to this capital by any means necessary
  - What to reward and punish, emphasize and ignore
- Decide in that pricing policy whether (and how much) to reflect:
  - Time and history
  - Fact and intuition
  - Return periods
  - Risk factors
- **There is nothing inherently right or wrong about any approach**
  - Only the algorithmic expression of the risk preferences

Desirable Features Of Capital Cost Allocation Approach
Actual Example

1. Drill-Down and Roll-Up (linear)
2. Produce Strictly Positive Allocation (DM pet criteria)
3. Explainable (to key opinion leaders) Methodology (Use Test)
4. Focus on Downside not simply Volatility
5. Measure Risk at the Portfolio Level
6. Stable and Robust (particularly w/r/t updating one business unit's results)

5 and 6 are mutually exclusive

Desirable Features Of A Good Allocation Metric = Covariance

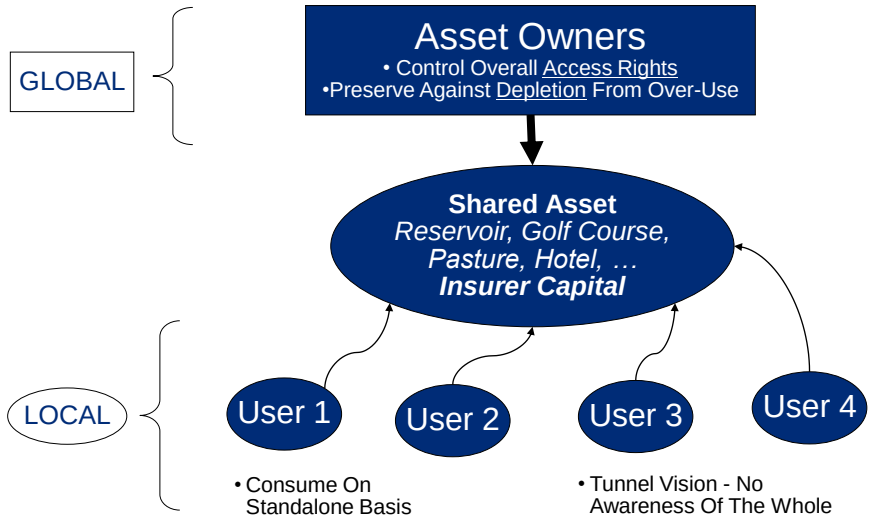
1. Drill-Down and Roll-Up	1. Yes – additive
2. Produce Strictly Positive Allocation	2. Yes –Risk Charge In Proportion Of Contribution To Total Variance
3. Explainable (to key opinion leaders) Methodology	**3.** ≈ - Implicit risk preferences are buried
4. Focus on Downside not simply Volatility	4. No – Volatility only
5. Measure Risk at the Portfolio Level	5. Yes – Total variance
6. Stable and Robust	6. No – Changes to one segment affect others

Desirable Features Of A Good Allocation Metric = Shared Asset

1. Drill-Down and Roll-Up	1. No – Interaction effects
2. Produce Strictly Positive Allocation	2. Yes – Rental + Consumption charges
3. Explainable (to key opinion leaders) Methodology	3. Yes – Intuitively Related To Opportunity Cost Of Capacity
4. Focus on Downside not simply Volatility	4. Yes – Downside based
5. Measure Risk at the Portfolio Level	5. Yes – Risk preference function defined at portfolio level
6. Stable and Robust	6. No – Changes to one segment affect others

2) Realistic Capital Cost Framework
Shared Asset – a reminder

Insurer Capital is a Shared Asset



Shared Assets Can Be Used Two Different Ways

•Consumptive Use

•Example: RESERVOIR

•***Permanent*** Transfer To The User

•Non-Consumptive Use

•Example: GOLF COURSE

•***Temporary*** Grant Of Partial Control To User For A Period Of Time

▪Both Consumptive and Non-Consumptive Use

▪Example: HOTEL

▪***Temporary*** Grant Of Room For A Period Of Time

▪Guest could destroy room or entire wing of hotel, which is ***Permanent Capacity Consumption***

An Insurer Uses Its Capital Both Ways

- **1. "Rental" Or Non-Consumptive**

➢Returns Meet Or Exceed Expectation

➢Capacity Is Occupied, Then Returned Undamaged

➢A.k.a. ***Room Occupancy***

- **2. Consumptive**

➢ Results Deteriorate

➢Reserve Strengthening Is Required

➢A.k.a. ***Destroy Your Room, Your Floor, Or Even The Entire Hotel***

Charge Each Segment for Its Capital Usage

Capital Usage Cost Calculation
Paying for the Parental Guarantee

Two Kinds Of Charges:

1. **Rental** = upfront fee for right to (possibly) use the Guarantee

   → ***Occupying underwriting capacity***

   BCAR, SPCAR, RBC, SCR, …

2. **Consumption** = contingent fee for using the Guarantee

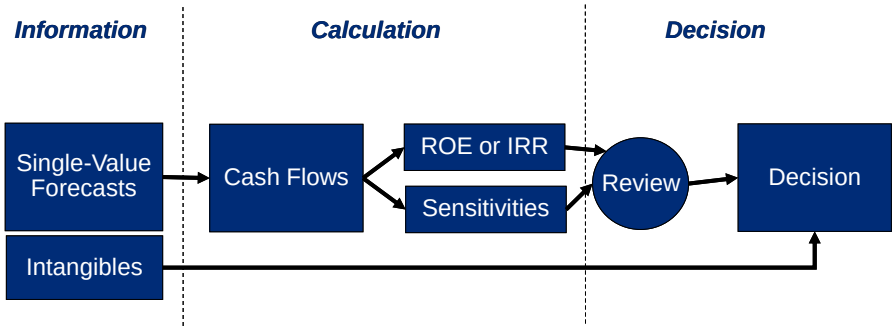
   → Function of ***Potential for Deficit*** *(Consumption)*

   Risk appetite / preference / riskiness leverage function

3) Consumption Costs via Risk Preference Function

Evolution of Decision Making

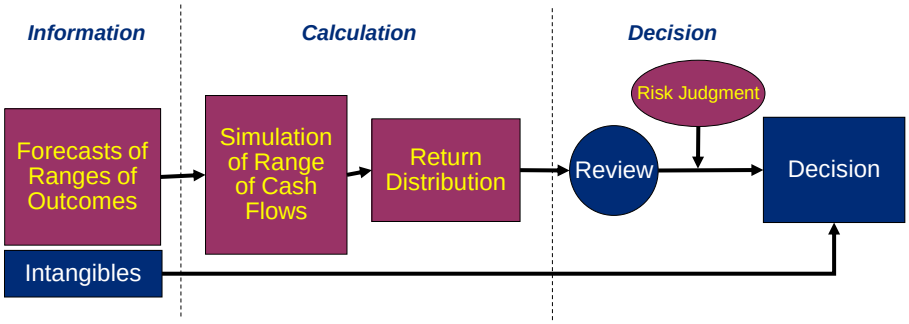
#1: Deterministic Project Analysis



- **Carl Spetzler**, "The Development of a Corporate Risk Policy for Capital Investment Decisions," *IEEE Transactions on Systems Science and Cybernetics*, Sept 1968

Next Step: Risk Analysis

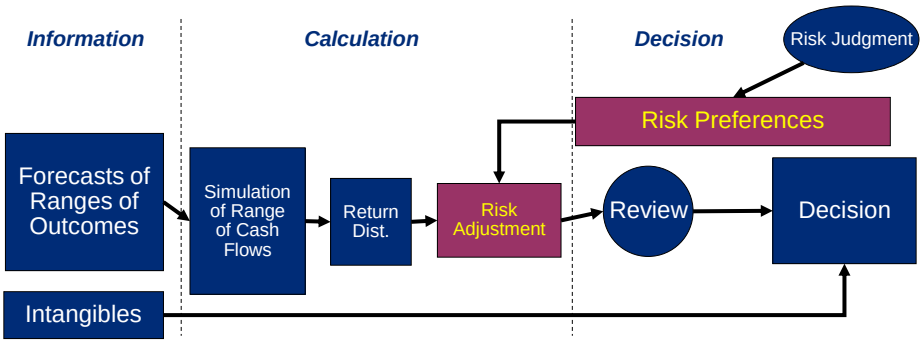
#2: Risk Analysis



- Similar to DFA or Monte Carlo processes
- Uncertainty in variables is quantified
  - Only info which is impossible/too costly to quantify remains intangible
- Judging the acceptability of alternatives ("Risk Judgment") is intuitive and specific to the decision maker

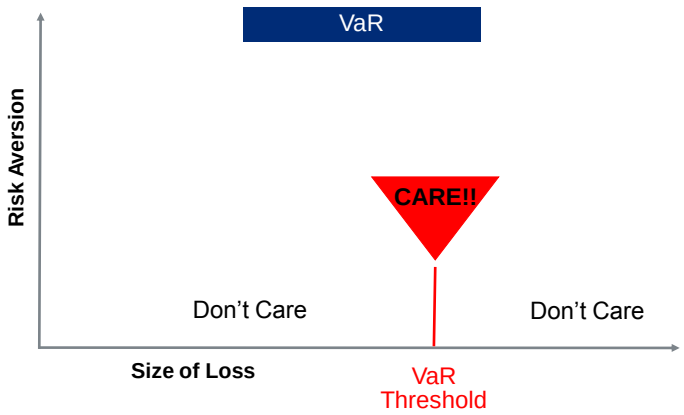
Next Step: Risk Preference Function

#3: Risk Preferences

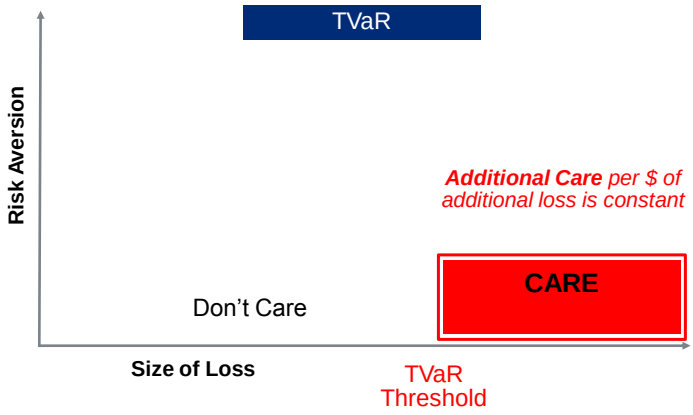


- An extension of Risk Analysis
- Intuitive risk judgment, which is applied in Risk Analysis, is quantified by means of a ***corporate Risk Preference function***
- Risk preference function does not replace judgment, but simply formalizes it so it can be ***applied consistently***

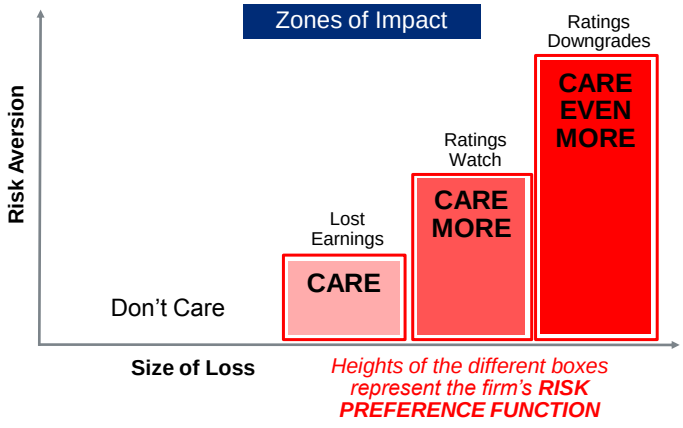
Every Approach Has an IMPLICIT Risk Preference
VaR



Every Approach Has an IMPLICIT Risk Preference
TVaR



Every Approach Has an IMPLICIT Risk Preference
"Zones of Impact" of Capital (Company X)



Riskiness Leverage Functions
Translating Risk Preferences into Capital Cost Allocation

- Rodney Kreps (2005)
- Simple idea: reflect risk opinion in a quantitative manner at the simulated scenario level
- More formally "$R = \int L(x)(x-\mu)f(x)\,dx$" where R is the risk load and L is the leverage function
- Use the whole curve
- The Use Test in Action
- We will walk through a simple example

Riskiness Leverage Functions
Simple Example

- We have ten realizations from a stochastic model for the overall business
- Sort the realizations in ascending order on total loss.
- The average total loss is the sum of the average loss for each segment.
- If we have zero aversion to risk, we could allocate capital to these lines of business based on the broken-out average.
- Equivalently, we are allocating capital based on the weighted average scenario, where the weights are each one.

Realization	Business Segment Losses A	B	C	Total
1	498	595	-	1,093
2	241	1,718	104	2,064
3	2,125	684	226	3,035
4	417	97	2,546	3,061
5	535	3,742	-	4,278
6	6,978	122	93	7,193
7	158	143	11,788	12,089
8	19,027	98	-	19,125
9	1,476	192	29,386	31,053
10	508	1,689	76,494	78,691
Average	3,196	908	12,064	16,168
Percentage	20%	6%	75%	100%

VaR (Value-at-Risk) and Contribution Measures

- We may decide to assign the 'most-important' pain point a weight of one, and zero weight to all other realizations.
- That point would be called VaR (Value-At-Risk), in this case at the 90th percentile.
- The contributions to VaR from individual segments add up to the total VaR, because the realization is one complete scenario.
- The contributing average amounts are called co-VaR.
- The Risk Charge is the excess of the weighted average over the straight average.
- Co-VaR is generally an unstable measure for capital allocation.

Realization	Weight	Business Segment Losses A	B	C	Total
1	0.0	498	595	-	1,093
2	0.0	241	1,718	104	2,064
3	0.0	2,125	684	226	3,035
4	0.0	417	97	2,546	3,061
5	0.0	535	3,742	-	4,278
6	0.0	6,978	122	93	7,193
7	0.0	158	143	11,788	12,089
8	0.0	19,027	98	-	19,125
9	**1.0**	1,476	192	29,386	31,053
10	0.0	508	1,689	76,494	78,691
	Straight Ave	3,196	908	12,064	16,168
	Wght Ave	1,476	192	29,386	31,053
	Percentage	5%	1%	95%	100%
				Risk Charge	**14,885**

Probability Transforms
An easy way to define smooth weights

- One way to define the weights is with a probability transform. The weights are defined by a curve *that effectively makes adverse realizations more likely*.
- The weights are a smooth way to recognize that the worst results are even more painful than the proportional size of their losses.
- Curve shape can be altered by changing parameter values, but only so much.
- In this example, we show a Wang transform. There are other curves.

Realization	Weight	Business Segment Losses A	B	C	Total
1	1.0	498	595	-	1,093
2	1.9	241	1,718	104	2,064
3	2.7	2,125	684	226	3,035
4	3.7	417	97	2,546	3,061
5	4.8	535	3,742	-	4,278
6	6.1	6,978	122	93	7,193
7	8.0	158	143	11,788	12,089
8	10.7	19,027	98	-	19,125
9	15.4	1,476	192	29,386	31,053
10	34.6	508	1,689	76,494	78,691
	Straight Ave	3,196	908	12,064	16,168
	Wght Ave	3,353	993	36,050	40,397
	% Allocation	8%	2%	89%	100%
				Risk Charge	**24,228**

Utility Transforms
Another way to define weights using total loss

- Another family of weighting schemes defines the curve with formulas that depend on total loss, *in other words the pain-per-dollar is explicitly changing*.
- It's still just a way to calculate this realization weights.
- These weights are an Esscher transform with h=.45.
- The curve has a different shape than that of the Wang transform, but we chose h=.45 to provide the same risk loading overall.

Realization	Weight	Business Segment Losses A	B	C	Total
1	1.0	498	595	-	1,093
2	1.0	241	1,718	104	2,064
3	1.1	2,125	684	226	3,035
4	1.1	417	97	2,546	3,061
5	1.1	535	3,742	-	4,278
6	1.2	6,978	122	93	7,193
7	1.4	158	143	11,788	12,089
8	1.7	19,027	98	-	19,125
9	2.3	1,476	192	29,386	31,053
10	8.7	508	1,689	76,494	78,691
Straight Ave		3,196	908	12,064	16,168
Wght Ave		2,537	1,120	36,739	40,397
% Allocation		6%	3%	91%	100%
				Risk Charge	**24,228**

Weighted TVaR
Explanation of the Statistic

- $TVaR_{50}$ (Tail Value at Risk at the 50th Percentile) is the average total loss for all realizations larger than the 50th percentile.
- The arbitrary threshold of the 50th percentile is chosen to quantify risk preferences.
- Co-$TVaR_A$ is the average losses from business segment A over the same realizations. Note that these realizations are not in strict ascending order for segment A losses.

Realization	Business Segment Losses A	B	C	Total
1	498	595	-	1,093
2	241	1,718	104	2,064
3	2,125	684	226	3,035
4	417	97	2,546	3,061
5	535	3,742	-	4,278
6	6,978	122	93	7,193
7	158	143	11,788	12,089
8	19,027	98	-	19,125
9	1,476	192	29,386	31,053
10	508	1,689	76,494	78,691

				$TVaR_{50}$
Co-$TVaR_{50}$	5,629	449	23,552	29,630
Percentage	19.0%	1.5%	79.5%	100.0%

TVaR Thresholds (Return Periods)

- If we chose the 80th percentile (i.e. 1 in 5 Return Period), the TVaR is larger.
- In this example, the tail risk is driven by Business Segment C. The allocation to C is more at the higher threshold.
- To allocate capital to support different levels of adverse loss events, we can weight the two TVaRs together. We will have to choose the weights.

Business Segment Losses

Realization	A	B	C	Total
1	498	595	-	1,093
2	241	1,718	104	2,064
3	2,125	684	226	3,035
4	417	97	2,546	3,061
5	535	3,742	-	4,278
6	6,978	122	93	7,193
7	158	143	11,788	12,089
8	19,027	98	-	19,125
9	1,476	192	29,386	31,053
10	508	1,689	76,494	78,691

$TVaR_{80}$

Co-$TVaR_{80}$	992	940	52,940	54,872
Percentage	1.8%	1.7%	96.5%	100.0%

$TVaR_{50}$

Co-$TVaR_{50}$	5,629	449	23,552	29,630
Percentage	19.0%	1.5%	79.5%	100.0%

TVaR Weighting

- Let's assign a weight of 43% to Co-$TVaR_{80}$ and 57% to Co-$TVaR_{50}$. The resulting weighted total TVaR is 40,397, producing the the same risk charge as in the previous examples.

Weight		A	B	C	Total
0.43	Co-$TVaR_{80}$	992	940	52,940	54,872
	Percentage	1.8%	1.7%	96.5%	100.0%
0.57	Co-$TVaR_{50}$	5,629	449	23,552	29,630
	Percentage	19.0%	1.5%	79.5%	100.0%
Weighted	Co-$TVaR_{Wgt}$	3,651	658	36,087	40,397
Total	Percentage	9.0%	1.6%	89.3%	100.0%

Weighted TVaR Under the Scenario View

- By using two TVaR measures we describe our preferences between different 'zones' of the loss distribution.

- The preferences 1 and 2.9 over the two zones can be directly calculated from the 43%/57% weights and the thresholds of 50th and 80th percentile.

- The realization weights are a step function. Each step (there can be more than two) occurs at an important capital management point, (e.g. earnings miss, single downgrade, solvency impairment).

Realization	Weight	Business Segment Losses A	B	C	Total
1	0.0	498	595	-	1,093
2	0.0	241	1,718	104	2,064
3	0.0	2,125	684	226	3,035
4	0.0	417	97	2,546	3,061
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8	1.0	19,027	98	-	19,125
9	2.9	1,476	192	29,386	31,053
10	2.9	508	1,689	76,494	78,691
Straight Ave		3,196	908	12,064	16,168
Wght Ave		3,651	658	36,087	40,397
% Allocation		9%	2%	89%	100%
				Risk Charge	**24,229**

5) Operational Buffer

Operational Buffer
AKA "Resist the urge to allocate capital to the policy level"

- Loaded terminology: allocation, capital, ROE
- Mixed stakeholder audiences: profit center heads, finance, actuarial
- Issues with "Allocating Capital":
  - Balancing to published figures
  - Responding to changes during the year
  - Producing granular ROEs requires allocation of other things (e.g., investment income)
- What is the operational goal?
  - Risk-adjusted performance evaluation
- Best practice
- Allocate to the lowest necessary level but no further
- Treat the capital costs as ***risk-based overhead expense***
  - Carry costs of the Shared Asset
- Below there, treat it like any other expense load
- Use your existing target PLR or CR frameworks
- Simplifies the transition and updating

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