

2017 SOA Annual Meeting & Exhibit

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Session 101, Methods to Evaluate Retirement Plan Designs

October 17, 2017



SOCIETY OF ACTUARIES

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- **Do** leave a meeting where any anticompetitive pricing or market allocation discussion occurs.
- **Do** alert SOA staff and/or legal counsel to any concerning discussions
- **Do** consult with legal counsel before raising any matter or making a statement that may involve competitively sensitive information.

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Background





A System to Evaluate and Compare Defined Contribution Plans



September 2016

Background

- A framework to evaluate the value and effectiveness of a DC plan
- Used to compare DC programs and highlight strengths and weaknesses
- Considers quantitative and qualitative features

<https://www.soa.org/research-reports/2016/system-evaluate-contributions/>

The screenshot shows a webpage with a grey header containing a menu icon on the left and 'MY SOA' with a dropdown arrow on the right. The main content area is white and features a large heading, a paragraph of text, and a list of names. A right-hand sidebar is titled 'Related Links' and contains three links with file type icons (PDF, XLS, PDF) and a link for 'Questions About Research Reports?' with an email address.

A System to Evaluate and Compare Defined Contribution Plans

The Society of Actuaries' Pension Section is pleased to make available material that develops an actuarial framework for assessing defined contribution retirement plan benefits. The report was authored by Marc Des Rosiers.

To access the material, click on the links to the right.

If you have any questions or comments regarding the report, please contact Steve Siegel, Research Actuary at ssiegel@soa.org.

The SOA's Pension Section would like to thank the following individuals for their input on the project:

- Dylan Porter, Chair
- Michael Economos
- Cindy Levering
- Andrea Sellars
- Joe Tomlinson
- Jack VanDerhei
- Steven Siegel, SOA Research Actuary
- Andrew Peterson, SOA Staff Fellow
- Barbara Scott, SOA Research Administrator

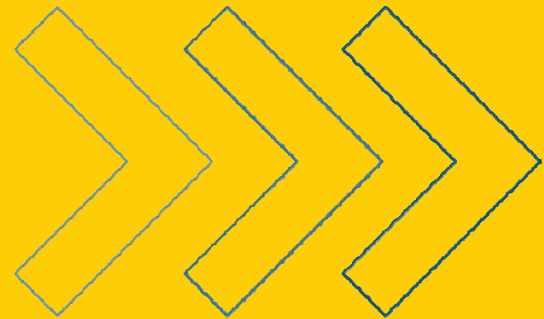
Related Links

- [A System to Evaluate and Compare Defined Contribution Plans](#) PDF
- [A System to Evaluate and Compare Defined Contribution Plans](#) XLS
- [A System to Evaluate and Compare Defined Contribution Plans - Presentation](#) PDF
- Questions About Research Reports?**
research@soa.org

Principles governing framework

- Evaluation of plans, not an individual
- Each feature compared against range of existing possibilities
- Range of features applicable to particular plan size/industry
- Measure of ongoing plan success
- Shared responsibility between member and sponsor/employer
- Importance of auto features (auto-enrollment and auto-escalation)

Objective Function



Objective Function

- Assigns a value between 0% and 100% to a DC plan
- Weights for each criterion (or subcriterion) add up to 100%
- Plan value is sum of the product of each criterion's weight times its value

Objective Function Has Two Versions

- Based on plan terms only, without regard to existing participant experience

$$\text{Plan value} = (\text{Provisions}) \times w_1 + (\text{Adequacy}) \times w_2 + (\text{Other criteria}) \times w_3$$

- Based on both plan terms and existing participant experience

$$\text{Plan value} = (\text{Provisions}) \times w_1 + (\text{Adequacy}) \times w_2 + (\text{Other criteria}) \times w_3 + (\text{Plan success}) \times w_4$$

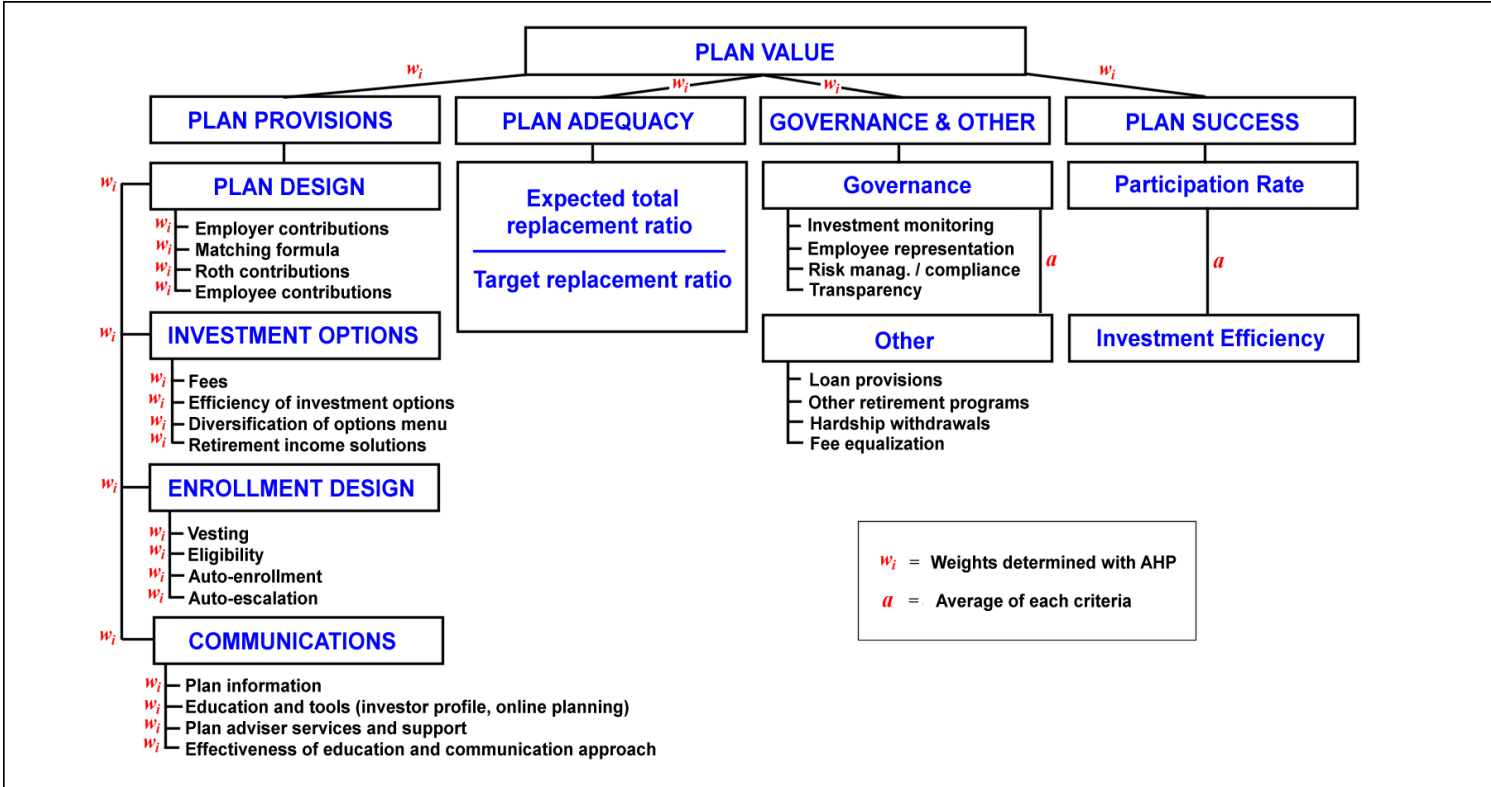
where w_i are weights assigned to each of the main criteria

Overview of Model

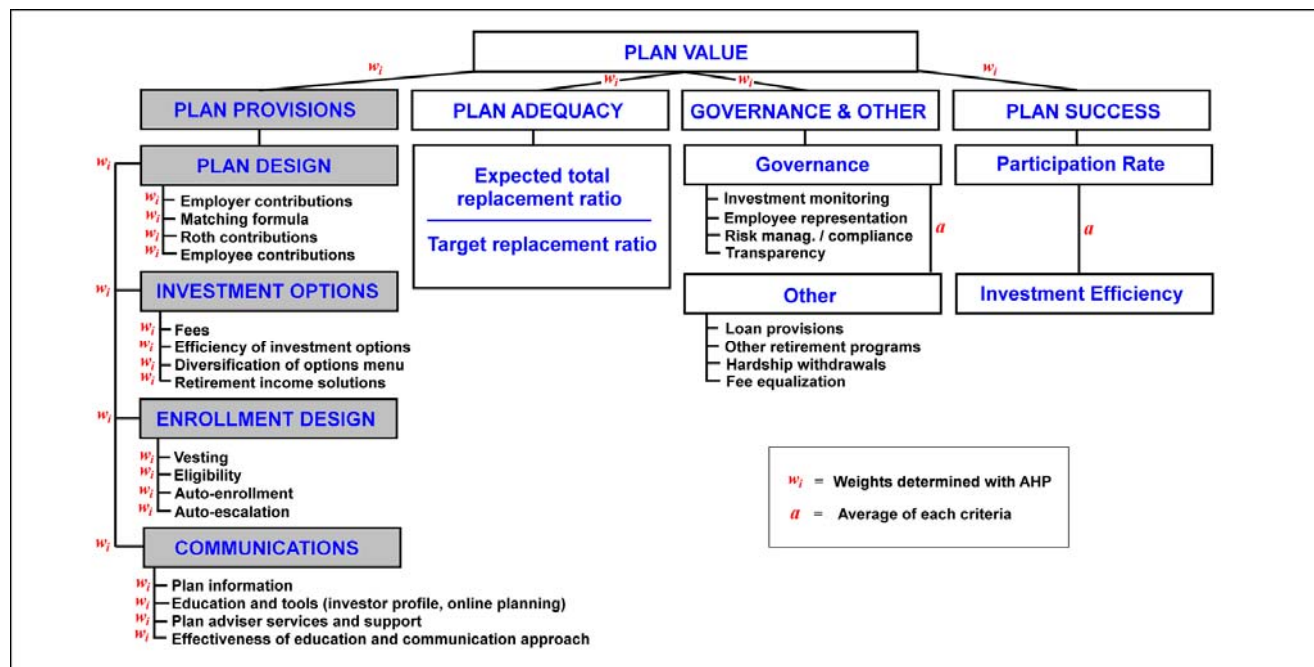


Other Models

- BrightScope
 - Quantitative and qualitative details
 - Highlights plan strengths and weaknesses
 - Nonmonetary features makes it comprehensive
 - Benefit adequacy
- Watson Wyatt study
 - Measures benefit adequacy, plan success and investment efficiency
- BrightScope and PLANSPONSOR
 - Data sources to determine range of plan features in the market



Plan Provisions Subcriteria



Plan design

Criteria	Value
Employer contributions	$\min(\text{Employer contribution rate}, 9\%)/9\%$
Matching formula	$\min(\text{Employer matching percentage}, 100\%)$
Availability of Roth contribution option	Available: 100%; Not available: 0%
Employee contributions	Available: 100%; Low: 50%; None: 0%

Investment options

Criteria	Value
Fees	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Efficiency of investment options	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Diversification of options menu	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Retirement income solutions	Qualitative assessment of 0%, 25%, 50%, 75% or 100%

1	PLAN PROVISIONS	Weight for Criteria	Weight Subcriteria	Subcriteria Value		Plan Analysis
	<u>Plan design</u>					
	<i>Subcriteria:</i>					<i>Describe provision and give a score of 0% to 100%.</i>
A	Employer contributions		70%	56%		Up to 5% of basic salary + bonus
B	Matching formula		10%	100%		Matching is 100% of contributions up to 5% Each pay period
			<i>(info for Report worksheet) Match frequency?</i>			
C	Availability of Roth contributions		10%	100%		Available option
D	Employee contributions		10%	100%		Up to a maximum of 12%
			100%			
			<i>Subcriteria value:</i>	69%		
		61%	<i>Subcriteria weight:</i>			
			<i>Value * Weight:</i>		42%	
	<u>Investment Options</u>					
	<i>Subcriteria:</i>					<i>Describe provision and select rating:</i>
A	Fees		51%	100%	Excellent	Fees are 45 bps for assets of \$250 M
B	Efficiency of investment options		8%	75%	Very Good	Menu has limited number of options; index funds are offered
C	Diversification of options menu		8%	75%	Very Good	12 fund options
D	Retirement income solutions		33%	25%	Fair	Systematic withdrawals offered
			100%			
			<i>Subcriteria value:</i>	71%		
		15%	<i>Subcriteria weight:</i>			
			<i>Value * Weight:</i>		11%	

Enrollment design

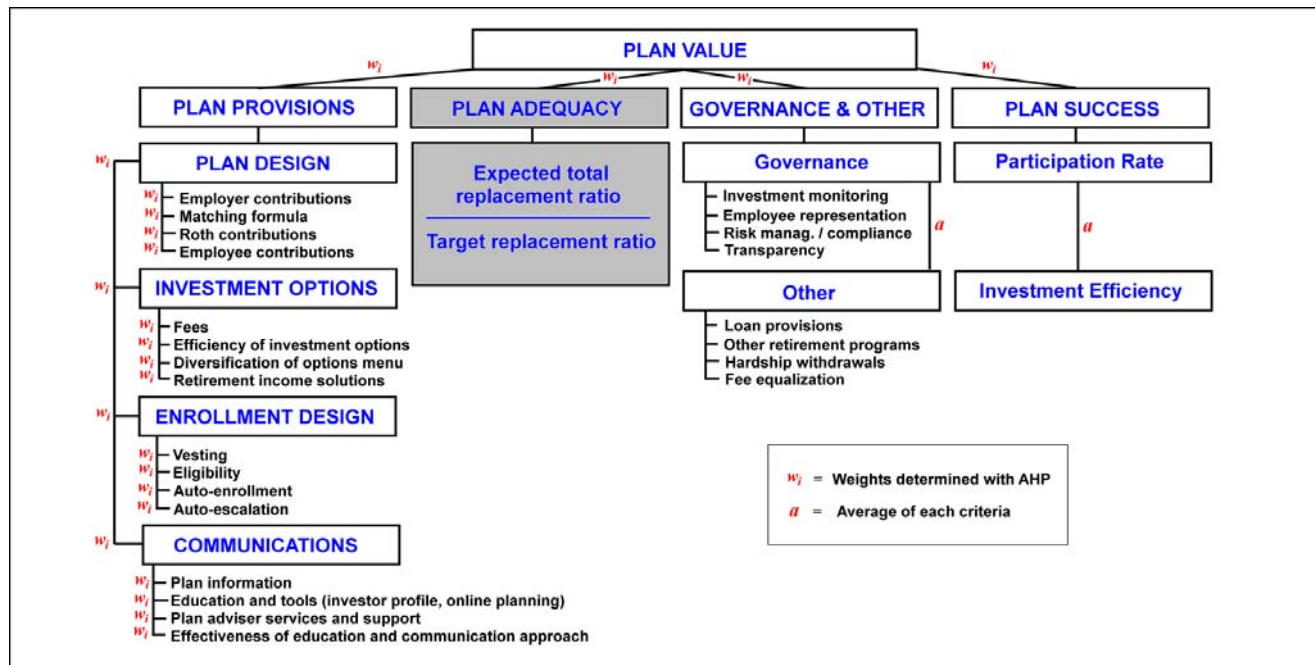
Criteria	Value
Vesting	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Eligibility	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Auto-enrollment	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Auto-escalation	Qualitative assessment of 0%, 25%, 50%, 75% or 100%

Communications

Criteria	Value
Plan information	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Education and tools (investor profile, online planning)	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Plan adviser services and support	Qualitative assessment of 0%, 25%, 50%, 75% or 100%
Effectiveness of education and communication approach	Qualitative assessment of 0%, 25%, 50%, 75% or 100%

Enrollment Design					
<i>Subcriteria:</i>					<i>Describe provision and select rating:</i>
A	Vesting	38%	50%	Good	20% with 2 years to 100% at 4 years
B	Eligibility	7%	50%	Good	Hourly and salaried after one year of service
C	Auto-enrollment	37%	100%	Excellent	Yes with 3.00% default
D	Auto-escalation	18%	100%	Excellent	Yes annual 0.50% increase to 6%
		100%			
		<i>Subcriteria value:</i>		78%	
		<i>Subcriteria weight:</i>	15%		
		<i>Value * Weight:</i>		12%	
Communications					
<i>Subcriteria:</i>					<i>Describe provision and select rating:</i>
A	Plan information	12%	75%	Very Good	Online account statements, electronic delivery
B	Education and tools	13%	75%	Very Good	Online access, robust tools
C	Plan adviser services and support	35%	25%	Fair	Annual seminar for pre-retirees
D	Effectiveness of education and communication approach	40%	25%	Fair	Appropriate for employee group
		100%			
		<i>Subcriteria value:</i>		38%	
		<i>Subcriteria weight:</i>	9%		
		<i>Value * Weight:</i>		3%	
		<i>Total:</i>	100%		
Plan value based on benefits provided				68%	

Plan Adequacy

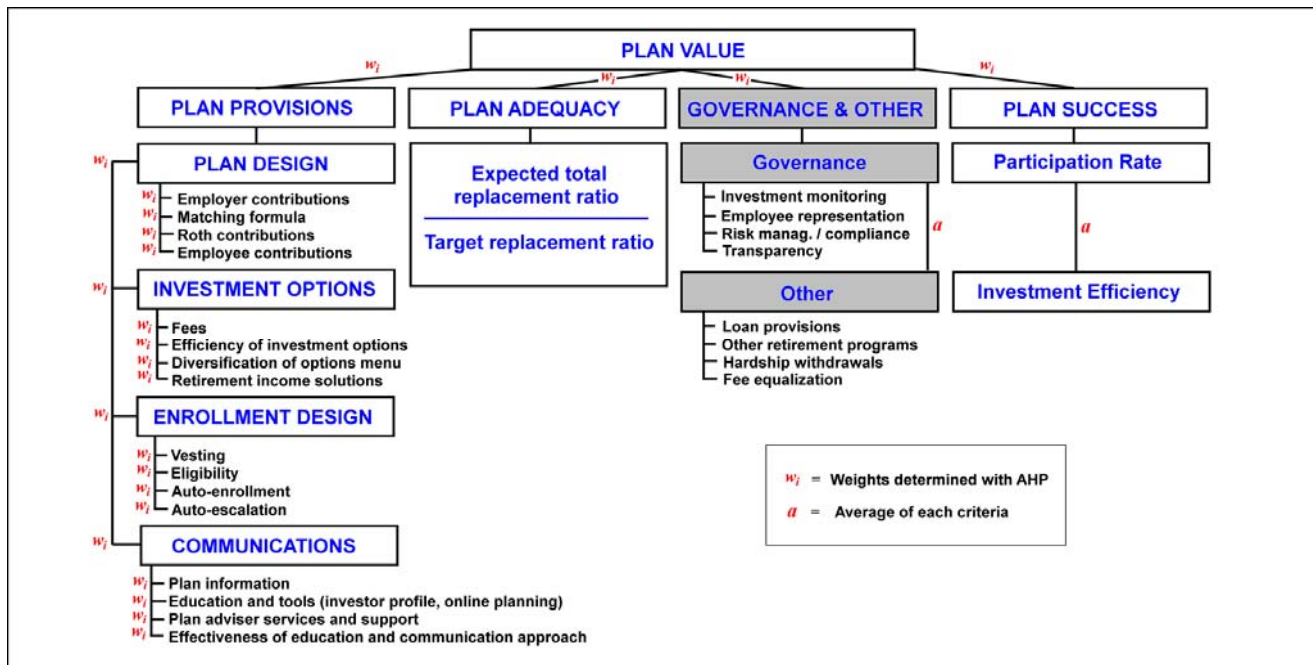


Plan Adequacy

- Value for plan adequacy =
$$\frac{\text{Expected total replacement ratio}}{\text{Target replacement ratio over full career}}$$
- *Expected total RR* = (Social security RR) + (Other employer-provided RR) + (Plan RR)
- *Social security RR* = Average social security RR based on income level
- *Other employer-provided pension RR* = Replacement ratio provided by another employer-sponsored pension plan over full career
- *Plan RR* =
$$\frac{\text{Accumulated assets at retirement as a multiple of real pay}}{\text{Annuity certain to end of life expectancy}}$$
- *Target RR* = Target replacement ratio required to provide adequate retirement income
- Based on employee and employer contribution accumulations, includes auto-escalation

2	PLAN ADEQUACY			
	<i>Sample data for adequacy calculations</i>	<i>Long service</i>	<i>Medium</i>	<i>Short</i>
	Entry age	35	45	55
	Retirement age	65	65	65
	Life expectancy	90	90	90
	Include auto escalation	No <input type="button" value="v"/>		
		<i>Value</i>		
A	Target replacement ratio	70%		
B	Social security replacement ratio	40%		
C	Other employer-provided pension replacement ratio	0%		
	Net replacement ratio [A - B - C]	30%		
	Average employer contribution as a percent of pay	5.0%		
	Average employee contribution as a percent of pay	5.0%		
	Expected annual real rate of return	2%	2%	2%
	Accumulation factor	40.97	24.54	11.06
	Accumulated assets at retirement as a multiple of real pay	4.10	2.45	1.11
	Annuity real discount rate	1%	1%	1%
	Annuity certain to end of life expectancy	22.13	22.13	22.13
	Plan replacement ratio	19%	11%	5%
	<i>employee portion</i>	10.0%	6.0%	3.0%
	<i>employer portion</i>	9.0%	5.0%	2.0%
	Expected total replacement ratio	59%	51%	45%
	Plan value based on replacement ratio	84%	73%	64%

Governance & Other



Governance criteria

- Investment monitoring and review process
- Employee committee representation
- Risk management framework and compliance
- Transparency

Qualitative assessment of 0%, 25%, 50%, 75% or 100%

Value is average of all criteria

“Other” Criteria

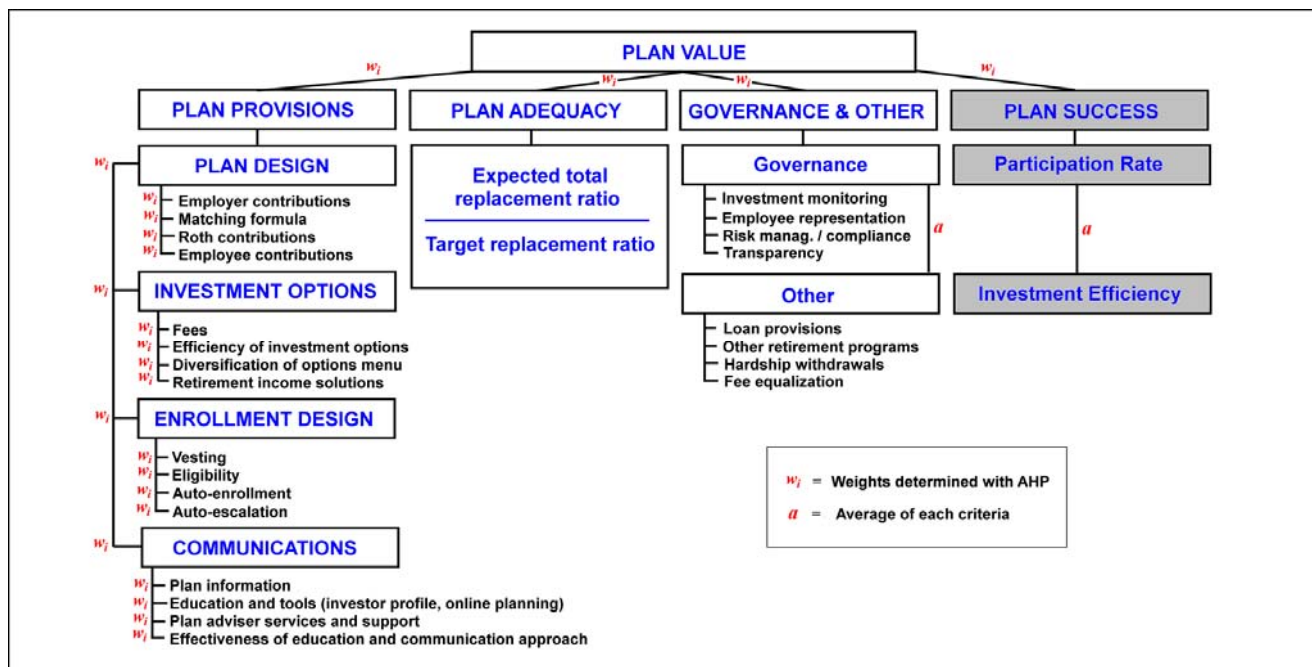
- Loan provisions
- Other retirement programs with employer
- Hardship withdrawal provisions
- Fee equalization policy

Qualitative assessment of 0%, 25%, 50%, 75% or 100%

Value is average of all criteria

3	OTHER CRITERIA			<u>Value</u>	
	<u>Governance</u>				
					Select rating:
A	Investment monitoring and review process			25%	Fair
B	Employee committee representation			0%	No
C	Risk management framework and compliance			25%	Fair
D	Transparency			25%	Fair
	<u>Other</u>				
					Select rating:
A	Loan provisions			75%	Very Good
B	Presence of other retirement programs with employer			0%	No
C	Hardship withdrawal provision			0%	Poor
D	Fee equalization policy			0%	Poor
	Value for governance and other provisions				19%

Plan Success



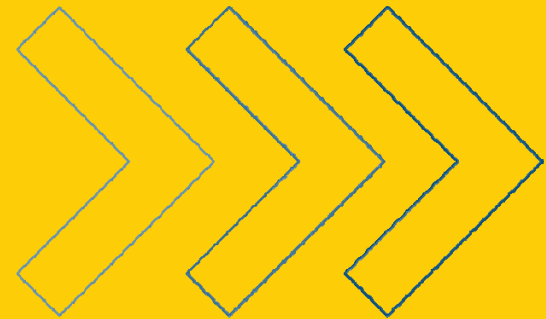
Participation Rate

- Participation = $\frac{\text{Actual participation rate}}{\text{Expected participation rate}}$
- Actual participation rate = (Number of plan members)/(Number of eligible employees)
- Expected participation rate = Estimated participation rate for plan size or industry

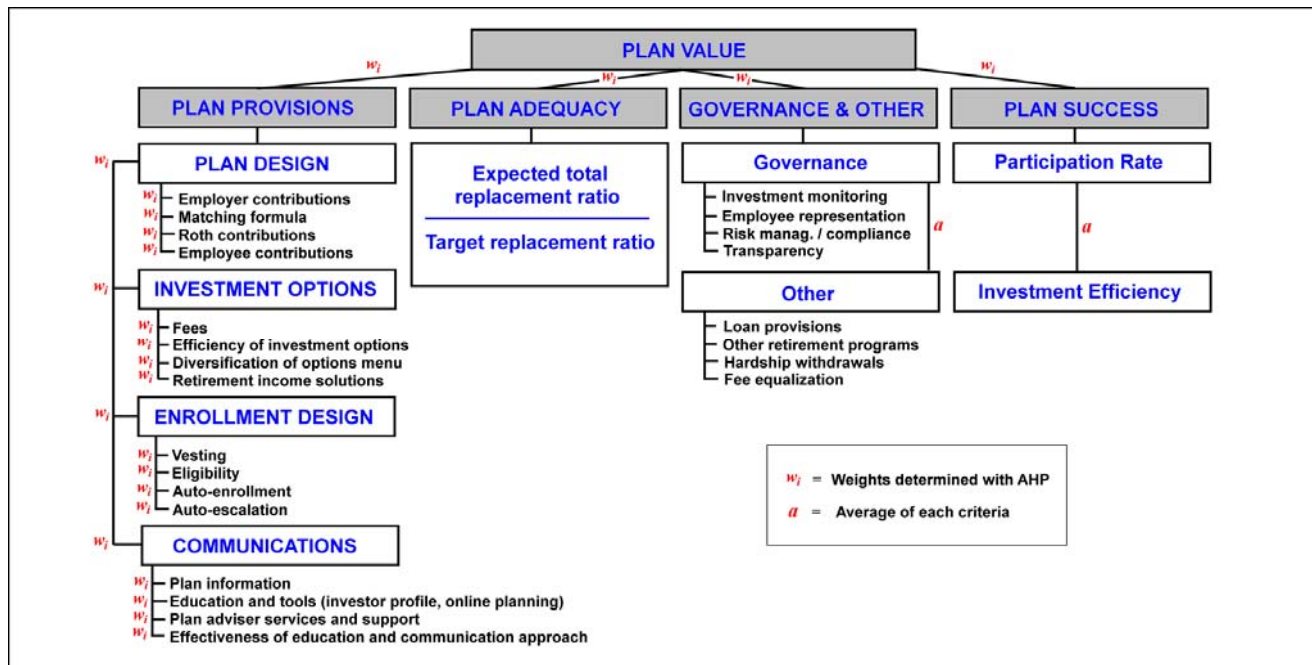
Investment Efficiency

- Investment efficiency = $\frac{\text{Actual percentage of diversified equities}}{\text{Optimal equity level}}$
- Investment efficiency = $100\% - \frac{|\text{Optimal equity level} - \text{Actual percentage of diversified equities}|}{\text{Optimal equity level}}$
- Actual percentage of diversified equities = Plan assets invested in diversified equities, excluding company stock
- Optimal equity level = $100\% - \text{Participant's average age} / 100$

Objective Function Results



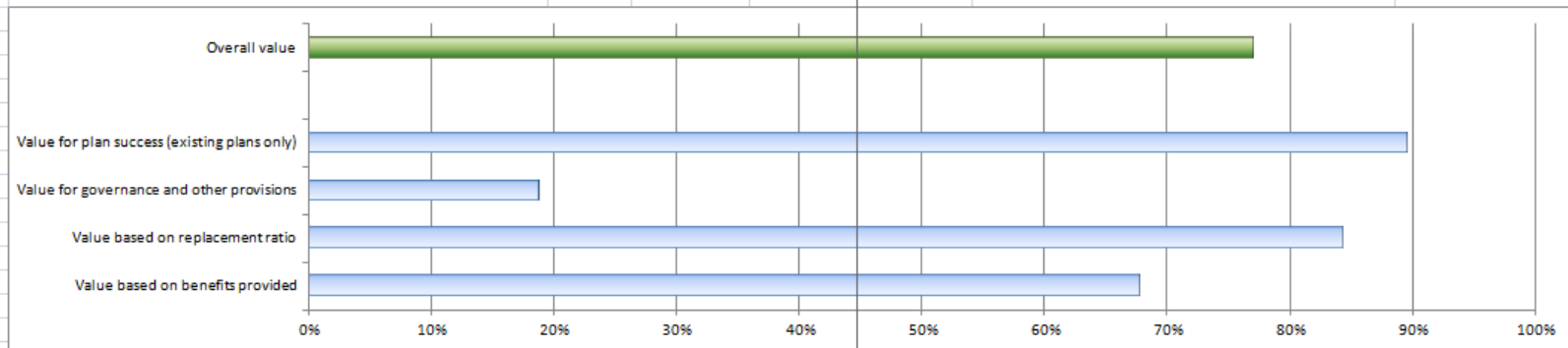
Top Level Function



Objective Function Weights

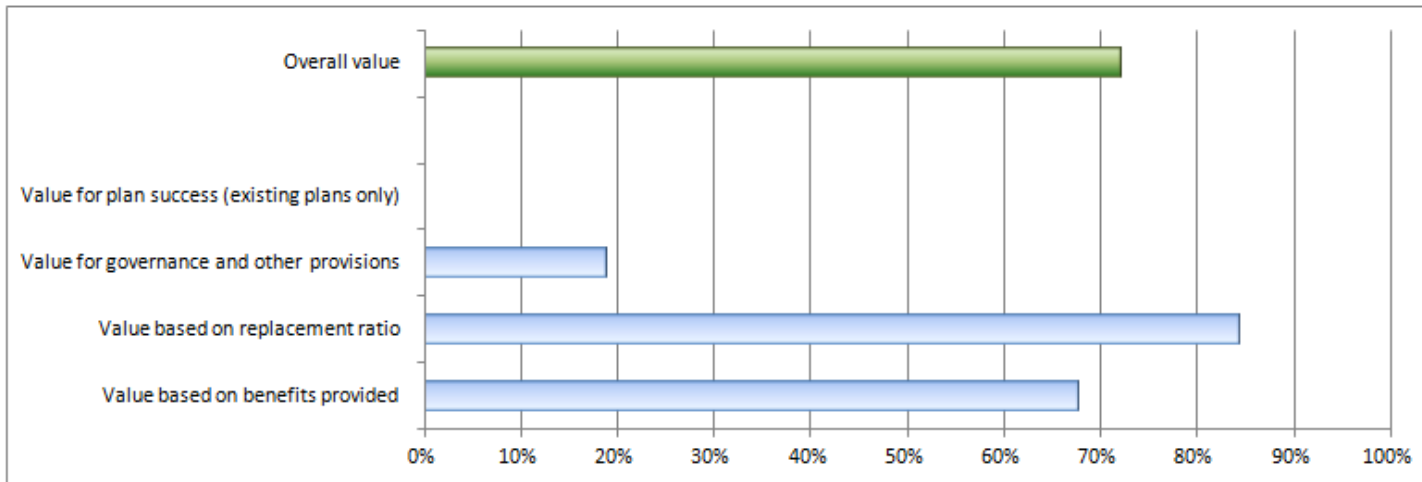
Criteria	Weights without existing plan	Weights with existing plan
Value for plan provisions	34%	25%
Value for plan adequacy	56%	41%
Value for governance and other provisions	10%	7%
Value for plan success (existing plans only)	N/A	27%
Total	100%	100%

Measurement of Plan Success			90%
5 OVERALL EVALUATION	<i>Weight for Criteria</i>		<i>Value</i>
	Value based on benefits provided	25%	68%
	Value based on replacement ratio	41%	84%
	Value for governance and other provisions	7%	19%
	Value for plan success (existing plans only)	27%	90%
Overall value			77%



Plan Evaluation

Value based on benefits provided	68%
Value based on replacement ratio	84%
Value for governance and other provisions	19%
Value for plan success (existing plans only)	N/A
Overall value	72%



Example *(Appendix B of Report)*

Criteria	Value
B1. Base case: 5% employer contributions	72%
B2. Base case but with alternate formula taking into account plan success	77%
B3. Base case but with 8% employer contributions	85%
B4. Base case but with auto-enrollment and auto-escalation	76%

Analytic Hierarchy Process



Analytic Hierarchy Process

- Weights are determined using the Analytic Hierarchy Process (AHP)
- Structured technique for organizing and analyzing complex decisions
- A branch of operations research, invented by mathematician Thomas L. Saaty
- Method to ensure importance of each criterion are consistent with each other

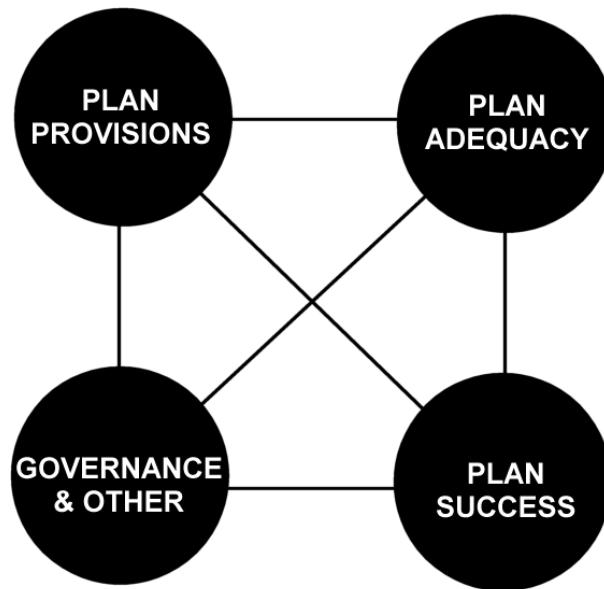
Principles of AHP

- Each criterion rated in terms of its importance relative to other criteria.
- A method to evaluate each criterion relative to each other in a consistent manner
- Based on linear algebra concepts — eigenvectors
- Converts values in a two-dimensional matrix to vectors to get objective function weights
- Google PageRank search engine algorithm uses eigenvectors!

“Pairwise” Comparisons

- AHP uses pairwise comparisons to establish a ranking hierarchy for each criterion
- Qualitative judgment on a scale of 1 to 9 between each two alternatives.
- Comparing each one to the others: six pairwise comparisons

Pairwise Comparisons with Four Nodes



AHP Value Judgment Scale

Intensity of Importance	Definition	Explanation
1	Equal importance	Two elements have the same value
3	Moderate importance	One element is moderately better
5	Strong importance	One element is significantly better
7	Very strong importance	One element is greatly better
9	Extreme importance	One element is better than the other at the highest possible degree

Value judgments for Each Pairwise Comparison

Plan provisions	1	Plan adequacy	3	Plan adequacy slightly more important than actual plan provisions
Plan provisions	5	Governance and other	1	Plan provisions such as employer contributions, vesting and enrollment significantly more important than other criteria
Plan provisions	1	Plan success	1	For an ongoing arrangement, plan provisions as important as participation levels and investment efficiency
Plan adequacy	5	Governance and other	1	Plan adequacy significantly more important than governance and other criteria
Plan adequacy	1	Plan success	1	Plan adequacy just as important as plan success
Governance and other	1	Plan success	3	Plan success somewhat more important than governance and other criteria

Reciprocal Matrix

- For each pairwise comparison, the number representing the greater weight is transferred to the cell that intersects in the matrix
- Reciprocal of that number is put into the cell of the other intersection, working horizontally

Criteria	Plan Provisions	Plan Adequacy	Governance and Other	Plan Success	Priority
Plan provisions	1	1/3	5	1	.25
Plan adequacy	3	1	5	1	.41
Governance and other	1/5	1/5	1	1/3	.07
Plan success	1	1	3	1	.27

"Priority" is the Weight

- The priority is the normalized value obtained by this formula:

Priority for criterion i = Sum of normalized values for row / Number of rows

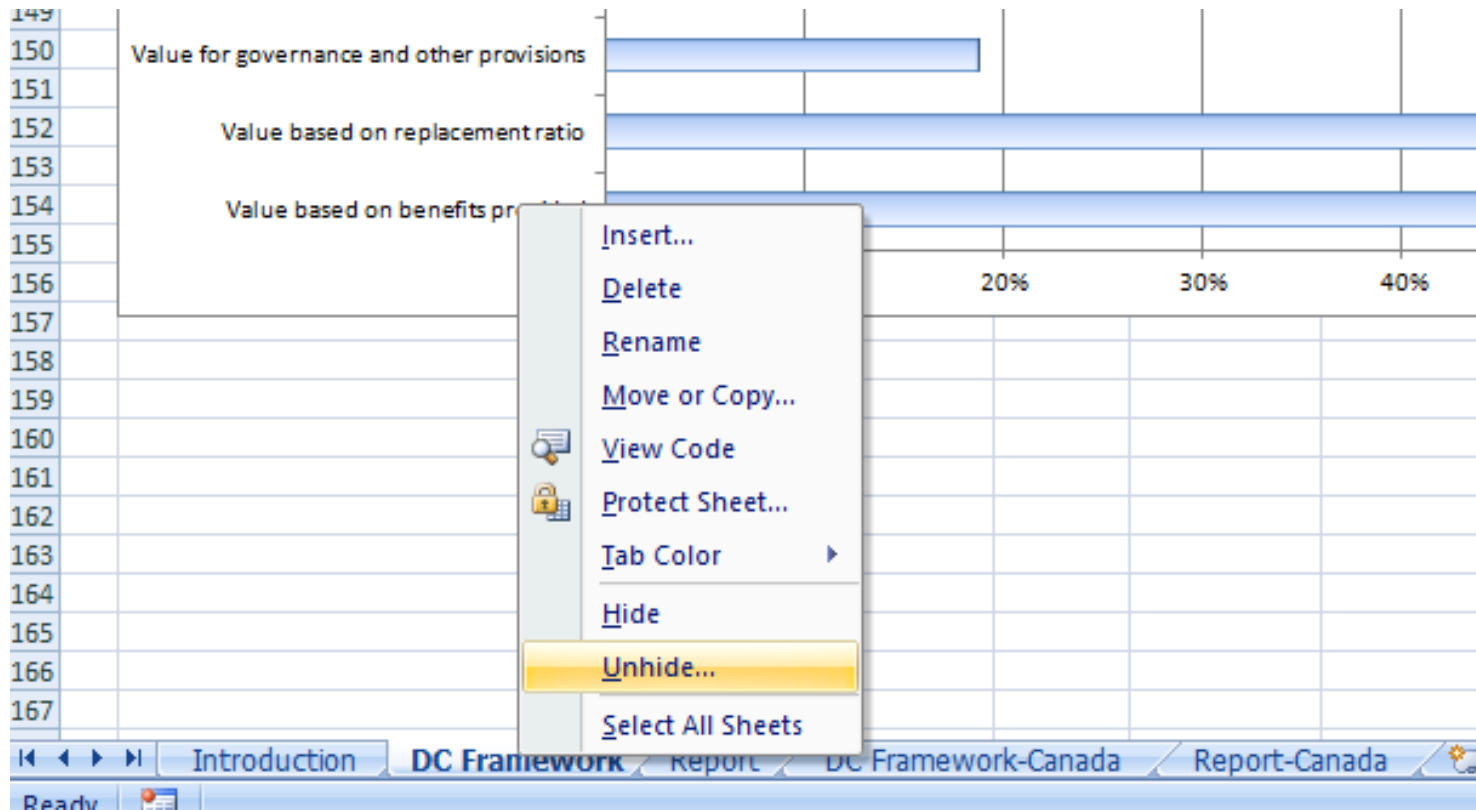
where:

- Normalized value for cell $[i, j]$ = value in cell $[i, j]$ / Sum of values in column j

Consistency Index and Consistency Ratio

- Method to verify if results are consistent
- Consistency index using as the lambda max a measure of the maximum eigenvalue of the matrix $L_{\max} = \lambda_{\max}$.
- Consistency Index (CI) = $(\lambda_{\max} - n) / (n - 1)$
- Consistency ratio (CR) = CI / RI
- where RI is the Random Index, the CI value obtained from randomly generated matrices

Lambda max	4.188127247	Consistency index	0.062709082
Assessment	Very consistent (<10%)	Consistency ratio	0.069676758



References



References Used to Derive Ranges

- Aon Hewitt, 2011 *Trends and Experience in Defined Contribution Plans*, 2011
- Deloitte / International Foundation of Employee Benefit Plans, *Annual Defined Contribution Benchmarking Survey*, 2014
- Vanguard Institutional Investor Group, *How America Saves 2014*, 2014
- Michael Clingman, Kyle Burkhalter, and Chris Chaplain, *Replacement Rates for Hypothetical Retired Workers*, Actuarial Note Number 2015.9, Office of the Chief Actuary, Social Security Administration, July 2015
- BrightScope / Investment Company Institute, *The BrightScope/ICI Defined Contribution Plan Profile: A Close Look at 401(k) Plans*, December 2014
- Jack Van Derhei and Lori Lucas, *The Impact of Auto-enrollment and Automatic Contribution Escalation on Retirement Income Adequacy*, Employee Benefit Research Institute Issue Brief, no. 349, November 2010
- PLANSPONSOR, *2014 DC Survey: Plan Benchmarking*, January 2015, <http://www.plansponsor.com/2014-DC-Survey--Plan-Benchmarking/>

Quick references to the report

- Section 3.2, Objective Function
- Benchmarking criteria:
 - Plan Provisions (Section 3.3)
 - Plan Adequacy (Section 3.4)
 - Other Criteria (Section 3.5)
 - Plan Success (Section 3.6)
- Appendix A: Using/Modifying the Excel Model Spreadsheet
- Appendix B : Examples

Summary



A System to Evaluate and Compare DC Plans

- Rational approach to quantify plan features, based on:
 - Contribution levels
 - Fees
 - Investment options
 - Auto-enrollment, auto-escalation
 - Eligibility, vesting
 - Replacement ratio adequacy
 - Plan participation and investment efficiency
 - Nonmonetary features (e.g., income solutions, communications, etc.)



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