Quantifying Defined Contribution Risk

By Minaz H. Lalani

INTRODUCTION

GLOBALLY, OVER THE LAST DECADE, there has been a shift towards the establishment of Defined Contribution (DC) Plans (Refer to IFRS—Definition of DC Plan). Traditionally most actuaries have participated in managing and quantifying Defined Benefit (DB) risks; however, there is sparse literature on managing and quantifying Defined Contribution (DC) risks. This lack of literature can be explained by the fact that the prevalent view is that plan sponsors bear the risk of DB plans and employees bear the risk in DC plans. The reality is that DC plans do carry material risks for sponsoring employers, and these risks should be actively managed and quantified. This article provides some insights into how actuaries can quantify DC plan risks.

DEFINED CONTRIBUTION RISKS AT A GLANCE

In order to better manage DC risks, DC stakeholders should be aware of the key risks inherent in DC plans. Table 1 summarizes the key DC risks within four broad risk categories usually used in an Enterprise Risk Framework (ERM).



Minaz H. Lalani, BSc, FCIA, FSA, CERA, is a principal and consulting actuary with Towers Perrin in Calgary, Canada. He can be reached at *minaz.lalani@towersperrin.com*.

INTERNATIONAL FINANCIAL REPORTING STANDARD (IFRS)— DEFINITION OF DC PLAN

Defined contribution plans are post-employment benefit plans under which an entity pays fixed contribution into a separate entity (a fund) and will have no legal or constructive obligation to pay further contributions if the fund does not hold sufficient assets to pay all employee benefits relating to employee service in current and prior periods.



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Table 1

Risks	Applicability of Risks to DC Plans (DC Risks)
Financial	
Market *Investment* *Longevity* *Inflation* *Settlement*	*DC members rely on market returns (via investment options) to provide the desired levels of investment returns to accumulate savings over their working lifetime and withdraw savings during their retirement years. Due to increasing life expectancies and inflationary expectations, there is a risk of outliving these savings and incurring losses in the real value of these retirement savings.* *From a plan sponsor standpoint, it is prudent to provide an adequate number of investment options, including default options, to provide the desired level of investment returns and inflation protection. Also, it is imperative that employees via use of modelling tools are made aware of the withdrawal (settlement) options at retirement and the likelihood of outliving their savings*
Strategic	
Design	*Plan sponsors should be designing DC plans that support business and human resource objectives. Failure to design strategic DC plans could result in the provision of an inadequate level of income and retaining retirement-eligible employees with unintended workforce management issues and potential impact on the business plan. A strategic DC plan should provide for a well-defined level of retirement income, instill a level of accountability on the employee for retirement savings and ensure that there is well documented and mutual understanding between the employer and employee regarding the responsibility of each party on retirement.*
Legal and Regulatory	
Governance *Legal* *Communication*	*DC plans should adhere to a high standard of governance, comply with all regulatory requirements and meet contractual commitments. It is imperative that the plan sponsor commitments implied ,or explicit regarding future investment returns, level of retirement income and other DC related provisions are well articulated and documented to minimize potential risk.*
Operational	
Vendor *Education* *Modelling*	*Operational risks are risks due to inadequate processes, systems, or ill-trained human resources. DC Plan sponsors should be aware that even well designed DC plans have significant risks if performance standards are not met by internal HR support, or external vendors (for example, there may be risk if accurate account balance reports with clear investment education material are not distributed on a timely basis). Also, It is important to ensure that DC members are provided with sophisticated models that are based on well conceived notions, best practices and robust assumptions to ensure operational excellence and support the strategic business intent for establishing the DC plan.*

Source: Adapted from the Canadian Institute of Actuaries Bulletin, Volume 18, Number 3, November 2007: The Role of Actuaries in Managing Defined Contribution Risks by Minaz H. Lalani.

> "...there are significant interrelationships between the identified DC risks which create additional risks."

It is important to note that this list of DC plan risks is not exhaustive or mutually exclusive within the risk categories; there are significant interrelationships between the identified DC risks which create additional risks. For example, at the time of writing in December 2008, most global markets had double digit market losses resulting in significant decline in the employee account balances. The interrelationship of the financial and strategic risks would result in an unintended "workforce management risk," that is, retaining senior employees planning to retire at their respective retirement ages but who do not have the financial resources to retire now. In this case, the employer will have to establish a strategic workforce plan to retain these senior employees until such time that these employees will be able to retire. It is imperative that plan sponsors are aware of such interrelationships when managing and quantifying these risks.

RETROSPECTIVE VIEW—DETERMINISTIC DC RISK RESERVING

The Deterministic DC Risk reserving concept is analogous to an actuarial valuation of a Defined Benefit (DB) plan. DB actuaries compare the assets and liabilities of a DB Plan to determine the actuarial surplus, or unfunded liability; this determination is done on either a going-concern basis, or solvency basis. Under a DC Plan, there is no concept of an actuarial valuation; the prevalent view is that once an employer contributes towards an employee DC account, then the employee is entitled to the "surplus," or responsible for the "shortfall."

The DC Risk reserving concept is based on the premise that in designing a DC plan[1] (1), employers have a well defined target retirement income objective; such an objective could be expressed as follows: "the employer will provide a retirement pension of x percent of pre-retirement earnings for a career employee with y years of service at retirement age of z years based on a target investment return of i percent per year." The value of this well defined retirement target (liabilities) provides a benchmark against which the assets (actual account balances) can be measured. The surplus or shortfall for each employee is calculated by comparing the actual account balance (assets) and expected target account balance (liabilities) at the valuation date.

Table 2: Sample Employee Data

Age Group	Employee Count	Average Salary	Average Years of Service	Actual Initial Account Balance as of Dec 31. 2006
<20	2	$25,821	2	$5,572
20-24	243	32,715	3	1,349,381
25-29	819	41,187	4	8,014,537
30-34	890	47,598	4	10,064,984
35-39	719	50,645	5	11,151,600
40-44	652	59,590	7	16,723,973
45-49	536	59,324	9	18,081,260
50-54	338	51,978	10	11,409,005
55-59	166	57,691	11	7,122,817
60-64	76	66,293	10	3,271,845
65+	7	31,267	4	52,002
Total	4448	$50,261	6	$87,246,977

The sample employee data as of Dec. 31, 2006 in Table 2 was used for all the analysis in this article. The DC plan used for the analysis was established in1996 with a few hundred DC members; the DC plan membership grew significantly to about 4,500 employees at Dec. 31, 2006. The DC plan has a level contribution of five percent per year.

FOOTNOTES:

[1] Canadian Institute of Actuaries Bulletin, Volume 18, Number 1, Sept. 2007: The Role of Actuaries in Defined Contribution Plan Design by Minaz H. Lalani.

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The deterministic target investment return was set at six percent per year. The effective actual return from the period 1999 to 2006 was 7.6 percent. The actual returns for the aggregated plan assets for each year were as follows:

Year	1999	2000	2001	2002	2003	2004	2005	2006
Actual Return	14.5%	7.1%	-5.5%	-5.1%	16.0%	9.8%	15.8%	11.4%

In aggregate the plan assets were allocated 40 percent in Canadian Equities, 20 percent in U.S. Equities, 35 percent in Canadian Bonds and five percent in Cash.

The difference or gap at the valuation date between the actual account balance (based on actual historical rate of return) and the target account balance (based on the target investment return) is the "surplus," or "deficit"/"shortfall." This is shown graphically in Chart A. Table 3 summarizes the result of the deterministic valuation.

Chart A:
Retrospective View—Deterministic Valuation

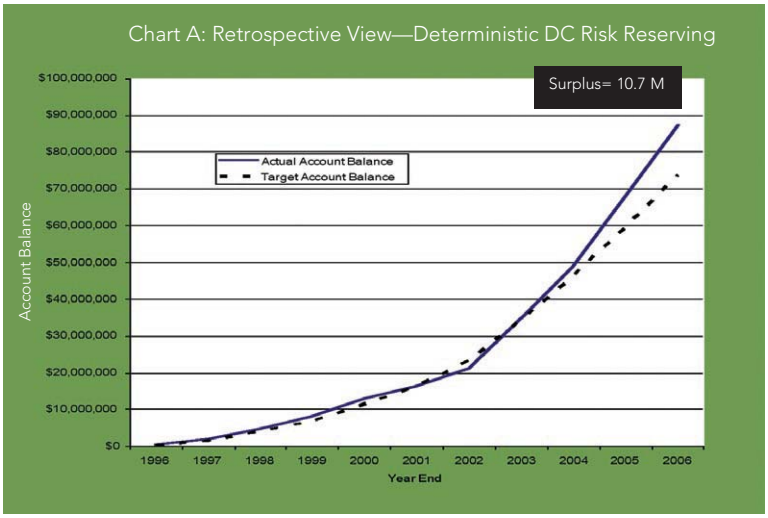


Table 3 :
Retrospective View—Deterministic Valuation

Age Group	Target Account Balance (Liabilities)	Actual Account Balance (Assets)	Deterministic Surplus / (Deficit)
<20	$5,235	$5,572	$337
20-24	1,226,088	1,349,381	123,292
25-29	7,036,545	8,014,537	977,992
30-34	8,836,781	10,064,984	1,228,202
35-39	9,632,246	11,151,600	1,519,354
40-44	14,810,519	16,723,973	1,913,455
45-49	16,045,839	18,081,260	2,035,421
50-54	9,996,329	11,409,005	1,412,676
55-59	6,083,047	7,122,817	1,039,770
60-64	2,866,722	3,271,845	405,124
65+	45,656	52,002	6,346
Total	$76,585,008	$87,246,977	$10,661,969

The deterministic valuation provides a retrospective view of the employee's actual investment performance versus the target deterministic investment return; the sum of the shortfall for all employees could provide an employer with an indication of investment risk, that is, risk of employees selecting investment options that did not attain the target return. Since the deterministic valuation is based on historical information, it does not provide a complete measure of the potential investment risk, that is, the risk of not attaining the target returns in future years(market risk), or meeting the defined target retirement income level(design risk).

PROSPECTIVE VIEW—STOCHASTIC DC VALUATION

The stochastic valuation is an extension of the DC Risk reserving concept; this is analogous to stochastic projections done for an asset liability study in respect of a DB Plan. Under the DC approach, employee's account balance with the underlying asset mix is projected to the target retirement age using stochastic investment returns, with internally consistent salary growth and other relevant

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assumptions, using a capital market model. For the stochastic analysis in this article, the asset allocation at the employee level was assumed to remain the same during the employee's working lifetime.

The actuarial present value of the projected account balance (analogous to the present value of future benefits under a DB Plan) is determined as the average of the stochastically projected account balances at retirement age discounted back to the valuation date using deflators (weighted stochastic returns that generated the specific projected account balance refer to Deflators).

For a DB Plan, the projected credit unit method attributes the present value of future benefits using the ratio of service to total service to retirement age. A similar service prorate approach is used for DC plans. Other attribution approaches can be used, for example, the attribution can be based on ratio of the target account balance at the valuation date to the projected target account balance at retirement age. For the analysis, a service prorate was used.

The surplus or shortfall for each employee is calculated by comparing the attributed account balance (assets) and expected target account balance (liabilities) at the determination date.

Table 4 summarizes the results of the stochastic valuation. Each employee's account balance was stochastically simulated using 500 generated economic scenarios (investment return and internally consistent salary growth assumptions) projected to retirement age of 65.The stochastic account balance is equal to present value of the attributed account balance for service to date (based on service prorate to age 65).

DEFLATORS

Deflators provide a means by which stochastically projected account balances can be converted into present values which are consistent with the market values while still allowing for any differences in volatility of returns between asset classes.

Table 4:
Prospective View—Stochastic DC Valuation

Age Group	Target Account Balance (Liabilities)	Stochastic Account Balance (Assets)	Stochastic Surplus / (Deficit)
<20	$5,235	$3,528	($1,707)
20-24	1,226,088	850,419	(375,669)
25-29	7,036,545	5,182,391	(1,854,154)
30-34	8,836,781	6,770,303	(2,066,478)
35-39	9,632,246	7,825,749	(1,806,496)
40-44	14,810,519	12,684,065	(2,126,454)
45-49	16,045,839	14,740,351	(1,305,489)
50-54	9,996,329	9,822,394	(173,935)
55-59	6,083,047	6,535,332	452,285
60-64	2,866,722	3,287,338	420,616
65+	45,656	55,459	9,803
Total	$76,585,008	$67,757,329	($8,827,678)

The stochastic analysis requires a significant number of computations and computer resources; therefore, it is highly recommend that active employee data be grouped to reduce the computations and expedite the analysis.

From an employer perspective, the shortfall using a stochastic valuation provides a better measure of potential DC risk due to the lack of employer's well defined retirement income objective (design risk), shortfall due to market conditions (market risk) , or potential risk of litigation due to non-performance of the DC Plan (litigation risk).

RETIREMENT VALUE AT RISK

The Value at Risk (VaR) or risk dollar concept is a well-understood risk measure and is used extensively by risk managers; it is also used by DB actuaries to understand the tail (downside) risks of specific DB measures (solvency deficits, funding ratios). As yet, the use of VaR for DC Plan has not been articulated in literature.

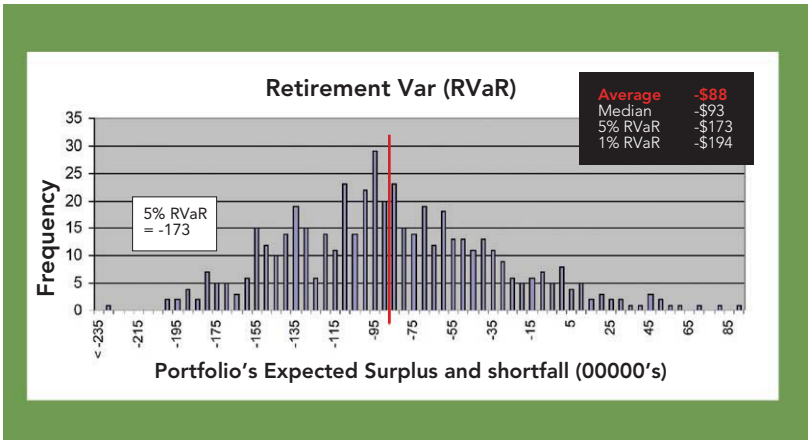
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For our analysis, the Retirement Value at Risk (RVaR) is an extension of the Stochastic DC Valuation. The DC VaR or RVaR is a measure of risk in respect of active employees in a DC plan. For example, a DC Plan with an RVaR of $17.3 million at a confidence level of 95 percent will have a 5 in 100 chance that the DC Plan will have a shortfall of at least $17.3 million over the employee's working lifetime (accumulation period) as measured at the Valuation date.

The RVaR is determined from the statistical distribution generated from stochastic valuation of the DC Plan (refer to Prospective View—Stochastic DC Valuation). The results are used to create 500 potential portfolios with surpluses and shortfalls. This is shown graphically in Chart B.

Chart B: DC Retirement Value at Risk



Note: The x-axis scale is in 100,000; therefore, "88" is equivalent to $8,800,000

Again, from an employer perspective, the probability of a shortfall at a given confidence level is more meaningful as it provides an estimate of the potential shortfall risk which could translate into a potential litigation risk; the degree of risk is depended on clarity and quality of the employer's communication to their employees regarding the employer's commitment in respect of the DC Plan.

RISK MITIGATION

Over the next 10-15 years, plan members will retire in increasing numbers from DC plans; most DC practitioners believe that inadequate management of DC plans due to ineffective DC plan design or lower than expected investment returns, will result in litigation as DC plan members begin reaching retirement age with less than adequate retirement funds.

Below is a short list of possible actuarial involvement to mitigate DC risks:

- Collaborate with the DC plan sponsor in defining the plan sponsor's retirement objectives clearly outlining the level of retirement pension to be delivered based on an expected target return
- Communicate the retirement objectives to employees ensuring there is clear articulation of the intended portion that the employer was expecting to deliver as a percentage of the total retirement income as a percentage of salary
- Prepare illustrations and projections of retirement income that are based on sound and acceptable assumptions for investment returns, mortality and retirement ages
- Develop web-based retirement modelling tools that provide a more sophisticated and complete picture of expected range of total retirement income using internally consistent actuarial assumptions
- Assist DC plan sponsors in developing alternative scenarios (including stochastic analyses) to better understand investment and longevity risks for pre-retirement (accumulation phase) and post-retirement (withdrawal phase)
- Quantify DC risks to better inform the plan sponsor of their potential liability, or risk due to ineffective plan design, or inadequate DC plan performance.

THE FUTURE

Currently, there is little work being undertaken by stakeholders, including actuaries, in managing and quantifying DC risks. Plan sponsors believe that there are no DC risks; also, in countries (e.g., United States) where there are 'safe harbor' rules, plan sponsors believe that they are protected from litigation risks. Before further progress can be made in this emerging field of practice, stakeholders

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have to embrace the fact that DC plans have inherent risks that need to be managed and quantified. The consequence of quantifying DC risk may require employers with DC plans to include the shortfall/liability on their financial statements. It is hoped that this article will spark some discussion and DC practitioners will develop additional and new techniques to quantify DC risks.

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The views in this article are the author's personal views and should not be attributed to his professional colleagues, or employer. ✦

