Liability Driven Investing (LDI) is an investment framework that focuses on managing pension assets in relation to pension liabilities. LDI is not new, as insurance companies have been using LDI for years under the name of Asset Liability Management. What is new is that defined benefit plan sponsors now have significant motivation to manage pension assets by taking into account pension liabilities, with a focus on managing volatility of the overall pension funded status.

**WHY LDI NOW?**

Recent changes in pension regulations and accounting standards, coupled with unprecedented volatility of the securities markets, created significant motivation for pension plan sponsors to actively manage pension plan risks and, as a result, adopt LDI strategies:

**Financial Accounting Standards Board (FASB) statement ASC 715 (2006)** requires companies to report funded status of defined benefit plans on their balance sheet. The second phase of the accounting reform is in progress, and the proposed changes may significantly increase volatility of the pension expense reported on the income statement.

**The Pension Protection Act of 2006** (PPA) drastically changed pension funding rules by significantly reducing the smoothing of pension assets and liabilities, introducing several yield curve options to determine pension liabilities, increasing PBGC premiums, and requiring full funding of pension plans over an accelerated seven-year period.

In July 2012, Congress enacted The Moving Ahead for Progress in the 21st Century Act (MAP-21) which reduces near-term funding requirements for pension plans by allowing them to discount future cash flows based on the average interest rate experienced over the past 25 years, rather than at current historically low rates.

**Security markets volatility** was unprecedented in recent years, leading to significant volatility of pension assets and liabilities, resulting in volatility of pension funded status, cash contributions, pension expense, and balance sheet impact.

**Pension plan operation complexity** increased substantially due to the new requirements by PPA with respect to the time sensitive certifications of the pension funding ratios (AFTAP), and introduction of AFTAP-based pension plan restrictions, which can drastically change pension plan operations (ex. lump sum and accrual restrictions). Therefore, stable pension funding ratios or AFTAP became very important for the operations of the pension plans under PPA.
LDI Framework:

Managing Pension Plan Risks

Given the current market conditions and pension funding levels, the LDI approach is based on the following key steps:

1. INITIAL ANALYSIS
LDI strategies start with a comprehensive analysis of pension plan provisions, including funding policy, investment policy statement, plan demographics and liability cash flows, and current economic and demographic assumptions.

2. DYNAMIC ASSET ALLOCATION ANALYSIS
The key feature of an LDI approach is dynamic asset allocation or glidepath. LDI strategy starts with only a certain (pre-determined) percentage of assets allocated to the liability matched assets. Over time, if and when funding status improves, periodic rebalancing leads to the increased allocation to the liability matched assets. As a result, the LDI framework is applied to the total pension trust and not just the liability matched assets.

3. ALM STUDIES
The Pension plan’s risk profile is analyzed and dynamic asset allocation decision rules are created based on Asset Liability Management (ALM) studies, carried out at the inception of the LDI strategy and typically repeated every 2-3 years. ALM studies are based on Monte Carlo simulations and reflect stochastic volatility, stochastic correlations, and extreme events.

4. LIABILITY-BASED BENCHMARK CREATION
The main objective of LDI strategies is to minimize volatility of pension plan’s funding status. As a result, the most appropriate benchmark for LDI strategies is the “return” on the pension plan’s liabilities, and plan-specific liability based benchmarks are created and customized for each plan in order to assess performance of LDI strategies.

5. LDI PORTFOLIO STRATEGIES
Once the dynamic asset allocation is established and the liability-based benchmark is created, a number of strategies are considered in order to achieve desired return for a given level of risk, where risk and return are expressed based on client-specific metrics, such as funding status and its volatility, and required contributions and their volatility.

6. MONITORING AND REBALANCING
Monitoring is an essential part of the LDI framework with market values of pension assets and liabilities determined on a regular basis. Once the thresholds are reached as specified by the dynamic asset allocation decision rules established at the inception of the strategy, asset rebalancing is initiated and any funded status gains earned are locked in.

Dynamic Asset Allocation/Glidepath

Since the main goal of the LDI framework is to control pension plan risk, defined as volatility of pension funded status, and lock in the gains once they are realized over time, an LDI strategy is designed as dynamic in nature. Asset allocation rebalancing rules are specified in advance at the inception of the strategy as to how to rebalance the portfolio if and when pension funded status improves and/or other conditional are met. The following plot provides an illustration of the decision rules for the LDI dynamic asset allocation strategy based on the pension plan’s funded status and levels of discount rates.
Asset Liability Management (ALM) Studies

ALM study is a proven tool for incorporating pension plan risk and funding status volatility into the plan sponsor’s decision making process with respect to the pension plan design, contribution strategy, investment policy, strategic asset allocation, and Enterprise Risk Management. ALM studies typically include 10-year (or longer) projections of the pension funded status, expense, balance sheet impact, cash contributions, and others, on a stochastic (Monte Carlo simulation) basis. The following chart shows projected funded status represented by a spectrum of outcomes for current asset allocation and for LDI framework.

Liability-Based Benchmark Construction

Since the objective of the LDI strategy is to manage pension plan assets in relation to liabilities and to provide the same return on assets as the “return” realized on liabilities, the LDI Benchmark should be directly related to pension plan liabilities, and asset-only benchmarks should only be used as supplemental benchmarks if plan sponsors desire so.

FASB defines pension liability (PBO) as the current market value of a hypothetical portfolio of high-quality zero coupon bonds whose coupon and principal amounts at each maturity are the same as the expected future pension benefit payments. PPA defines pension liability (Funding Target) as expected future pension benefit payments discounted with full yield curve or three-segment rate yield curve published by the IRS and based on investment grade corporate bonds in the top three quality levels.

Given these definitions, the ideal LDI Benchmark should be a hypothetic portfolio of investment grade corporate bonds selected in such a way that coupon and principal cash flows from this bond portfolio match projected benefit cash flows from the pension plan. However, two other liability-based benchmark options are also available as summarized in the following table.

The Pension plan’s actuary determines pension obligations every year with the discount rate for PBO determined once per year and the interest rate for Funding Target published by the IRS monthly. Therefore, annual “return” on PBO and annual/monthly “return” on Funding Target can serve as a benchmark. However, Tracking Error will be high because this benchmark is not investable and the LDI strategy can only provide approximation of liability.

Citigroup publishes a corporate-bond-based discount curve on a monthly basis, and auditors typically accept it as a valid basis for determining PBO discount rates. Even though more information is now available with respect to the discount curve construction, this benchmark is still not investable, and as a result tracking error will exist.
LDI PORTFOLIO CONSTRUCTION

Once the LDI benchmark is created, the next step is to construct a portfolio of fixed income securities with the objective of minimizing volatility of funding status by matching the “return” on pension liability. The portfolio is constructed based on pension plan specific cash flows, and once the cash flows change, which typically happens once per year after completion of the actuarial valuation, the LDI benchmark is updated and the portfolio is rebalanced. Strategies that can be used for LDI portfolios are:

- **Duration Matching**: investing in assets in order to only match total duration of pension plan liability, resulting in greater mismatch of asset and liability cash flows, but providing higher yield than full replication.
- **Key Rate Duration Matching**: investing in assets in order to match several key rates of the pension plan liability.
- **Stratified Sampling**: investing only in a subset of securities from the liability-based benchmark according to specified criteria.
- **Horizon Matching**: full cash flow matching the near-term maturities to ensure benefit payments, and only duration-matching cash flows with maturities thereafter.
- **Full Replication**: replication of the benchmark by investing in every security, based on the security’s weight in the benchmark. This will result in the lowest tracking error.
- **Other strategies**, including Alpha Overlay Strategies.

**Input Assumptions**: Inputs include assumed returns, risk, and correlations for each asset class. Assumed returns, risks, and correlations are based on the historical behavior of the listed asset classes, and are not representative of the performance of any actual investment portfolio. Assumed return data is provided for illustrative purposes only and may not be indicative of actual future results. Risk is measured as annualized standard deviation of returns.