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CR01

Credit Spread Sensitivity (CR01) = change in market value for 1bp change in credit spread

PV01

BPV (basis point value) or PV01 (present value of an 01) are often synonym of DV01, although PV01 better refers to the value of a 1 dollar or 1 basis point annuity. For par bond and flat yield curve, DV01 (derivative of price w.r.t. yield) = PV01 (value 1\$ annuity).

DV01

Dollar duration is derivative of the value with respect to yield

$$D_{\$} = DV01 = -\frac{\partial V}{\partial y}$$

It is the product of the modified duration and the price (value):

$$DV01 = (\text{Market Value} + \text{Accrued Income}) \times \text{Modified Duration} / 10,000$$

DV01 is analogous to the delta in derivative pricing (The Greeks) viz. the ratio of a price change in output (dollars) to unit change in input (a basis point of yield). Dollar duration or DV01 is the change in price in dollars, not in percentage. It gives the dollar variation in a bond's value per unit change in the yield. It is often measured per 1 basis point - DV01 is short for "dollar value of an 01" (or 1 basis point)

Acceptances

Bill of exchange or negotiable instrument drawn by borrower for payment at maturity & accepted by a bank; acceptance constitutes a guarantee of payment by the bank and can be traded in the money market; bank earns a "stamping fee" for providing this guarantee

Advanced Internal Ratings Based Approach (AIRB)

A measurement of credit risk under Basel II that uses risk weights determined from internal risk parameters, including probability of default, loss given default and exposure at default

Antithetic variates

The antithetic variates method is a variance reduction technique used in Monte Carlo methods. Considering that the error reduction in the simulated signal (using Monte Carlo methods) has a square root convergence (standard deviation of the solution), a very large number of sample paths is required to obtain an accurate result.

ALM

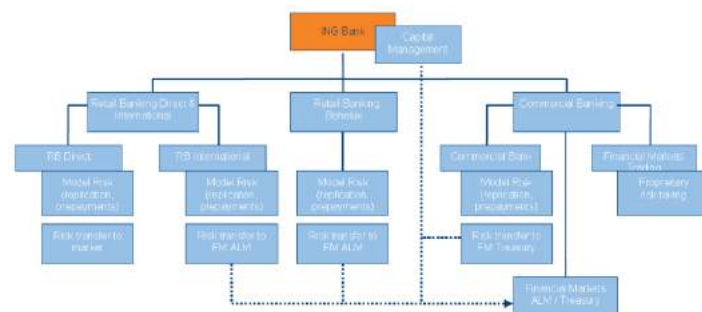
Range of assets, liabilities, off B/S items • Liquidity risk and interest rate risk in Basel II Pillar 2 banking book requirements • Reports (static and dynamic interest rate and liquidity gap reports, beta gap reports, duration and convexity reports) • Tools (dynamic B/S income simulation, EaR, CFaR, VaR, market value sensitivity analysis) • IAS 39/FAS 133 prospective testing • Matched-maturity funds transfer pricing (FTP)

ALM beta-adjusted gap reports modified to mollify the errors caused by basis risk because all interest rates do not change by the same amounts, but there is correlation between changes in various interest rates. Some rates are more sensitive to change than other rates. In beta-adjusted gap analysis, the volumes of assets and liabilities subject to re-pricing are weighted to reflect the historical sensitivity of the yields or costs of those assets and liabilities relative to some benchmark yield or cost

ALM maturity gap stratify bank's assets, liabilities and off-B/S instruments into maturity segments (time bands) based on instruments next re-pricing or maturity date. Balances within time band summed (assets as +ve amounts, liabilities as -ve amounts) to produce net gap position for each time band. Risk measured by size of gap (amount of net imbalance within time band and length of time gap is open) Off B/S \$100M 5-year interest swap (receives fixed rate, pays 3-month Libor) reported as positive \$100M in 5-year time band and negative \$100M in 3-month time band; 'long' fixed rate payment (owning fixed rate asset) and 'short' floating-rate payment (floating-rate liability)

- **Capital Management Regulatory** OSFI Tier 1 – Tier 2 risk-weighted assets (on/off B/S exposures + market risk exposures)
- **Capital** ① **Legal** (common equity+preferred shares) >= **Target Regulatory** (capital adequacy measures for risk-weighted assets) >= **Economic** (must-have net value at year start to ensure small probability of defaulting in that year) ② **Required Capital** regulator's assessed Bank's risks ③ **Available Capital** regulator's assessed banks assets minus liabilities according to accounting principles ④ **Capital Adequacy Ratio** $CAR = \frac{[Tier\ I + Tier\ II\ Capital]}{(\% \times RWA)}$ ⑤ **Economic Capital by risk type** **Credit Risk**, **Debt Specific Risk (Credit VaR)**, **Market Risk (VaR)**, **Operational Risk**, **Strategic Risk** (failure due to significant investments through acquisition/ growth), **Investment Risk** (associated with Merchant Banking type securities), **Customer behavior risk** (mortgages deviations from contractual cash flows due to customer prepayments, liquidations) ⑥ **Economic Capital parameters** **expected default frequency EDF** (5 years historical data) **EAD** (70/80% of facility and current usage) **LGD** (by internal ratings) **Time Horizon** 1 year, **Confidence Level** 99.97%, **Transition Matrix**, **Expected Loss** ⑦ **Total MR Capital = General MR Capital + Specific Risk Capital + Incremental Risk Capital** where **general MR** = risk of losses due to movements in prices/ volatilities, **specific risk** = risk of losses due to idiosyncratic factors related to individual issuer/obligor; **product coverage** debt securities (bonds, CD, CP, debentures), credit (CDS), derivatives, equity; **correlations** significant (credit migration/ default events of obligors) + **negligible** (credit migration/default events, systematic market risk factors); **risk factors** equity prices, equity volatility surfaces, interest rate curves, IR spread curves, caplet volatility surfaces, swaption volatility surfaces, FX rates, firm assets from which to determine defaults, bond spread curves, CDS spread curves; default and migration implied by asset model calibrated to transition matrices

ALM Framework ING



ALM Gap report

	Days 0-90		Days 91-180		Days 181-360		1 Yr to 2 Yrs		2 Yrs to 3 Yrs		beyond 3 Yrs	
	Balance	Rate	Balance	Rate	Balance	Rate	Balance	Rate	Balance	Rate	Balance	Rate
Net Fixed Assets	56,530	0.25%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Net Cash and Working	30,426	2.25%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Investments												
Total Investments	0	0.00%	2,500	0.75%	17,830	0.75%	12,620	0.62%	260	1.00%	250	0.50%
Total Accts	10,774	4.47%	20,172	0.75%	20,345	0.44%	30,345	0.44%	13,274	0.44%	13,274	0.44%
Total Municipal	4,961	4.68%	2,186	2.14%	17,830	0.32%	30,345	0.30%	29,197	0.30%	54,482	0.48%
Total Corporate	4,961	2.15%	7,986	2.15%	2,515	2.21%	1,515	2.21%	2,080	2.00%	7,792	2.00%
Total Corp & Other	225	0.50%	0	0.00%	2,320	0.60%	4,650	0.44%	3,715	0.20%	10,126	0.44%
Total Cash & Liqui											2,386	1.38%
Total Cash & Liqui	25,005	1.00%	35,218	1.72%	25,873	1.81%	126,955	2.22%	93,554	0.20%	84,170	0.43%
Total Investments												
Total Cash & Liqui												
Total Current Assets	64,102	0.53%	10,648	2.50%	24,779	0.53%	12,693	0.51%	18,264	0.59%	22,601	0.61%
Total Current Liab	6,102	0.68%	7,797	0.54%	12,685	0.64%	36,714	0.64%	62,268	0.74%	88,851	0.84%
Total Liabilities	6,102	0.68%	7,797	0.54%	12,685	0.64%	36,714	0.64%	62,268	0.74%	88,851	0.84%
Total Acct	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Total Debt	16,556	4.96%	32,196	0.60%	3,865	0.40%	4,778	0.35%	5,239	0.25%	2,399	0.25%
Total Other	7,558	0.34%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Total Liab	14,830	0.91%	32,196	0.60%	3,865	0.40%	4,778	0.35%	5,239	0.25%	11,647	0.89%
Stocks & Bonds												
Net Working Cap	291,524	3.84%	371,714	2.54%	128,181	0.46%	172,181	1.82%	113,018	0.84%	181,129	0.58%
Deposits												
Total Deposits	117,949	0.30%	0	0.00%	0	0.00%	198,507	0.30%	0	0.00%	0	0.00%
Total M3/90	20,002	0.00%	0	0.00%	0	0.00%	171,831	0.00%	0	0.00%	0	0.00%
Total Savings	4,603	0.10%	0	0.00%	0	0.00%	22,219	0.00%	0	0.00%	0	0.00%
Total CTS	44,708	0.18%	34,967	0.18%	56,418	0.18%	5,771	0.18%	0	0.00%	0	0.00%
Total IRAD	6,664	1.00%	2,001	1.74%	6,958	1.29%	2,723	2.64%	2,348	2.44%	5,956	2.44%
Total IRAD	194,017	0.49%	31,568	1.00%	63,833	1.29%	205,000	0.27%	5,648	2.44%	5,648	2.44%
Liabilities												
Total Off-Bal Pay	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Total Off-Bal Pay	0	0.00%	0	0.00%	0	0.00%	10,000	0.40%	0	0.00%	0	0.00%
Total IRAD	97,306	0.84%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Total Other Debt	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Total Debt	97,306	0.84%	0	0.00%	0	0.00%	10,000	0.40%	0	0.00%	0	0.00%
Total Net Working Capital	291,261	0.49%	370,008	1.00%	165,430	1.20%	206,910	0.29%	5,448	2.14%	164	2.39%
Repaying Debt	(29,717)		(10,688)		(10,688)		(10,688)		(10,688)		(10,688)	
Repaying Debt	(29,717)		(10,688)		(10,688)		(10,688)		(10,688)		(10,688)	
GAAP Rate (R&B) CAP	0.50	1.80	1.17	1.17	0.54	0.54	0.54	1.80	1.80	1.37		
GAAP Rate (R&B) CAP	0.50	1.80	1.17	1.17	0.54	0.54	0.54	1.80	1.80	1.37		

Allowance for credit losses

Amount deemed adequate to absorb identified credit losses as well as losses that have been incurred but are not yet identifiable as at the balance sheet date. This allowance is established to cover the lending portfolio including loans, acceptances, guarantees, letters of credit, and unfunded commitments. The allowance is increased by the provision for credit losses, which is charged to income and decreased by the amount of write-offs, net of recoveries in the period.

Alt-A assets

A term used in the U.S. to describe assets (mainly mortgages) with a borrower risk profile between the prime and subprime categorizations. Categorization of assets as Alt-A (as opposed to prime) varies, such as limited verification or documentation of borrowers' income or a limited credit history.

Asset-backed securities (ABS)

Securities created through the securitization of a pool of assets, for example auto loans or credit card loans

Assets-to-capital multiple

Total assets plus specified off-balance sheet items, as defined by OSFI, divided by total regulatory capital.

Assets under administration (AUA)

Assets administered by us, beneficially owned by clients, as at October 31, unless otherwise noted. Services provided in respect of assets under administration are of an administrative nature, including safekeeping, collecting investment income, settling purchase and sale transactions, and record keeping.

Assets under management (AUM)

Assets managed by us, which are beneficially owned by clients, as at October 31, unless otherwise noted. Services provided in respect of assets under management include the selection of investments and the provision of investment advice. We have assets under management that are also administered by us and included in assets under administration.

Auction rate securities (ARS)

Securities issued through special purpose entities that hold long-term assets funded with long-term debt, with an interest rate reset every week to 35 days via auctions managed by participating financial institutions. In the U.S., the securities are issued by sponsors such as municipalities, student loan authorities or other sponsors through bank-managed auctions.

Bank-owned life insurance contracts (BOLI)

Our U.S. Insurance and Pension solutions business provides banks with BOLI stable value agreements ("wraps"), which insure the life insurance policy's cash surrender value from market fluctuations on the underlying investments, thereby guaranteeing a minimum tax-exempt return to the counterparty. These wraps allow us to account for the underlying assets on an accrual basis instead of a mark-to-market basis.

Basel Capital Adequacy Return (BCAR)

This return provides the capital to risk-based assets ratio and assets-to-capital multiple of the reporting institution, as well as details of the calculation **STATUTORY** Section 628 of the Bank Act and Section 495 of the Trust and Loan Companies Act **APPLICATION** This return applies to all deposit-taking institutions except foreign bank branches. The BCAR short form

is available only to subsidiaries of IRB banks under certain conditions **FREQUENCY** Institutions with fiscal year-ends of October - Quarterly- January, April, July and October - Institutions with fiscal year-ends of December - Quarterly - March, June, September and December **REPORTING DATES** The return must be completed on a quarterly fiscal basis and filed within 30 days of fiscal quarter end **GENERAL INSTRUCTIONS** The BCAR is to be completed using the methodologies and calculations described in **OSFI's Capital Adequacy Requirements (CAR)** Guideline (the "guideline") Footnote 1. The purpose of these instructions is to ease completion of the return by referencing its components to the applicable section(s) of the guideline. Reference is by section number (e.g., section 3.1.1) and, in some cases, paragraph number (e.g., para 231)

BCAR Short Form is limited to the following schedules from the full BCAR return: 1 Ratio Calculations 1A Ratios, Capital, and Risk-weighted Assets on Transitional Basis 2 Summary of Risk-weighted Assets 3 Capital Elements 3A Qualifying Capital Issued Out of Subsidiaries 4 Allowance for Impairment: Capital Treatment 38 Other Credit Risk-weighted Assets 39 Off-balance Sheet Exposures Excluding Derivatives and Securitization Exposures 40 Derivative Contracts 41 Securitization Exposures 42 Minimum Capital Required for Market Risk 43 Minimum Capital Required for Operational Risk 45 Balance Sheet Coverage by Risk Type & Reconciliation to Consolidated Balance Sheet

Basin point bp

One one-hundredth of a percentage point (.01%) - Unit = 0.01% = 1/100th of 1%; to denote change in a financial instrument, for calculating changes in interest rates, equity indexes and the yield of a fixed-income security

BLACK-SCHOLES formula

- The first part, $SN(d_1)$, derives the expected benefit from acquiring a stock outright. This is found by multiplying stock price $[S]$ by the change in the call premium with respect to a change in the underlying stock price $[N(d_1)]$.
- The second part of the model, $Xe^{-rt}N(d_2)$, gives the present value of paying the exercise price on the expiration day. The fair market value of the call option is then calculated by taking the difference between these two parts.

$$C = SN(d_1) - Xe^{-rt}N(d_2)$$

$$P = Xe^{-rt}N(-d_2) - SN(-d_1)$$

Put-call parity requires that $P = C - S + Xe^{-rt}$

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

σ = Standard deviation of stock returns

\ln = Natural logarithm

Canadian GAAP

Canadian generally accepted accounting principles

Capital

①Legal ②Regulatory ③Economic (net value a bank must have at the beginning of the year to ensure that there is only a small probability of defaulting in that year)

Capital adequacy

The level of capital that is sufficient to underpin risk and accommodate potential unexpected increases in risk within specified regulatory targets while maintaining our business plans. This includes risks for which minimum regulatory capital requirements may not be specified.

Capital position

Measures the extent to which illiquid (long term) assets are funded by short-term liabilities and represents a formula-based measure of mismatches in effective maturity between assets and liabilities including both comparative and directional structural liquidity risk

Comprehensive Capital Analysis and Review (CCAR)

Federal Reserve annual exercise ensures that institutions have robust, forward-looking capital planning processes that account for their unique risks and sufficient capital to continue operations throughout times of economic and financial stress. As part of the CCAR, the Federal Reserve evaluates institutions' **capital adequacy**, **internal capital adequacy assessment processes**, and their plans to make **capital distributions**, such as dividend payments or stock repurchases. The CCAR includes a **supervisory stress test** to support the Federal Reserve's analysis of the adequacy of the firms' capital. Boards of directors of the institutions are required each year to review and approve capital plans before submitting them to the Federal Reserve

Conditional VaR (CVaR)

Risk assessment technique to reduce the probability a portfolio will incur large losses. This is performed by assessing the likelihood (at a specific confidence level) that a specific loss will exceed the value at risk. CVaR is derived by taking a weighted average between the value at risk and losses exceeding the value at risk. This term is also known as "Mean Excess Loss", "Mean Shortfall" and "Tail VaR".

Collateral

Assets pledged as security for a loan or other obligation; many forms: cash, highly rated securities, property, inventory, equipment and receivables. The exposure for counterparty with a collateral agreement is measured as: •Assuming a collateral call is made when the portfolio MTM at certain time node (t) is above the Threshold (T) and Minimum Transfer Amount (MTA). The exposure at time t is calculated as **T+MTA + 10-day close-out exposure (t+10)**. •Once collateral call is made, we assume the exposure is reduced down to T+MTA rather than T to add additional layer of buffering for conservative purpose. In reality, the collateral amount called is the MTM amount above T. •Similarly assuming CIBC has to

post collateral when the portfolio MTM is below CIBC's T+MTA. However, the exposure will be brought back to CIBC's threshold level. •No collateral call/pledge is required if the portfolio exposure is within both counterparty's and CIBC's T and MTA. •No collateral call/pledge during the close-out period will be made. •This has been done by inserting a 10-day node to each time node we predefined in the market factor evolution model. In this way, for collateralized counterparty, the simulation and exposure calculation time step is doubled. No simulation on simulation is conducted (nested Monte Carlo) •Constraints in current practice: •Collateral is always assumed to be cash •Cash collateral is assumed to be in USD •Payment or deal expiry during close-out period is not captured •A fixed 10-day close-out period is used across agreements and across products.

Collateralized debt obligation (CDO)

Securities with multiple tranches issued by special purpose entities and collateralized by debt obligations including bonds and loans. Each tranche offers a varying degree of risk and return so as to meet investor demand.

Collateralized loan obligation (CLO)

Securities backed by a pool of commercial or personal loans, structured so that there are several classes of bonds with varying maturities, called tranches.

Commercial mortgage-backed securities (CMBS)

Securities created through the securitization of commercial mortgages.

Commitments to extend credit

Unutilized amount of credit facilities available to clients either in the form of loans, bankers' acceptances and other on-balance sheet financing, or through off-balance sheet products such as guarantees and letters of credit

Covered bonds

Full recourse on-balance sheet obligations issued by banks and credit institutions that are also fully collateralized by assets over which investors enjoy a priority claim in the event of an issuer's insolvency

Credit default swaps (CDS)

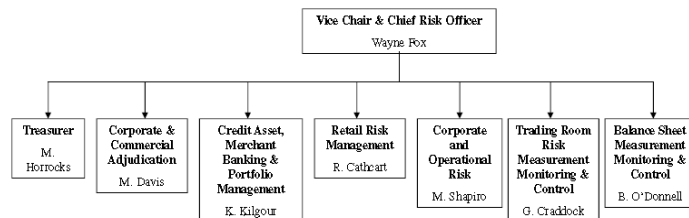
A derivative contract providing the purchaser with a one-time payment if the referenced entity/entities default (or a similar triggering event occurs)

Credit Risk Adjudication

Credit adjudication units analyze and evaluate all significant credit requests for corporate and commercial credit exposures, to ensure that risks are adequately assessed, properly approved, continually monitored and actively managed. The decision-making process begins with an assessment of the credit risk of the individual borrower or counterparty. Key factors considered in the assessment include: •Borrower's management •Borrower's current and projected financial results and credit statistics •Industry in which the borrower operates •Economic trends; and •Geopolitical risk. Based on this assessment, a **risk rating** is assigned to the individual borrower or counterparty, using the Bank's risk rating systems. A separate risk rating is also assigned at the **facility level**, taking into consideration additional factors, such as **security, seniority of claim, structure, term and any other forms of credit risk mitigation** that affect the amount of potential loss in the event of a default of the facility. **Security** typically takes the form of charges over **inventory, receivables, real estate, and operating assets** when lending to corporate and commercial borrowers; and cash or treasuries for trading lines such as securities lending, repurchase transactions, and derivatives. The types of acceptable **collateral**, and related valuation processes are documented in risk management policies and manuals. Other forms of credit risk mitigation include **third party guarantees** and, in the case of derivatives facilities, **master netting agreements**. Internal borrower and facility risk ratings are assigned when a facility is first authorized, and are promptly re-evaluated and adjusted, if necessary, as a result of changes to the customer's financial condition or business prospects. Re-evaluation is an ongoing process, and is done in the context of general economic changes, specific industry prospects, and event risks, such as revised financial projections, interim financial results and extraordinary announcements. Global Risk Management is the final arbiter of internal risk ratings. The internal credit risk ratings are also considered as part of the Bank's adjudication limits, as guidelines for hold levels are tied to different risk ratings. Single borrower limits are much lower for higher risk borrowers than low risk borrowers. The credit adjudication process also uses a **risk-adjusted return on equity profitability** model to ensure that the client and transaction structure offers an appropriate return for a given level of risk. For the corporate portfolio, and the large borrowers in International, the Loan Portfolio Management Group reviews the profitability model results, together with external benchmarks, and provides an opinion on the relative return and pricing of each transaction above a minimum threshold. Individual credit exposures are regularly monitored by both the business line units and Global Risk Management for any signs of deterioration. In addition, a review and risk analysis of each borrower is conducted annually, or more frequently for higher-risk borrowers. If, in the judgment of management, an account requires the expertise of specialists in workouts and restructurings, it will be transferred to a special accounts group for monitoring and resolution.

Credit Risk Creation

Credit originates from primarily two departments: ①Corporate & Commercial Adjudication (CCA) ②Retail Risk Management



Credit Valuation Adjustment (CVA)

Credit value adjustment (CVA) is the difference between the risk-free portfolio value and the true portfolio value that takes into account the possibility of counterparty's default. In other words, CVA is the market value of counterparty credit risk. **CVA = Expected (average) credit loss from c/p transactions = Expected exposure (mean of distribution of evolution of mark to markets) * Counterparty default probability * LGD**
See CVA

Credit VaR (CVaR)

Consider a credit portfolio that consists of default-sensitive instruments such as lines of credit, corporate bonds, and government bonds. The corresponding credit value-at-risk (VaR), is the minimum loss of next year if the worst 0.03 percent event happens. In another words, 99.97 percent of the time the loss will not be greater than VaR. Note that the credit VaR is measured at the time span of one year and is different from the 10-day convention adopted by market VaR. 0.03 percent is chosen because it is a rating agency standard of granting an AA credit rating **According to Jorion, banks allocate roughly 60 percent of their regulatory capital to credit risks, 15 percent to market risks, and 25 percent to operational risks**

Credit Equivalent CE = mark-to-market MTM + potential exposure PE

Loan equivalent LE = mark-to-market MTM + expected exposure EE

Factor-based interim PE (override) = USD notional * exposure exception factor

Potential Future Exposure PFE = maximum of zero and the market value of the portfolio = Maximum exposure under normal market conditions for a future point in time

Expected Positive Exposure EPE = weighted average over time of the expected exposure, where the weights are the proportion that an individual expected exposure represents of the entire exposure horizon time interval

Derivative

Contract between 2 parties, requiring little or no initial investment and where payments between the parties are dependent upon the movements in price of an underlying instrument, index or financial rate. Examples include swaps, options, forward rate agreements and futures. The notional amount of the derivative is the contract amount used as a reference point to calculate the payments to be exchanged between the two parties, and the notional amount itself is generally not exchanged by the parties.

Dividend payout ratio

Common dividends as a percentage of net income after preferred share dividends

Dividend yield

Dividends per common share divided by the average of the high and low share prices in the relevant period

Duration

Measure the sensitivity of the price (value of principal) of a fixed-income investment to a change in interest rates, i.e. interest rate risk (rate fluctuations); expressed as a number of years. Rising interest rates mean falling bond prices. Calculation involves present value, yield, coupon, final maturity and call features.

Effective duration

Effective Duration = $V_2 - V_3 / 2(V_1)(\Delta y)$

Where Δy = change in yield in decimal (Δ = "delta"); V_1 = initial price; V_2 = price if yields decline by Δy ; V_3 = price if yields increase by Δy

Effective duration requires binomial trees to calculate the **option-adjusted spread (OAS)**.

McCauley Duration

$$\text{Macaulay Duration} = \frac{\sum_{t=1}^n \frac{t \cdot C}{(1+i)^t} + \frac{n \cdot M}{(1+i)^n}}{P}$$

Where n = number of cash flows, t = time to maturity, C = cash flow, i = required yield, M = maturity (par) value, P = bond price

Modified Duration

Modified duration is a modified version of the Macaulay model that accounts for changing interest rates – thus appropriate to measure a bond's volatility. It is the approx. percentage change in a bond's price for a 100 basis points change in yield, assuming that the bond's expected cash flow does not change when the yield changes. This works for option-free bonds such as Treasuries but not with option-embedded bonds because the cash flows may change due to a call or prepayment.

$$\text{Modified Duration} = \left[\frac{\text{Macaulay Duration}}{1 + \frac{\text{yield} - \text{to-maturity}}{\text{number of coupon periods per year}}} \right]$$

Key-Rate Duration

The key-rate duration calculates the spot durations of each of the 11 "key" maturities along a spot rate curve. These 11 key maturities are at the three-month and 1, 2, 3, 5, 7, 10, 15, 20, 25, and 30-year portions of the curve.

Key-rate duration, while holding the yield for all other maturities constant, allows the duration

$$\frac{\text{Price of security after a 1\% decrease in yield} - \text{Price of security after a 1\% increase in yield}}{2 * (\text{Initial price of security}) * 1\%}$$

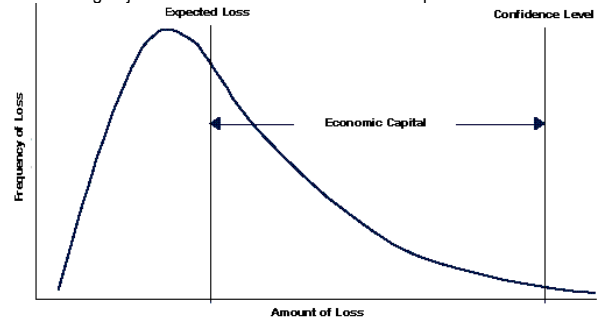
of a portfolio to be calculated for a one-basis-point change in interest rates. The key-rate method is most often used for portfolios such as the bond ladder, which consists of fixed-income securities with differing maturities. **The sum of the key-rate durations along the curve is equal to the effective duration**

Earnings per share (EPS), basic

Net income less preferred share dividends divided by the average number of shares outstanding

Earnings per share (EPS), diluted

Net income less preferred share dividends divided by the average number of shares outstanding adjusted for the dilutive effects of stock options and other convertible securities



Economic capital

An estimate of the amount of equity capital required to underpin risks. It is calculated by estimating the level of capital that is necessary to support our various businesses, given their risks, consistent with our desired solvency standard and credit ratings. The identified risks are **credit, market** (trading and non-trading), **operational, business, fixed asset and insurance**. Economic capital also includes **goodwill and intangibles**, and allows for diversification benefits across risks and business segments

By risk type ①Credit Risk ②Debt Specific Risk ③Market Risk ④Operational Risk ⑤Strategic Risk (strategic failure due to significant investments through acquisition or growth) ⑥Investment Risk ⑦Customer Behavior Risk (possible deviations from contractual cash flows due to customer prepayments, liquidations, etc.)

Parameters •Time Horizon 1 year •Confidence Level 99.97% •Price Risk Parameters - Time to Reduce and Core Level •Transition Matrix - Credit rating migration probabilities •Expected Loss •Probability of Default: CIBC maps internal ratings to a corresponding expected default frequency (EDF) based on 5 years of historical data •EAD For Large Corporate and Commercial Loans CIBC uses the minimum of 70/80% of a facility and the current usage •LGD defined by internal ratings

Models •Market Risk: VaR •Debt Specific Risk: CreditVaR and New DSR Model •Credit Risk –OTC Derivatives –Large Corporate and Commercial Loans –Other **RAROC**

Equity Basket Option

A basket option with underlying is a portfolio consisting of a set of stocks or a stock index. The component stocks may belong to a specific sector/industry or a few sectors/industries. Furthermore, the stock portfolio can be constructed so as to replicate a particular market index, wholly or partially. Generally speaking, a section of an index is often used instead of the broader index due to the fact that some component stocks need not necessarily be actively traded on exchanges. The value of an equity basket option is sensitive to the volatility of underlying stocks and the correlation among individual stocks. Equity basket options are normally held by investors who expect a basket of stocks to move substantially during the option's life. To that end, they attempt to avail of the lower premiums on basket options with respect to that on stand-alone options on each component stock.

Equity Risk

①General Market risk due Δ stock market indices level (systemic risk not diversifiable) ②Specific risk stock's price volatility due firm specifics - "unsystematic risk" can be diversified away ③Vega risk due Δ underlying volatility

Equity Swap

•In an equity swap, 2 parties make series of payments (1 set determined by stock or index return, 1 set as fixed or floating rate or return on another stock or index) •Used to substitute direct transaction in stock •Applications ①Diversifying Concentrated Portfolio ②Achieving International Diversification ③Executing an Asset Allocation Decision ④Create Index Fund ⑤Hedging an Equity Position

Equity underwriting

Equity warehousing

Gross adjusted assets (GAA)

For the calculation of the Assets-to-capital multiple; represent total assets including **specified off-balance sheet items and net of prescribed deductions**. Off-balance sheet items are direct

credit substitutes, including letters of credit and guarantees, transaction-related contingencies, trade-related contingencies and sale & repurchase agreements

Guarantees and standby letters of credit

Irrevocable assurances that a bank will make payments in the event that its client cannot meet its financial obligations to third parties; Other guarantees, e.g. bid and performance bonds, represent non-financial undertakings

Harmonized sales tax (HST)

Canadian sales tax that replaced the federal goods and services tax (GST) and the provincial sales tax (PST) in 5 of 10 Canadian provinces: British Columbia, Ontario, New Brunswick, Newfoundland and Labrador, and Nova Scotia

Hedge

A risk management technique used to mitigate exposure from market, interest rate or foreign currency exchange risk arising from normal banking operations. The elimination or reduction of such exposure is accomplished by establishing offsetting positions. For example, assets denominated in foreign currencies can be offset with liabilities in the same currencies or through the use of foreign exchange hedging instruments such as futures, options or foreign exchange contracts

Hedge funds

A type of investment fund, marketed to accredited high net worth investors, that is subject to limited regulation and restrictions on its investments compared to retail mutual funds, and that often utilize aggressive strategies such as selling short, leverage, program trading, swaps, arbitrage and derivatives

Home equity products

This is comprised of residential mortgages and secured personal loans whereby the borrower pledges real estate as collateral

Impaired loans

When there has been a deterioration of credit quality to the extent that management no longer has reasonable assurance of timely collection of the full amount of principal and interest in accordance with the contractual terms of the loan agreement. Credit card balances are **not** classified as impaired as they are directly written off after payments are 180 days past due

Innovative capital instruments

Capital instruments issued by Special Purpose Entities (SPEs), whose primary purpose is to raise capital. We previously issued innovative capital instruments, RBC Trust Capital Securities (RBC TruCS) and RBC Trust Subordinated Notes (RBC TSNs), through three SPEs: RBC Capital Trust, RBC Capital Trust II and RBC Capital Trust III. As per OSFI guidelines, innovative capital can comprise up to 15% of net Tier 1 capital with an additional 5% eligible for Tier 2 capital

Incremental risk charge (IRC)

Effective in Q1 of 2012, as part of the revisions to the Basel 2.5 frameworks, the IRC is a supplemental market risk capital charge that is intended to capture the **credit rating migration and default risk of held for trading positions**. We calculate the IRC for all cash and credit derivative positions that attract models-based regulatory capital including sovereign issuers. The implementation of the IRC increased RWA and reduced capital ratios compared to the prior year

International Financial Reporting Standards (IFRS)

principles-based standards, interpretations and framework adopted by International Accounting Standards Board

Interest Rate Risk

Interest rate risk's 3 components: term structure risk, basis risk, options risk.

Term structure risk

(Yield curve or re-pricing risk) = risk due to changes in fixed income term structure when maturity mismatches or with floating rate assets/liabilities causing **re-pricing** risks when interest rate is reset—either due to maturities or floating rate resets.

Basis risk

(Spread risk) = risk due to changes in spreads when lending rate (prime) is different from funding rate (LIBOR).

Options risk

Risk due to fixed income options—stand-alone (caps, swaptions) or embedded (callable bonds, prepayment). The market risk of fixed income options arises primarily from 2 sources: changes in underlying interest rates, and changes in implied volatilities, therefore term structure risk (including option risk), and basis risk

Interest Rate Swap IRS

•Contractual obligation to exchange series of interest payments (fixed/floating) over predetermined **swap term** •For borrowers (most frequent users): **synthetic fixed rate for fixed term** •Underlying funding still accomplished through floating rate (such as Bankers Acceptance ("B.A.)) issuance; client agrees to pay fixed rate & receive floating rate (i.e. borrower continues to fund by Bankers Acceptances or LIBOR and receives that index in return for paying a fixed rate) •Floating index either 1 or 3-month B.A.'s or LIBOR •Cash flows from swap (fixed versus floating rate) netted out •Swap rate effectively represents **break-even analysis** of anticipated path of short-term rates implied by yield curve over term of transaction •Any **amortization schedule** (mortgage-style, equal principal payment, roller coaster, etc.) or principal structure •Priced to reflect forward (delayed) start or prior-dated start as appropriate •Cash-settled on "effective date" for utilization as hedge against

upcoming debt issuance •Daily weighted average B.A. calculation rather than one-time reset to better emulate cost-of-funds over given period •Accommodate **periodic rate setting** at end of period rather than beginning - known as "**arrears**" **structure** (conventionally, rate setting takes place at beginning of period and payment settlement t at end of period) •Incorporate **B.A. stamping fee** into fixed rate calculation to create appearance of mortgage-style payments •Established for longer term than underlying credit facility by utilizing **Mutual Puts** (refers to both parties to the transaction having one-day right to terminate the swap with any breakage costs being borne by the out-of-the-money party) •Determination of frequency of periodic swap settlements made in conjunction with client, taking into account conditions imposed by client's credit agreement with CIBC (requirement for client to make monthly payments of principal and interest will require swap settlement occurs monthly) •Formula to calculate periodic settlement (assuming standard Canadian market conventions): **(Swap Rate - B.A. Rate) * Notional Amount * # of Days in Period / 365 = Settlement Amount** •Positive amounts are debited to client while negative amounts are credited •Assume Fixed Swap Rate of 4.50% and a B.A. Rate of 5.00% at some future point in time on a bullet style swap on a \$5,000,000 underlying loan and quarterly resets: $(4.50\% - 5.00\%) * \$5,000,000 * 91 \text{ days} / 365 \text{ days} = -\$6,232.88$ - A credit to the clients account of \$6,232.88 results in the floating rate interest cost being reset to the predetermined fixed rate interest rate of 4.50% excluding B.A. stamping fee

Liquidity Risk

•**Issues** (liquidity mismatch analysis, market liquidity risk, funding liquidity risk, liquid assets portfolios, collaterals, concentrations, contingent liabilities) •Product coverage with modeling of cash flows, optionality, pricing •**Analytics** (gap reports, runoffs, ratios, stochastic analytics, counterbalancing capacity) •Scenario generation, stress testing •Behavioral models of core demand deposits, pre-payable mortgages, mortgage pipeline and revolving facilities, with twin views of contractual and behaviorally modeled cash flows •Stochastic scenario-based dynamic simulation of future business •**Functionalities** (cash flow simulation, dynamic behavioral modeling, stochastic & stress scenarios, compliance with regulations, e.g. FSA's Individual Liquidity Adequacy Standards •Scenario-based optimizer to assess earnings & values trade-off

Market risk sensitivities

Delta, Gamma, Vega, Theta, Rho **Delta** = NPV of shifted curved –non-shifted curved; shift usually 1 basis point up or down OSFI uses 14-point base curve for calculation **Delta Dollar** represented in dollar - Cash has no **Vega** (for only product with optionality) **Gamma** second derivative of delta

Market risk types

•**Interest Rate risk** ("curve" risk, basis risk) •**Commodity** (concentration, liquidity) •**FX** (domestic, foreign, spot) •**Equity** (general + specific) •**idiosyncratic risk, spread risk, cross gamma risk**

Market Risk type (and risk factors)

•**IR** (yield curves, implied volatility of yield, swap spread) •**Credit spread** (yield curves, spread curves, FX rates, correlations between indices) •**Equity** (stock, index prices, index implied volatilities) •**FX** (rate, implied volatilities) •**Commodities** (spot, forward, implied volatility, zero) •**DSR** (log returns of credit spreads, default/idiosyncratic spread/ downgrade risk) **ENHANCED VAR MEASURES** •**IR Basis Risk** (due to changes in spreads, from changes in different market sectors e.g. LIBOR v Prime) •**Equity Skew Vega Risk** (due to difference in implied volatility (IV) between out-of-the-money, at-the-money and in-the-money options; affected by sentiment and supply/demand relationship; explains preference to write calls or puts; **Vega risk** due to variations in volatility, or volatility of volatility) •**Commodity Skew Vega Risk** (skew caused by fear of underlying rallying over underlying falling.) •**IR Skew Vega Risk** •**Correlation Risk** •**Dividend Risk** •**Customer Behavior** •**Re-pricing Risk**

Master netting agreement

Agreement with counterparty designed to reduce credit risk of multiple derivative transactions through creation of a legal right of offset of exposure in the event of a default

Monte Carlo Simulation

A broad class of computational algorithms that rely on repeated random sampling to obtain numerical results; typically one runs simulations many times over in order to obtain the distribution of an unknown probabilistic entity

Monte Carlo methods

•Define a domain of possible inputs •Generate inputs randomly from a **probability distribution** over the domain •Perform a **deterministic** computation on the inputs •Aggregate the results.

Normal or "bell curve"

User simply defines the mean or expected value and a standard deviation to describe the variation about the mean. Values in the middle near the mean are most likely to occur. It is symmetric and describes many natural phenomena such as people's heights. Examples of variables described by normal distributions include inflation rates and energy prices.

Lognormal

Values are positively skewed, not symmetric like a normal distribution. It is used to represent values that don't go below zero but have unlimited positive potential. Examples of variables described by lognormal distributions include real estate property values, stock prices, and oil reserves.

Uniform

All values have an equal chance of occurring, and the user simply defines the minimum and maximum. Examples of variables that could be uniformly distributed include manufacturing costs or future sales revenues for a new product.

Triangular

The user defines the minimum, most likely, and maximum values. Values around the most likely are more likely to occur. Variables that could be described by a triangular distribution include past sales history per unit of time and inventory levels.

PERT

The user defines the minimum, most likely, and maximum values, just like the triangular distribution. Values around the most likely are more likely to occur. However values between the most likely and extremes are more likely to occur than the triangular; that is, the extremes are not as emphasized. An example of the use of a PERT distribution is to describe the duration of a task in a [project management model](#).

Discrete

The user defines specific values that may occur and the likelihood of each. An example might be the results of a lawsuit: 20% chance of positive verdict, 30% chance of negative verdict, 40% chance of settlement, and 10% chance of mistrial

Net interest income

The difference between what is earned on assets such as loans and securities and what is paid on liabilities such as deposits and subordinated debentures

Net interest margin (average assets)

Net interest income as a percentage of total average assets

Net Interest Income NII, Net Interest Margin, Non-Interest revenues

Net Interest Income NII = Earnings on assets (loans + securities) + interests + dividend income – interest expense paid in liabilities (deposits)

Net Interest Margin = NII / earning assets

Non-Interest revenues = revenues–NII = securities commissions & fees + deposit & payment services + lending fees + card fees + investment management & custodian fees +mutual fund revenues + underwriting & advisory + **Trading-related revenues**

Normal course issuer bid (NCIB)

Program to repurchase our own shares for cancellation through a stock exchange that is subject to the various rules of the relevant stock exchange and securities commission

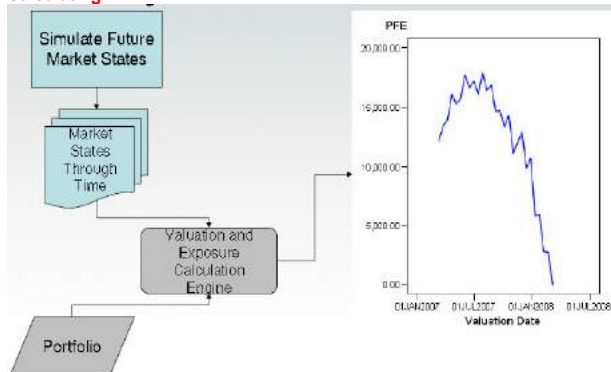
Notional amount

Contract amount used as a reference to calculate derivatives payments

Potential Future Exposure PFE

Potential Future Exposure is maximum exposure under normal market conditions for a future point in time **Exposure = MAX(0, MtM)** •PFE is sort of like VaR, but deals with the positive side of the MtM distribution •PFE looks at long holding periods while VaR is for short term fluctuations (default risk usually negligible in the short term)

Calculating PFE



Issues with Long Dated Simulations ❶Shape of volatility forward curve ❷Non-normality of price distributions ❸Seasonality of prices and volatility ❹Shifting Correlations

Simulation Methodology ❶Modified Covariance Simulation ❷Model Based Simulation

❸PCA (Principal Component Analysis Simulation) of Forward Curves

Primary sources of risk

❶Incremental VaR (incremental impact of 1 asset) ❷Delta VaR (risk contribution of 1 asset to a portfolio)

Productivity ratio

(Most common) expense-to-revenue ratio or cost to revenue ratio measures non-interest expenses as a proportion of operating revenue. Costs include salaries, technology, buildings, supplies, and administrative expenses. Revenue includes net interest income (interest revenue less interest expenses) plus fee income. Cash productivity ratio or cash efficiency ratio - deducts the amortization of intangible assets from noninterest expenses, before calculating the efficiency ratio

Off-balance sheet financial instruments

A variety of arrangements offered to clients, which include credit derivatives, written put options, backstop liquidity facilities, stable value products, financial standby letters of credit, performance guarantees, credit enhancements, mortgage loans sold with recourse, commitments to extend credit, securities lending, documentary and commercial letters of

credit, note issuances and revolving underwriting facilities, securities lending indemnifications and indemnifications.

Office of the Superintendent of Financial Institutions Canada (OSFI)

Primary regulator of federally chartered financial institutions and federally administered pension plans in Canada; OSFI's mission is to safeguard policyholders, depositors and pension plan members from undue loss

Operating leverage

Difference between our revenue growth rate and non-interest expense growth rate

Options

A contract or a provision of a contract that gives one party (the option holder) the right, but not the obligation, to perform a specified transaction with another party (the option issuer or option writer) according to specified terms

Option-adjusted spread OAS

Option-adjusted spread (OAS) is the flat spread which has to be added to the Treasury yield curve in a pricing model (that accounts for embedded options) to discount a security payment to match its market price. In contrast to the simple "**yield curve spread**" or "**Z-spread**" measurement of bond premium over a fixed cash-flow model, the OAS describes the market premium over a model including two types of volatility: **variable interest rates** and **variable prepayment rates**.

Portfolio run-off

Decrease in the assets of a mortgage-backed securities portfolio due to the prepayment of the securities held in that portfolio. It is risk these portfolios face, which can lead to prepayment risk; this usually forces the fund to reinvest the proceeds at lower yields than where the original securities were purchased. MBS has an embedded call option held by the borrowers of the underlying mortgages backing those securities. When interest rates fall or home values rise, an incentive is created for homeowners to refinance their mortgage, which leads to portfolio runoff for the investors in those mortgages

Prepaid pension benefit cost

The cumulative excess of amounts contributed to a pension fund over the amounts recorded as pension expense

Primary dealer

A formal designation provided to a bank or securities broker-dealer permitted to trade directly with a country's central bank. Primary dealers participate in open market operations, act as market-makers of government debt and provide market information and analysis to assist with monetary policy

Provision for credit losses (PCL)

The amount charged to income necessary to bring the allowance for credit losses to a level determined appropriate by management. This includes both specific and general provisions

RAROC Risk-Adjusted Return on Capital

Single hurdle rate to be used across all businesses to assess performance evaluation

• **RAROC = Net risk-adjusted profit / Economic Capital**

For performance measurement:

• **RAROC = [Revenue – Cost of Funds – Non Interest Expenses – Taxes + Return on E.C. – Expected Credit Losses] / [Credit + Market + Operational + Other Capital]**

Repurchase agreements

Involve the sale of securities for cash and simultaneous repurchase of the securities for value at a later date. These transactions do not constitute economic sales and therefore are treated as collateralized financing transactions

Residential mortgage-backed securities (RMBS)

Securities created through the securitization of residential mortgage loans

Return on common equity (ROE)

Net income less preferred share dividends, expressed as a percentage of average common equity

Reverse repurchase agreements

Involve the purchase of securities for cash and the simultaneous sale for value at a later date. These transactions normally do not constitute economic sales and therefore are treated as collateralized financing transactions

Risk

Credit risk, market risk, liquidity and funding risk, operational risk, legal and regulatory compliance risk, reputation risk, insurance risk, and strategic risk

Risk-weighted assets (RWA)

Assets adjusted by a regulatory risk-weight factor to reflect the riskiness of on and off-balance sheet exposures; certain assets are not weighted, but deducted from capital. The calculation is defined by guidelines issued by OSFI based on Basel II, effective November 1, 2007. Refer to the Capital management section

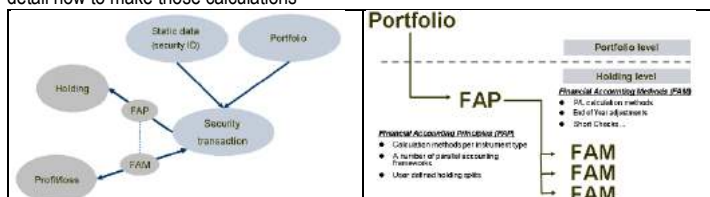
SCD Data Format Setup DFS

SCD Financial Accounting Methods FAM

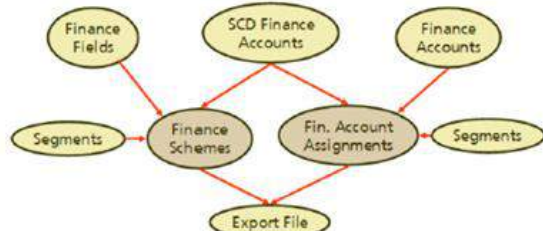
Approach or formulas used to calculate profit/loss and End-of-Period values. A FAM may be defined using combinations of accounting methods.

SCD Financial Accounting Principles FAP

Specifies which fields are significant in the holding key and the appropriate FAM for calculations. FAPs define how many individual calculations should be made, and FAM's detail how to make those calculations



SCD Financial Scheme, Financial Account Assignments



- **Finance Account Assignments** not transaction but instrument/ holding key segmented mappings, to handle account assignment for all transactions meeting various segment criteria (assignment handling all US equities (long/ short/ buys/ sells/ mtn/ dividends/ reclaims)
- **Finance Scheme** transaction & instrument specific • Raw transaction values assigned to **Finance Fields** mapped to **Finance Accounts** via **Finance Scheme** setup for **Agreement Date (AD)** & **Settlement Date (SD)** entries; in **Finance Account Debit/Credit** columns, Finance Fields assigned to generic **SCD Finance Accounts** • **Instrument Segment-Instrument Type- Transaction Segment** to further segment particular instruments/transactions that can use the scheme; **transaction segment** to specify other criteria (long equity versus short equity positions) • In **Finance Account Assignment**, **Finance Accounts** mapped into (final internal GL accounts); system allows DR/CR accounts to be configured to depend on sign of amount is +/- (distinguish interest income on positive cash balances from interest expense on negative cash balances ⇒ map Finance Field to generic SCD Finance Account 'Interest Inc/Exp' then, based on signage, map +ve amounts to income account and -ve amounts to expense account)

[SCD SIMCORP](#) [More on SCD](#)

Securities lending

Transactions in which the owner of a security agrees to lend it under the terms of a prearranged contract to a borrower for a fee. The borrower must collateralize the security loan at all times. An intermediary such as a bank often acts as agent for the owner of the security. Two types of arrangements: lending with and without credit or market risk indemnification. If without indemnification, the bank bears no risk of loss. If with indemnification, it bears the risk of loss if the borrower defaults and the value of the collateral declines concurrently

Securities sold short

A transaction in which the seller sells securities and then borrows the securities in order to deliver them to the purchaser upon settlement; at a later date, the seller buys identical securities in the market to replace the borrowed securities

Securitization

The process by which various financial assets are packaged into newly issued securities backed by these assets

Special purpose entities (SPEs)

May take the form of a corporation, trust, partnership or unincorporated entity; created to accomplish a narrow and well-defined objective with legal arrangements that impose strict limits on the decision-making powers of their governing board, trustee or management over

its operations. Frequently these provisions specify that the policy guiding the ongoing activities of the SPEs cannot be modified, other than perhaps by its creator or sponsor

Standardized Approach

Risk weights prescribed by OSFI are used to calculate risk-weighted assets for the credit risk exposures. Credit assessments by OSFI recognized external credit rating agencies of S&P, Moody's, Fitch and DBRS are used to risk weight our Sovereign and Bank exposures based on the standards and guidelines issued by OSFI. Our Business and Retail exposures use OSFI standard risk weights

Static P&L or hypothetical P&L

Would have occurred if portfolio at previous day's close were held constant for current day assuming no additional transactions are made (i.e. ignoring or types of P&L that arise from intra-day trading activities, fees and commissions, and new business revenue)

Stress test, scenario analysis

Determine size (not frequency) of potential losses for specific scenarios

Structured investment vehicles

Managed investment vehicle that holds mainly highly rated asset-backed securities and funds itself using the short-term commercial paper market as well as the medium-term note (MTN) market

Subprime lending

Practice of making loans to borrowers who do not qualify for the best market interest rates because of their deficient credit history. It carries more risk for lenders due to the combination of higher interest rates for the borrowers, poorer credit histories, and adverse financial situations usually associated with subprime applicants

Taxable equivalent basis (teb)

Income from certain specified tax advantaged sources is increased to a level that would make it comparable to income from taxable sources. The offsetting adjustment in the tax provision generates the same after-tax net income

Tier 1 capital and Tier 1 capital ratio

Tier 1 capital comprises the more permanent components of capital and consists primarily of common shareholders' equity, non-cumulative preferred shares, the majority of which do not have conversion features into common shares, and the eligible amount of innovative capital instruments. In addition, goodwill and other items as prescribed by OSFI are deducted from Tier 1 capital to determine adjusted net Tier 1 capital

Tier 1 capital ratio = adjusted net Tier 1 capital / risk-weighted assets

Tier 2 capital

Subordinated debentures, trust subordinated notes, the eligible amount of innovative capital instruments that could not be included in Tier 1 capital, and an eligible portion of the total general allowance for credit losses, less OSFI prescribed deductions.

Total capital and total capital ratio

Total capital is the total of net Tier 1 and Tier 2 capital. The total capital ratio is calculated by dividing total capital by risk weighted assets

Tranche

A security class created whereby the risks and returns associated with a pool of assets are packaged into several classes of securities offering different risk and return profiles from those of the underlying asset pool. Tranches are typically rated by ratings agencies, and reflect both the credit quality of underlying collateral as well as the level of protection based on the tranches' relative subordination

Troubled asset workout

Bulk asset transfers + one-off loan sales (low transaction costs + limited risk) to third-party investors, borrowers, guarantors

Trust Capital Securities (RBC TruCS)

Transferable trust units issued by special purpose entities RBC Capital Trust or RBC Capital Trust II to raise innovative Tier 1 capital

Trust Subordinated Notes (RBC TSNs)

Transferable trust units issued by RBC Subordinated Notes Trust for the purpose of raising innovative Tier 2 capital

Value-at-Risk (VaR)

A generally accepted risk-measurement concept that uses statistical models based on historical information to estimate within a given level of confidence the maximum loss in market value we would experience in our trading portfolio from an adverse one-day movement in market rates and prices

VaR

Maximum loss not exceeded with a given confidence level over given period of time = a quantile of return distribution", common confidence level: 95% or 99% **3 components**
1 position measures **2** market data distribution assumptions **3** measurement models - Measure VaR effectiveness compare realized vs. predicted P&L

VaR Enhanced VaR

1 FX basis risk spread (foreign interest rates implied based on market forward points & domestic interest rates); segregate FX forward IR risk = [risk from IIR changes of base/ domestic CCY (USD) and IR changes of foreign CCY] **2** Data sources swap + spot FX rates from MHS, forward points from Bloomberg, IR Delta sensitivities from Voyager **3** VaR methods Excel linked to Bloomberg terminal (a) get USD swap rates, foreign CCY swap rates, FX spot rates + forward points, settlement dates for each CCY and each term from

Bloomberg (b) calculate implied foreign interest rates + FX basis (c) get FX basis sensitivities for each CCY and term (d) calculate FX basis P&L as product of change in FX basis from previous COB date to COB date and IR delta for CCY/term for last 2 years (e) calculate VaR as 1st percentile of P&L for CCY

VaR IRC (incremental risk charge)

Special risk of securitization in trading book (credit risk transformed into market risk) IRC models measure losses due to default and migration at 99.9% CI over 1 year, accounting for liquidity horizons applicable to individual trading positions or sets of positions

VaR Stressed VAR

Merge stress testing with VAR, jump/tail effects, fat tail Gaussian volatilities of returns, turbulent market collective behavior, high confidence level (easy), liquidity penalties (hard), idiosyncratic (hard), different time scales for different risks/ environments, dynamic trading effects (model) **Enhanced VaR** = stressed VaR, back testing and stress testing **MtM (mark-to-market) & MC VaR** $X(t) = [x_1(t), x_2(t), \dots, x_n(t)]$ time series market data, $P()$ trade price function, T current date **MtM** $MtM(T) = P[X(T)]$, $X(T)$ spot data; \forall scenario s , trade value $ScenValue(s) = P[X(s)] \Rightarrow P\&L(s) = ScenValue(s) - MtM(T)$ **Historical simulation of $X(s)$** $X(s) = X(T) * shock(s)$ if relative shock or $X(s) = X(T) + shock(s)$ if absolute shock; shock(s) from historical market data $X(t)$, $t < T$ **Monte Carlo simulation of $X(s)$** $X(s) = F[X(T), a(X(t)), z(s)]$, $F()$ market data model, $z(s)$ random variable vector, $a(X(t))$ model parameters estimated from historical market data $X(t)$, $t < T$

Variable interest entity (VIE)

Either does not have sufficient equity at risk to finance its activities without additional subordinated financial support, or where the holders of the equity at risk lack the characteristics of a controlling financial interest

FX Trading Private

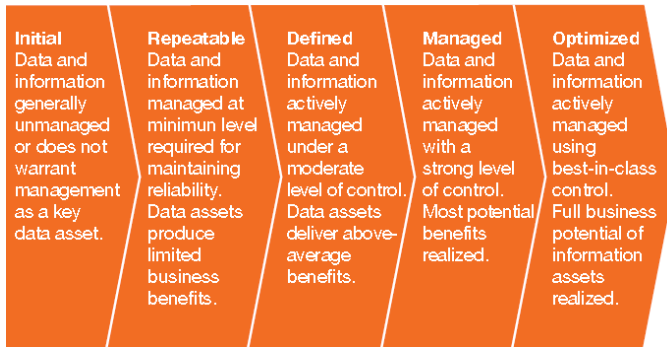
FX Demand Draft - aka "remotely created checks", method used by individuals to make transfer payments from one bank account to another. Demand drafts are marketed as a relatively secure method for cashing checks. The major difference between demand drafts and normal checks is that demand drafts do not require a signature in order to be cashed

FX Overdraft - A revolving facility repayable on Demand, made available in connection with a current account. Money is withdrawn from a bank account and the available balance goes below zero. In this situation the account is said to be "overdrawn". If there is a prior agreement with the account provider for an overdraft, and the amount overdrawn is within the authorized overdraft limit, then interest is normally charged at the agreed rate. If the negative balance exceeds the agreed terms, then additional fees may be charged and higher interest rates may apply

Data Management

Data Management Maturity

Data management maturity model



DARPA data management framework

Data Management 11 Knowledge Areas

1 **Data Governance** planning, oversight, control over management of data + use of data and data-related resources 2 **Data Architecture** overall structure of data and data-related resources as an integral part of enterprise architecture 3 **Data Modeling & Design** analysis, design, building, testing, and maintenance 4 **Data Storage & Operations** structured physical data assets storage deployment & management 5 **Data Security** privacy, confidentiality and appropriate access 6 **Data Integration & Interoperability** acquisition, extraction, transformation, movement, delivery, replication, federation, virtualization & operational support 7 **Documents & Content** storing, protecting, indexing, and enabling access to data found in unstructured sources (electronic files and physical records), and making this available for integration and interoperability with structured (database) data 8 **Reference & Master Data** managing shared data to reduce redundancy and ensure better data quality through standardized definition and use of data values 9 **Data Warehousing & Business Intelligence** managing analytical data processing & enabling access to decision support data for reporting and analysis 10 **Meta-data** collecting, categorizing, maintaining, integrating, controlling, managing, delivering meta-data 11 **Data Quality** defining, monitoring, maintaining data integrity, improving data quality

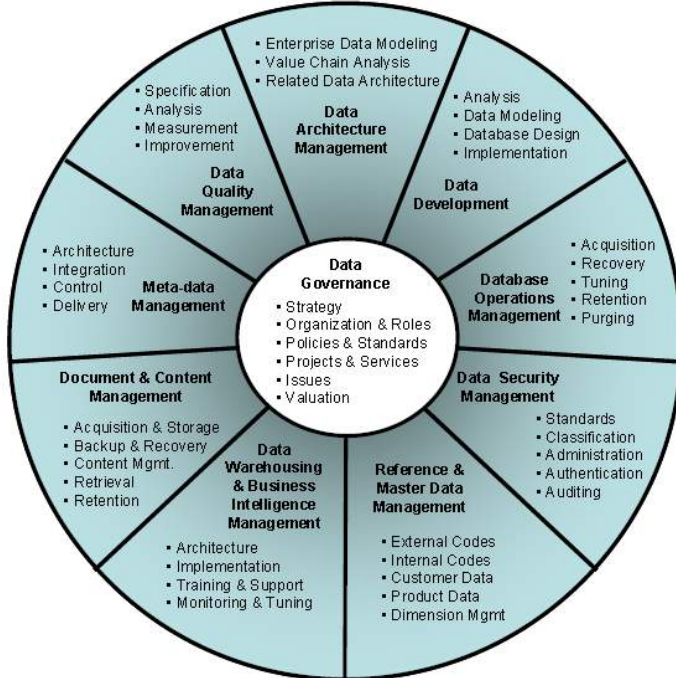


Figure 1.4 Data Management Functions – Scope Summary

Data Management Context diagram

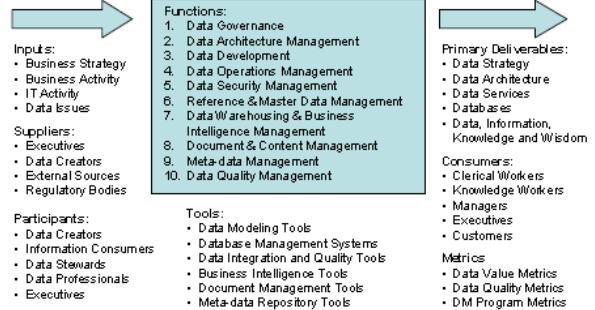
Data Management

Definition: The planning, execution and oversight of policies, practices and projects that acquire, control, protect, deliver, and enhance the value of data and information assets.

Mission: To meet the data availability, quality, and security needs of all stakeholders.

Goals:

1. To understand the information needs of the enterprise and all its stakeholders.
2. To capture, store, protect, and ensure the integrity of data assets.
3. To continually improve the quality of data and information.
4. To ensure privacy and confidentiality, and to prevent unauthorized or inappropriate use of data and information.
5. To maximize effective use and value of data and information assets.



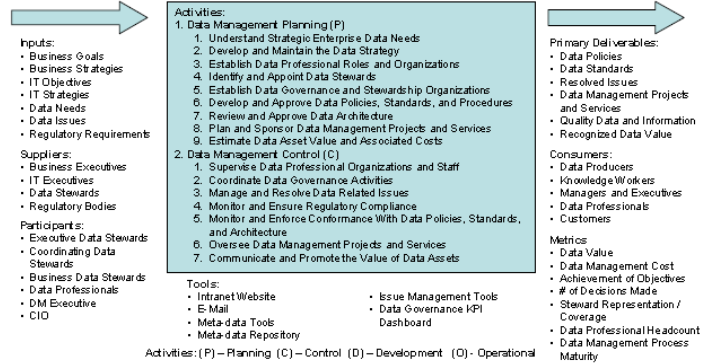
Data Governance Context Diagram

1. Data Governance

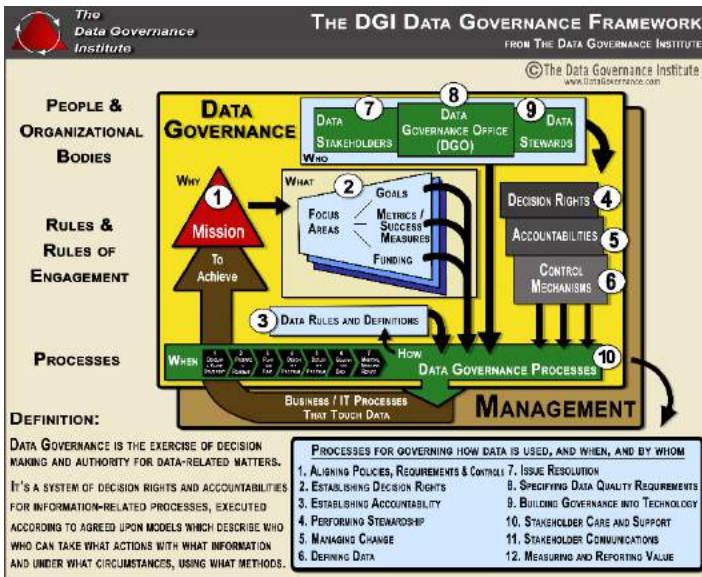
Definition: The exercise of authority and control (planning, monitoring, and enforcement) over the management of data assets.

Goals:

1. To define, approve, and communicate data strategies, policies, standards, architecture, procedures, and metrics.
2. To track and enforce regulatory compliance and conformance to data policies, standards, architecture, and procedures.
3. To sponsor, track, and oversee the delivery of data management projects and services.
4. To manage and resolve data related issues.
5. To understand and promote the value of data assets.



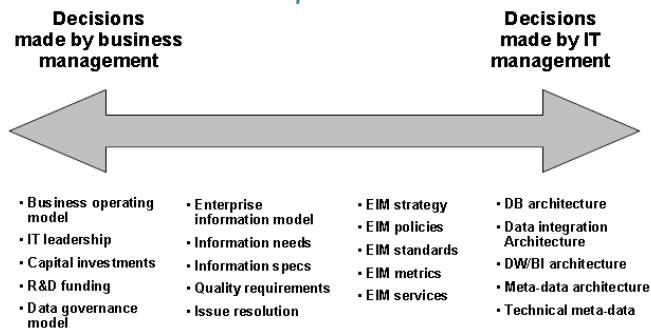
Data Governance Framework (DGI)



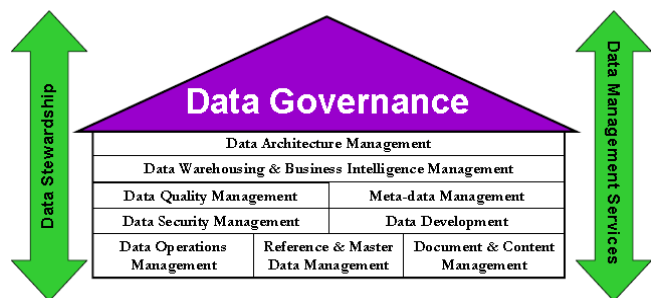
7 Data governance scope

1 **Data Strategy & Policies** (define, communicate, monitor) 2 **Data Standards & Architecture** (review, approve, monitor) 3 **Regulatory compliance** (communicate, monitor, enforce) 4 **Issue Management** (identify, define, escalate, resolve) 5 **Data management projects** (sponsor, oversee) 6 **Data asset valuation** (estimate, approve, monitor) 7 **Communication** (promote, build awareness, appreciate)

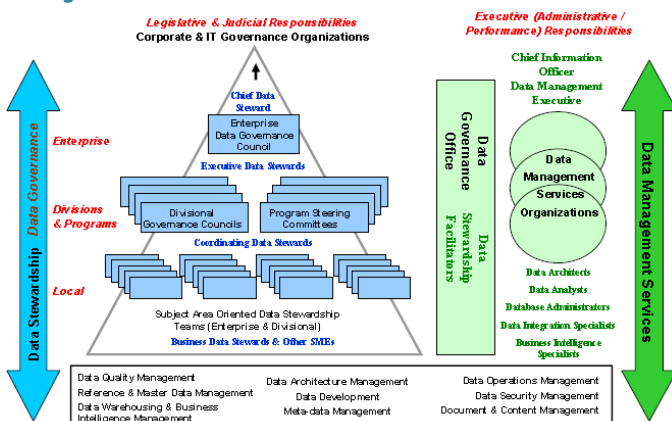
Data Governance Decision Spectrum



Data Governance, Stewardships and Services



Data governance activities



Data Strategy (13)

1 Compelling vision for data management 2 Business Case 3 Guiding principles, values, management perspectives 4 Mission, long-term goals 5 Measures for success 6 Short-term (12-24 months) SMART objectives 7 DM organizations, roles, responsibilities 8 DM program components & initiatives 9 Implementation roadmap (projects, action items) 10 Scope boundaries, decisions & issues for postponement 11 DM Project charter (vision, business case, goals, guiding principles, success measures, CSF, risks) 12 DM Scope Statement (3-year planning horizon goals & objectives, roles, organizations, RACI) 13 DM Implementation Roadmap (programs, projects, task assignments, delivery milestones)

Data Policies (9)

1 Data modeling, other development activities within SDLC 2 Development and use of data architecture 3 Data & Metadata quality expectations, roles, responsibilities 4 Data Security (confidentiality, intellectual property rights, personal data privacy, access & usage) 5 Data recovery and retention 6 Access & use of external sources 7 Sharing internally, externally 8 DW/BI policies 9 Files/physical records policies

Data Procedures (10)

1 Data modeling & architecture standards (data naming, definition, domains, abbreviations) 2 Business & technical meta-data to capture, maintain, integrate 3 Data model management guidelines & procedures 4 Metadata integration & usage 5 DB recovery, business continuity, DB performance, data retention, external data acquisition 6 Data security standards & procedures 7 Reference data management & control procedures 8 Match/merge, data cleansing standards & procedures 9 BI standards & procedures 10 Enterprise content management standards & procedures (enterprise taxonomies, support for legal discovery, document and email retention, electronic signatures, report formatting standards, report distribution approaches)

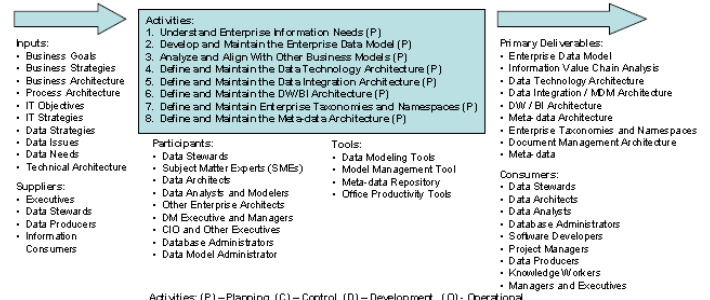
Data Architecture Management

2. Data Architecture Management

Definition: Defining the data needs of the enterprise and designing the master blueprints to meet those needs.

Goals:

1. To plan with vision and foresight to provide high quality data.
2. To identify and define common data requirements.
3. To design conceptual structures and plans to meet the current and long-term data requirements of the enterprise.



Data Architecture Categories (3)

1 Enterprise Data model heart & soul of data architecture 2 Information value chain analysis align data, business processes, enterprise architecture components 3 Related data delivery architecture (DB architecture, data integration architecture, DW/BI architecture, document content architecture, metadata architecture)

Enterprise Architecture (6)

1 Information architecture business entities, relationships, attribute, definitions, reference values 2 Process architecture functions, activities, workflow, events, cycles, products, procedures 3 Business architecture goals, strategies, roles, organization structures, locations 4 System architecture applications, SW components, interface, projects 5 Technology architecture networks, HW, SW, protocols 6 Information value chain artifacts relationship (data, process, business systems, technology)

Enterprise Data Model

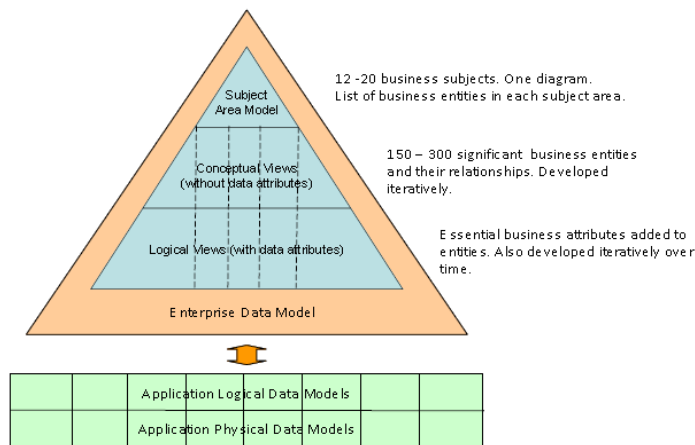


Figure 4.3 Enterprise Data Model Layers

Business Value Chain

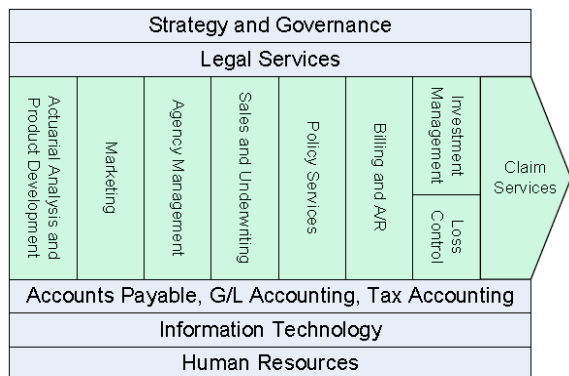


Figure 4.4 Example Insurance Business Value Chain

Methods to define Enterprise Architecture

- IBM Business System Planning
- James Martin Information System Planning

Zachman Enterprise Framework (6)

❶ **Planner View (Scope context)** list of subject areas, business entities
 ❷ **Owner View (Business Concepts)** conceptual data models
 ❸ **Designer View (System Logic)** Fully attributed & normalized logical data model
 ❹ **Builder View (Technology)** physical data models
 ❺ **Implementer View (component assemblies)** data structures, DDL
 ❻ **Functional enterprise actual implemented instances**

Normalization levels

• **1NF** Entity has valid Primary Key; all elements depend on PK, no repeating groups, atomic (not multi-valued) data element
 • **2NF** Entity has minimal PK, all elements depend on complete PK
 • **3NF** No hidden PK, each element depends on no data element outside PK ("the key, the whole key and nothing but the key")

Data Development Context Diagram

3. Data Development

Definition: Designing, implementing, and maintaining solutions to meet the data needs of the enterprise.

Goals:

1. Identify and define data requirements.
2. Design data structures and other solutions to these requirements.
3. Implement and maintain solution components that meet these requirements.
4. Ensure solution conformance to data architecture and standards as appropriate.
5. Ensure the integrity, security, usability, and maintainability of structured data assets.



Inputs:

- Business Goals and Strategies
- Data Needs and Strategies
- Data Standards
- Process Architecture
- Application Architecture
- Technical Architecture

Suppliers:

- Data Stewards
- Subject Matter Experts
- IT Steering Committee
- Data Governance Council
- Data Architects and Analysts
- Software Developers
- Data Producers
- Information Consumers

Participants:

- Data Stewards and SMEs
- Data Architects and Analysts
- Database Administrators
- Data Model Administrators
- Software Developers
- Project Managers
- DM Executives and Other IT Management

Activities:

1. Data Modeling, Analysis and Solution Design (D)
 1. Analyze Information Requirements
 2. Develop and Maintain Conceptual Data Models
 3. Develop and Maintain Logical Data Models
 4. Develop and Maintain Physical Data Models
2. Detailed Data Design (D)
 1. Design Physical Databases
 2. Design Information Products
 3. Design Data Access Services
 4. Design Data Integration Services
3. Data Model and Design Quality Management
 1. Develop Data Modeling and Design Standards (P)
 2. Review Data Model and Database Design Quality (C)
 3. Manage Data Model Versioning and Integration (C)
4. Data Implementation (D)
 1. Implement Development/ Test Database Changes
 2. Create and Maintain Test Data
 3. Migrate and Convert Data
 4. Build and Test Information Products
 5. Build and Test Data Access Services
 6. Validate Information Requirements
 7. Prepare for Data Deployment

Tools:

- Data Modeling Tools
- Database Management Systems
- Software Development Tools
- Testing Tools
- Data Profiling Tools
- Model Management Tools
- Configuration Management Tools
- Office Productivity Tools

Activities: (P) – Planning (C) – Control (D) – Development (O) – Operational

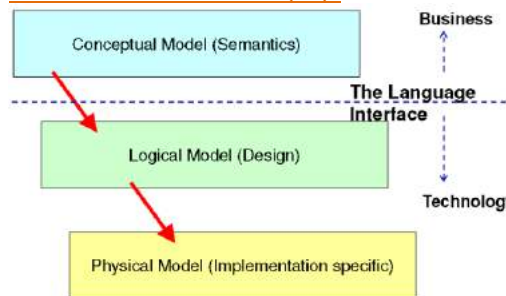
Data Lifecycle

Level (from Zachman)	Data	Function
0 Scope (contextual)	Relevant to business	Set of business processes
1 Business Model (conceptual)	Semantic Model	Functional Requirements (Use Case)
2 System Model (logical)	Logical Data Model	Logical Design
3 Technology Model (physical)	Physical Data Model	Physical Design
4 Detailed Representation	Data definition	Program

Deliverables per analysis stage

Analysis Stages	Models	Language
1 Business Analysis	• Business Use cases semantics	• Process models • Business data UML
2 Requirements Analysis	• Requirement Use Cases • Message choreographies	• Business data models UML
3 Logical Analysis	• Package & Class Models • Message Sequence Diagrams	• Message Sequence UML
4 Logical Design	Class Models	UML
5 Physical Design	Program code, XML schema	TBD

Semantics and Business Language



Semantics Relation (signs, things referring to/ meaning) Requirements for **Conceptual Model** owned and validated by business
 ❶ Manage "Language interface" between tech and business SME
 ❷ Everything in English
 ❸ Everything reviewable
 • Spreadsheets
 • Dialect-free diagrams
Ontology = model with [• Description of concepts in domain of discourse (i.e. Classes)
 • Properties of each concept (class) describing features & attributes (i.e. slots, properties, roles)
 • Restrictions on those properties (i.e. facets)]
Ontology + instance of information modeled according to that ontology = **knowledge base**
Ontology = formal specification of conceptualization
Taxonomy = Structured classification scheme (e.g. Linnaeus Taxonomy of Species, taxonomy of Financial Instruments)
Ontology adds formal properties to taxonomy/ describes real world things
Vocabulary/ Lexicon words for things
Resource Description Framework (RDF) = general-purpose language for representing information in the Web

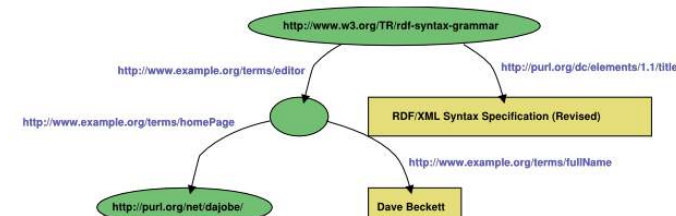


Figure 1: Graph for RDF/XML Example (SVG version)

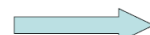
Data Operations Management

4. Data Operations Management

Definition: Planning, control, and support for structured data assets across the data lifecycle, from creation and acquisition through archival and purge.

Goals:

1. Protect and ensure the integrity of structured data assets.
2. Manage availability of data throughout its lifecycle.
3. Optimize performance of database transactions.



Inputs:

- Data Requirements
- Data Architecture
- Data Models
- Legacy Data
- Service Level Agreements

Suppliers:

- Executives
- IT Steering Committee
- Data Governance Council
- Data Stewards
- Data Architects and Modelers
- Software Developers

Participants:

- Database Administrators
- Software Developers
- Project Managers
- Data Stewards
- Data Architects and Analysts
- DM Executives and Other IT Management
- IT Operators

Activities:

1. **Database Support**
 1. Implement and Control Database Environments (C)
 2. Obtain Externally Sourced Data (O)
 3. Plan for Data Recovery (P)
 4. Backup and Recover Data (O)
 5. Set Database Performance Service Levels (P)
 6. Monitor and Tune Database Performance (C)
 7. Plan for Data Retention (P)
 8. Archive, Retain, and Purge Data (O)
 9. Support Specialized Databases (O)
2. **Data Technology Management**
 1. Understand Data Technology Requirements (P)
 2. Define the Data Technology Architecture (P)
 3. Evaluate Data Technology (P)
 4. Install and Administer Data Technology (C)
 5. Inventory and Track Data Technology Licenses (C)
 6. Support Data Technology Usage and Issues (O)

Tools:

- Database Management Systems
- Data Development Tools
- Database Administration Tools
- Office Productivity Tools

Primary Deliverables:

- DBMS Technical Environments
- Dev/Test, QA, DR, and Production Databases
- Externally Sourced Data
- Database Performance
- Data Recovery Plans
- Business Continuity
- Data Retention Plan
- Archived and Purged Data

Consumers:

- Data Creators
- Information Consumers
- Enterprise Customers
- Data Professionals
- Other IT Professionals

Metrics:

- Availability
- Performance

Activities: (P) – Planning (C) – Control (D) – Development (O) – Operational

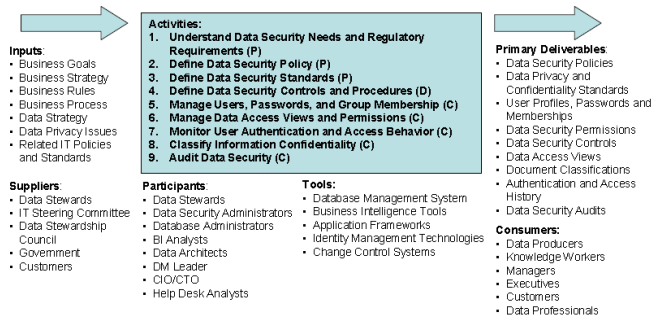
Data Security Management

5. Data Security Management

Definition: Planning, development, and execution of security policies and procedures to provide proper authentication, authorization, access, and auditing of data and information.

Goals

1. Enable appropriate, and prevent inappropriate, access and change to data assets.
2. Meet regulatory requirements for privacy and confidentiality.
3. Ensure the privacy and confidentiality needs of all stakeholders are met.



Data Security in the outsourced world

1. SLA
2. Limited liability provisions in outsourcing contracts
3. Right-to-audit clauses
4. Consequences to breaching contractual obligations
5. Frequent data security reports
6. Independent monitoring of vendor activity
7. Frequent and thorough security auditing
8. Communication with vendor

Reference and Master Data Management

Reference Data Management

Control over defined domain values (a.k.a. vocabularies), including:

- standardized terms
- code values & other unique identifiers
- business definition for each value
- business relationships within & across domain value lists
- shared use of accurate, timely & relevant reference data value to classify and categorize data

Master Data Management

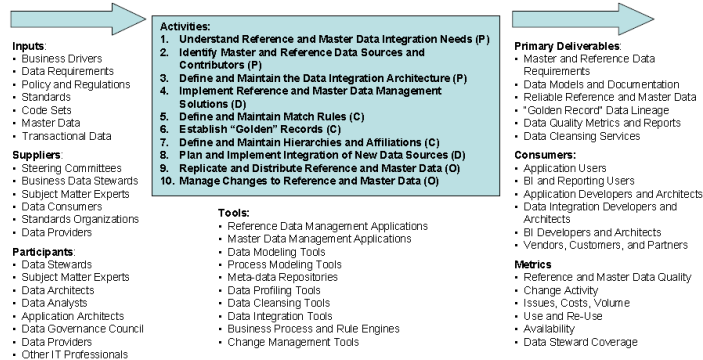
Control over master data values for consistent, shared, contextual use across systems

6. Reference & Master Data Management

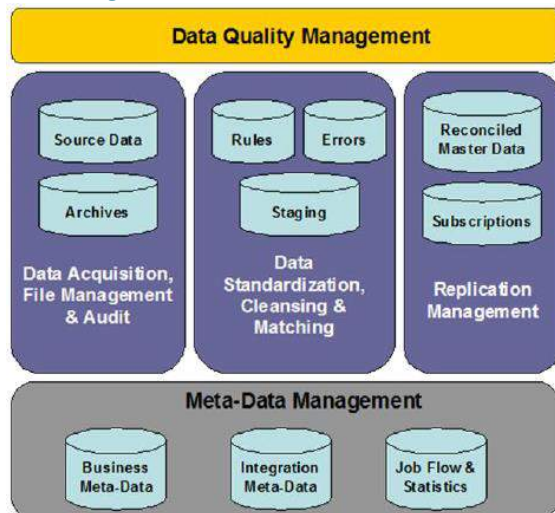
Definition: Planning, implementation, and control activities to ensure consistency with a "golden version" of contextual data values.

Goals

1. Provide authoritative source of reconciled, high-quality master and reference data.
2. Lower cost and complexity through reuse and leverage of standards.
3. Support business intelligence and information integration efforts.



Data Integration Architecture



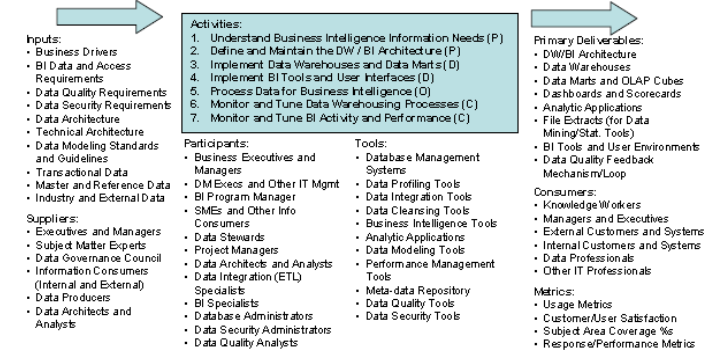
Data Warehousing & Business Intelligence Management

7. Data Warehousing & Business Intelligence Management

Definition: Planning, implementation, and control processes to provide decision support data and support knowledge workers engaged in reporting, query and analysis.

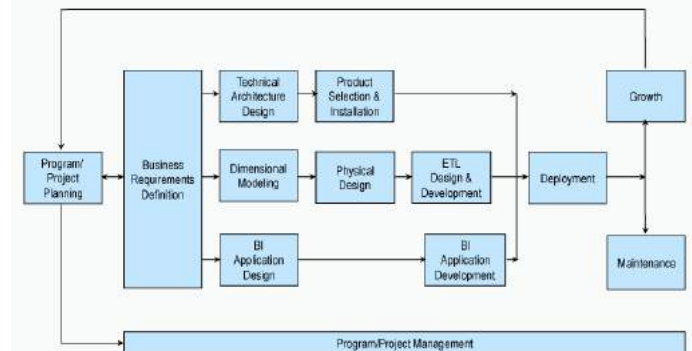
Goals

1. To support and enable effective business analysis and decision making by knowledge workers.
2. To build and maintain the environment / infrastructure to support business intelligence activity, specifically leveraging all the other data management functions to cost effectively deliver consistent integrated data for all BI activity.

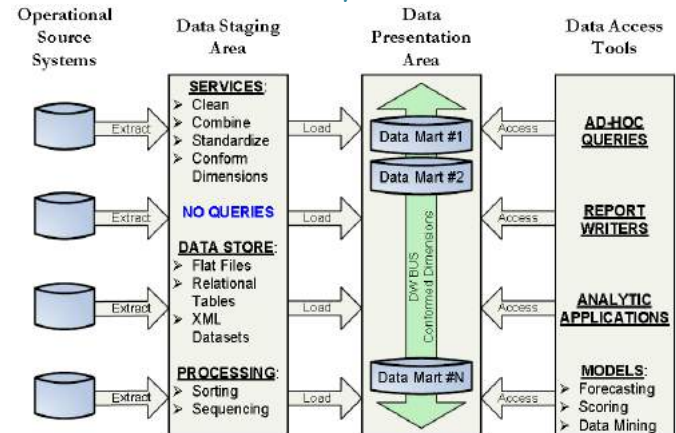


Kimball Business Lifecycle

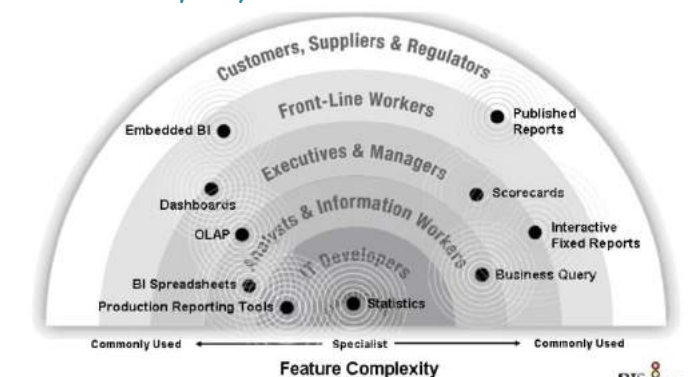
1. Business Focus (immediate, long-term)
2. Atomic Dimensional Data Models
3. Iterative Evolution Management



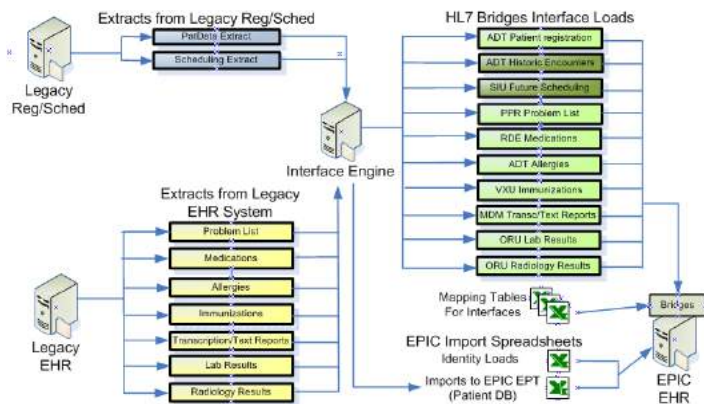
Kimball's data warehouse chess pieces



BI Level of Complexity



Sample data conversion architecture



SIMCORP Data warehouse

Data Warehouse Processes (IBM)

- 1 Establish project
- 2 Prepare project
- 3 Initiate DB
- 4 Explore DB
- 5 Implement
- 6 Iterate/Expand

P1 Establish Project

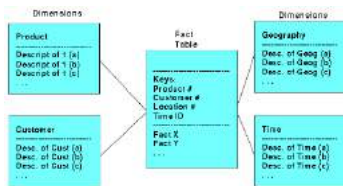
- 1 Gain corporate commitment & sponsorship
- 2 Define high-level architecture
- 3 Target opportunities
- 4 Project attributes (-source data existing & easily acquired -end users committed -results have immediate value)
- 5 Scope attributes (- Target single subject area -From 2 to 6 sources at most -From 2 to 4 consumers -Common usage across consumers - Can be achieved in 3-6 months - Incremental investment)
- 6 Establish realistic goals
- 7 IT (-Build client/server solution skills -8 to 10 data warehouse tables)
- 8 End user (- Reproduce x, y and z reports from DW -Have at least hard copy metadata -Able to track sales trends for last 12 months by product)
- 9 Develop high level project plan
- 10 Iterative approach (-Get minimal data through process -Debug process -Add more data/subject areas -Incorporate discoveries into next cycle)
- 11 Timebox (deadlines)

P2 Prepare project

- 1 Define key tasks -Data acquisition -Data Modeling -Operations -Metadata -Tools selection -Support
- 2 Gather high-level requirements
- 3 Business requirements -Processes involved -Critical success factors -Business entities, attributes, relationships (hierarchical, horizontal)
- 4 Business measurements -Types of users (executive, novice/casual, analyst, power, developer) -Budget for project
- 5 Technical requirements -Physical topology HW, SW, network configuration -Logical topology -Source database -Warehouse database issues (data needed, structure, transportation, transformation, cleansing, propagation requirements size and growth, operations (security, availability, automation))
- 6 Assemble team Technical project leaders, design/implement warehouse database, data marts and metadata
- 7 Business SME Corporate sponsors
- 8 End user end user tool classes, data access/query, report writers, multi-dimensional database (MDD) management systems, advanced decision support, Executive Information Systems (EIS)

P3 Initiate DB

- 1 Gather detailed user requirements/ expectations
- 2 Identify transformation & derivation attributes ⇒ Effort for
- 3 Cleansing/ checking data for validity, consistency, accuracy, correctness, trustworthiness
- 4 Mapping/ translation/ consolidating data sources
- 5 Calculations for data aggregation/ summarization



- 6 Model facts & dimensions
- 7 Architect database (including metadata) multiple tiers, ROLAP, MOLAP
- 8 Design infrastructure HW, SW, propagation methods/ frequency, availability
- 9 Acquire source data
- 10 Populate data warehouse database

P4 Explore (Test) DB

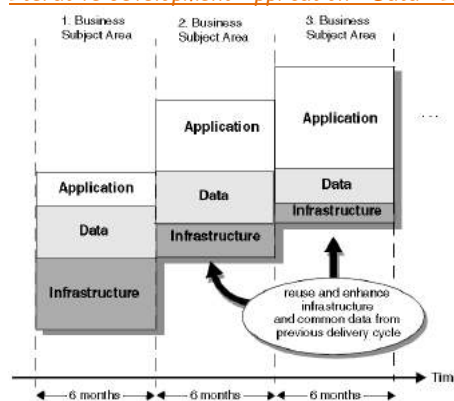
- 1 Identify propagation, preparation dependencies
- 2 Monitor end user usage (access patterns and performance)
- 3 Tune database & tools for optimal performance (iteration on table design as needed (summarize, aggregate, etc))
- 4 Plan & schedule update process/cycle
- 5 Define monitoring & control procedures
- 6 Define backup & recovery methods
- 7 Design archiving & retrieval plans/techniques
- 8 Create rollout plan for full implementation

P5 Implement

- 1 Prepare production environment
- 2 Train users
- 3 Define/initiate support process
- 4 Move into production

P6 Iterate/Expand

Iterative development Application - Data - Infrastructure



Data Warehouse Activities

Activities	Deliverables	Responsible	Approving	Contributing
Understand BI information needs	DW-BIM project requirements	Data/BI Analyst, PM, SME	Data Stewart, Executives	Meta-data specialist, Business Process
Define Architecture	DW/BI Architecture	DW/BI Architect	Enterprise Data Architect, Data Architecture Steering Committee	BI specialists, IT Specialists, Data Integration Specialists, DA, DBA
Implement data warehouse, data marts, OLAP Cubes	Data warehouse, data marts, OLAP Cubes	BI specialists	DW Architect, Data Stewardship Team	Data Integration Specialists, DA, DBA
Implement BI Tools and UI	BI Tools & User Environments, Query & Reporting, Dashboards, Scorecards	BI Specialists	DW Architect, Data Stewardship Team, Data Governance	DW Architect, DA, DBA
Process Data for BI (O)	Accessible Integrated Data, Data Quality feedback	Data Integration Specialists	Data Stewards	DA, DBA
Monitor & Tune DW processes	DW Performance Reports	DBA, Data Integration Specialists		IT Operators
Monitor & Tune BI activity & performance	BI performance reports, new indexes, new aggregations	BI Specialists, DBAs, BI Analysts		DA, DBA, IT Operators, Auditors

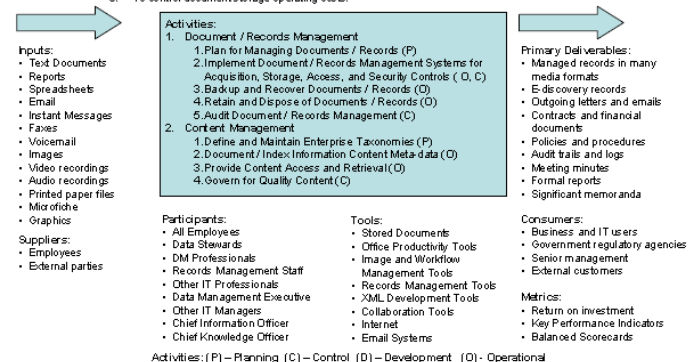
Document and Content Management

8. Document & Content Management

Definition: Planning, implementation, and control activities to store, protect and access data found within electronic files and physical records (including text, graphics, images, audio, and video).

Goals:

1. To safeguard and ensure the availability of data assets stored in less structured formats.
2. To enable effective and efficient retrieval and use of data and information in unstructured formats.
3. To comply with legal obligations and customer expectations.
4. To ensure business continuity through retention, recovery, and conversion.
5. To control document storage operating costs.



ANSI 859 Documents Controls

Data asset	Formal	Revision	Custody
Action item lists		X	
Agendas			X
Audit findings		X	X
Budgets	X		
DD 250s			X
Final proposal			X
Financial data and reports	X	X	X
Human resources data		X	
Meeting minutes			X
Meeting notices, minutes, attendance lists		X	X
Project plans (including data management and configuration management plans)	X		
Proposal (in-process)		X	
Schedules	X		
Statements of work	X		
Trade studies		X	
Training material	X	X	
Working papers			X

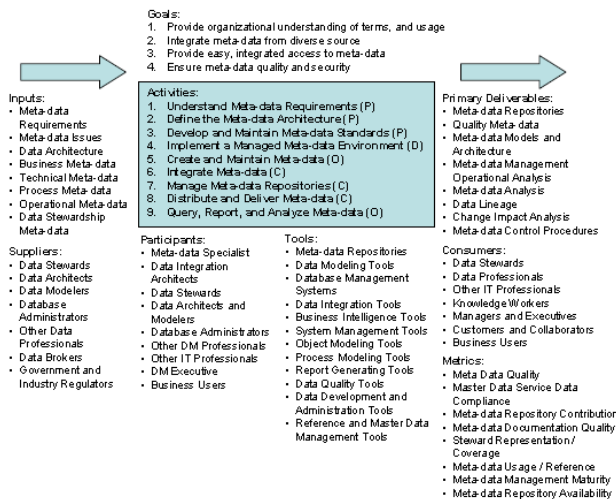
Meta Data Management

16 Meta data subject areas

1 Business Analytics data definition, reports, users, usage, performance
2 Business Architecture roles & organizations, goals & objectives
3 Business Definition terms & explanations for concepts, facts
4 Business Rules calculations, derivations
5 Data governance policies, standards, procedures, programs, roles, organizations, stewardship assignments
6 Data Integration sources, targets, transformations, lineage, ETL workflows, EAI, EII, migration, conversion
7 Data quality defects, metrics, ratings
8 Document content management unstructured data, documents, taxonomies, ontology, name sets
9 IT Infrastructure platforms, networks, configuration, licenses
10 Logical data model entities, attributes, relationships & rules, business names & definitions
11 Physical data model files, tables, columns, views, business definitions, indexes, usage, performance, change management
12 Process models functions, activities, roles, inputs/outputs, workflow, business rules, timing, stores
13 Systems portfolio & IT governance databases, applications, projects, programs, integration roadmap, change management
14 Service oriented architecture (SOA) information components, services, messages, master data
15 System design & development requirements, designs, test plans, impact
16 System management data security, licenses, configuration, reliability, service levels

9. Meta-data Management

Definition: Planning, implementation, and control activities to enable easy access to high quality, integrated meta-data.



Business Meta Data (13)

1 Business data definitions, calculations
2 Business rules, algorithms, hierarchies
3 Data lineage, impact analysis
4 Data model enterprise, conceptual, logical
5 Data quality statements (confidence, completeness indicators)
6 Data stewardship information & owning organizations
7 Data update cycle
8 Historical data availability
9 Historical/ alternate business definitions
10 Regulatory/ contractual constraints
11 Reports list & data contents
12 System of record for data elements
13 Valid value constraints

Technical & Operational Meta Data (15)

1 Audit controls & balancing information
2 Data archiving & retention rules
3 Encoding/ reference table conversions
4 History of extracts & results
5 Identification of source system fields
6 Mappings, transformations, statistics for system of record to data stores (OLTP, OLAP)
7 Physical data model (data table names, keys, indexes)
8 Program job dependencies, schedule
9 Program names, descriptions
10 Purge criteria
11 Recovery & backup rules
12 Relationships data models, data warehouse, marts
13 System of record

feeding target data stores (OLTP, OLAP, SOA)
4 User report/ query access patterns, frequency, execution time
5 Version maintenance

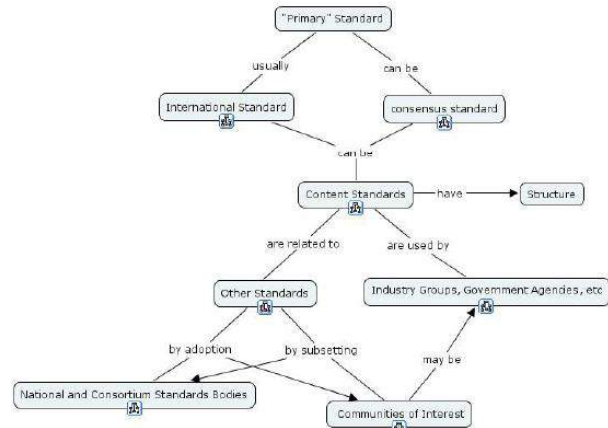
Process Meta Data (10)

1 Data stores & data involved
2 Government/ regulatory
3 Organization owners, stakeholders
4 Process dependencies, decomposition
5 Process feedback loop documentation
6 Process name
7 Process order, timing
8 Process variations due input/ timing
9 Roles, responsibilities
10 Value chain activities

Data Stewardship Meta data (11)

1 Business drivers/ goals
2 Data CRUD rules
3 Data definition business/ technical
4 Data owners
5 Data sharing rules, agreements, contracts
6 Data stewards, roles, responsibilities
7 Data stores/ systems involved
8 Data subject areas
9 Data users
10 Government/ regulatory
11 Governance organization structure/ responsibilities

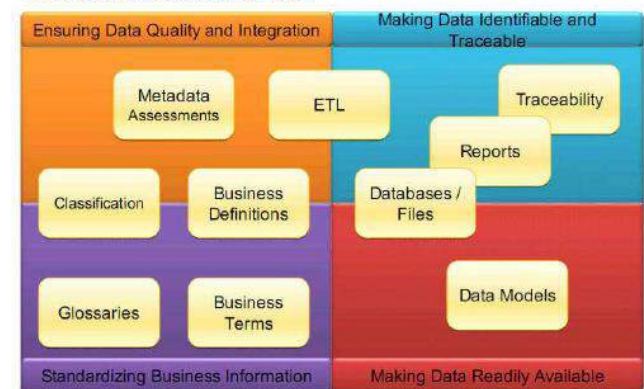
Meta Data Standard



Metadata Products & Services 4 requirements

1 Data quality & Integration
2 Standard business information
3 Identifiable and traceable data
4 Data availability

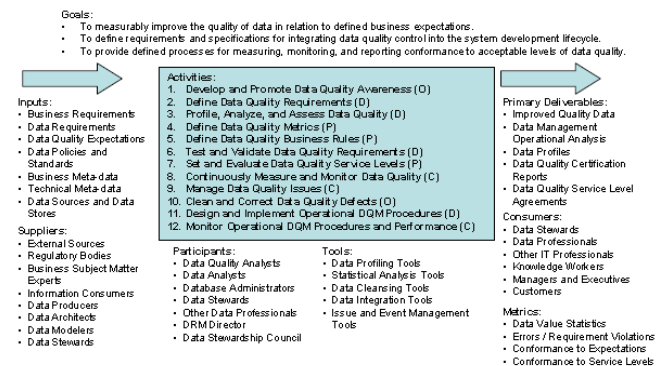
Metadata Product & Services



Data Quality Management

10. Data Quality Management

Definition: Planning, implementation, and control activities that apply quality management techniques to measure, assess, improve, and ensure the fitness of data for use.



Database Quality Dimensions

1 Process 2 Data 3 Semantic 4 Behavior

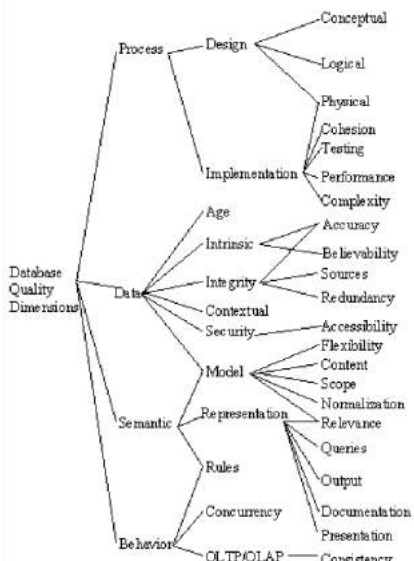


Figure 1. Database Quality Dimensions.

Tools

From HYPERCUBE

- Protégé
 - Freeware
 - Good for logical statements
- TopBraid Composer
 - Open Source and inexpensive
 - Good graphical views
- UML Editors (MagicDraw, EA)
 - Can be extended to represent OWL
 - Easier to link into MDA framework
 - But would not have all the powers of an OWL tool

Apache's HADOOP, MapReduce (MR), HBase

Data Quality Dimensions

❶ **Accuracy** – Degree data correctly represents 'real-life' entities; measured by how values agree with identified reference source
 ❷ **Completeness** a) Attributes always have assigned value b) All appropriate rows present c) Encompasses usability & appropriateness – **completeness rules**: constraint-mandatory attributes, conditionally optional values, inapplicable attribute values
 ❸ **Consistency** - Data values in one set consistent with other set (e.g. no conflict in values from separate sets); predefined constraints or rules between values of attributes across records or messages; *record-level consistency*, *cross-record consistency*, *temporal consistency*
 ❹ **Currency** – How current with modeled world? Fresh, correct (time-wise); measured as function of expected refreshment frequency; define data lifetime before expiry and update
 ❺ **Precision** – detail level, numerical accuracy
 ❻ **Privacy** – access control + usage monitoring
 ❼ **Reasonableness** – for consistency expectation e.g. # transactions < 105% of running average # transactions for previous 30 days
 Ⓣ **Referential Integrity** – unique identifier as foreign key, constraints against duplication
 Ⓢ **Timeliness** - time expectation for accessibility, availability e.g., measured by time between expectation and actual availability
 Ⓤ **Uniqueness** – only 1 entity within a data set, 1 key value relates to 1 unique identity; more achievable level of controlled redundancy
 Ⓥ **Validity** - Conformance to data type, precision, format patterns, use of predefined value enumeration, domain ranges, underlying storage formats (different from **accuracy**)

Data Quality Metrics

❶ **Measurability** ❷ **Business Relevance** ❸ **Acceptability** (thresholds acceptable by business)
 ❹ **Accountability** (business owner) / **Stewardship** (corrective action)
 ❺ **Controllability** (undesirable range reflects uncontrolled aspect of business thus triggering corrective action)
 ❻ **Trackability** (quality improvement over time, measure SLA, ensure predictability of continuous data quality)

DOD Guidelines on Data quality management

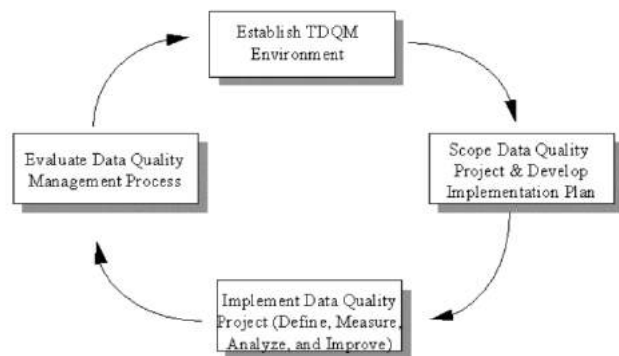


Figure 1: DoD Total Data Quality Management Process

❶ **Establish DQM environment** a) **Strategic Plan** (quality goals, objectives, action plans, strategies and projects to achieve data quality goals and objectives, measurable data quality objectives) b) **Cultural environment** (organizational responsibilities for improving data quality, training programs and/or initiatives within functional areas, opening lines of communication between functional experts)
 ❷ **Scope project and implementation plan** a) Identify DQM projects b) develop implementation plan
 ❸ **Define** Identify data quality requirements and establish data quality metrics b) **Measure** conformance with established business rules and develop exception reports c) **Analyze** Verify, validate, and assess the causes for poor data quality and analyze opportunities for improvement d) **Improve** change data entry procedures, update data validation rules, data standards for uniform representation of data
 ❹ **Evaluate DQM project**

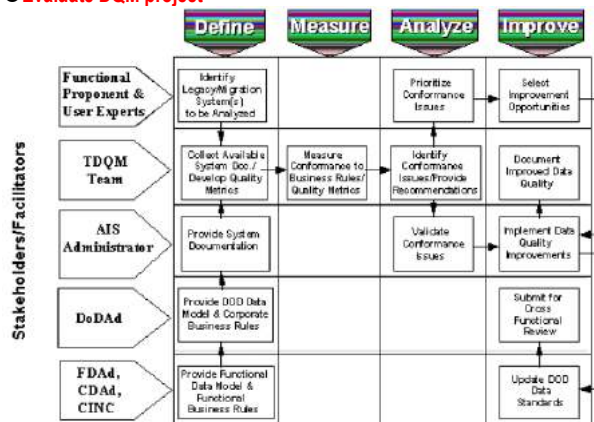


Figure 3: DoD Data Quality Management - Stakeholders and Facilitators

Table 2: Examples of Data Quality Rule Set Generation

Historical Data Problem	Rule Type	Generic Rule Set	Specific Rule Set
The equipment identifier fields are often blank.	Null Constraints	If the equipment identifier is zero, blank, or null then error.	Select equip_id from equip where equip_id = 0 or equip_id = or equip_id = NULL;
The interchangeability and substitutability (ISO) codes are not valid.	Domain Validation	If ISO code is not 'B', 'T', 'G' or 'M', then error.	Select iso_cd from equip where iso_cd not = 'B' or 'T' or 'G' or 'M';
The value of unit price is not greater than zero.	Operational Rule Set	If unit price = \$00.00, then error.	Select * from equip where unit_price = 00.00;
The unit price for direct material is less than \$10.00.	Relationship Validation	If material classification code equals 'D', then unit price must be greater than \$10.00	Select * from equip where mat_class_cd = 'D' and unit_price < 10.00;

Service Management

Skills & Experiences in Service Management & IT Governance

ITIL Infrastructure

❶ Service strategy [❷ Service Design ❸ Service transition ❹ Service operation] ❺ Continued service improvement

Core Topics

Service Strategy (SS)	Service Design (SD)	Service Transition (ST)	Service Operation (SO)	Continued Service Improvement (CSI)
<ul style="list-style-type: none"> Service management Service life cycle Service assets & value creation Service provider types & structures Strategy, markets, offerings Financial management Service portfolio Demand management Organizational design, culture, development Sourcing strategy Service automation & interfaces Strategic tools Challenges & risks 	<ul style="list-style-type: none"> Balanced design Requirements, drivers, activities, constraints Service oriented architecture Business service management SD models Service catalogue Service level Capacity and availability Service continuity Information security Supplier management Data & information management Application management Roles & tools Business impact analysis Challenges & risks SD package Service acceptance criteria Documentation Environmental issues Process maturity 	<ul style="list-style-type: none"> Goals, principles, policies, context, roles, models Planning, support Change management Service asset, configuration management Release deployment Service validation, testing Evaluation Knowledge management Communication, commitment Stakeholder management Configuration management Staged introduction Challenges & risks Asset types 	<ul style="list-style-type: none"> Balance in SO Operational health Communication Documentation Events, incidents, problems Request fulfillment Access management Monitoring & control IF & service management Facilities & data centre management Information & physical security Service desk Technical, IT operations, application management Roles, responsibilities, organizational structures Technology support to SO Managing changes, projects, risks Challenges Competency guidelines 	<ul style="list-style-type: none"> Goals, methods, techniques Organizational change Ownership Drivers Service Level management Services measurement Knowledge management Benchmarks Models, standards, quality 7-step improvement ROI, business issues Roles Authority matrices (RACI) Support tools Implementation Governance Communication Challenges & risk Innovation, correction, improvement Best practices

ITIL Mapping V2 (ITIL LITE) and v3

Service Strategy (SS)	Service Design (SD)	Service Transition (ST)	Service Operation (SO)	Continued Service Improvement (CSI)
Financial management	Service level management	Change management	Incident management	Service Improvement
Service Portfolio management	Availability management	Service asset & configuration management	Problem management	Service measurement
Demand management	Capacity management	Release & Deployment management	Service Desk	Service Reporting
Strategy Generations	IT Service continuity management	Transition planning & support	Request fulfillment	
	Service catalog management	Service Validation & testing	Access management	
	Information Security management	Evaluation	Event management	
	Supplier management	Knowledge management	Technical management	
			IT Operations management	
			Application management	

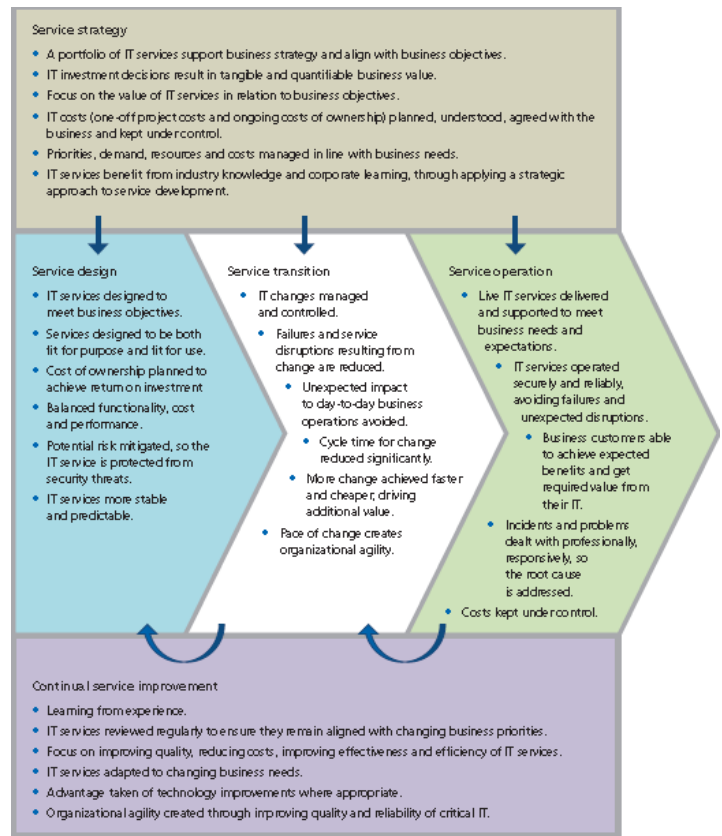
Service Support Service Delivery V3 Components

ITIL Strategic questions

❶ **Organizational goals, success metrics** ■ Which has consistent exec level visibility through reports, meetings, and customer forums? a. Client Retention / Loyalty / Satisfaction b. Competitive Customer Service / Interaction Capabilities c. Frequency and Types of Customer Interaction d. Employee Satisfaction e. Cost of contact center based Customer Interaction f. Client Complaints g. Client Escalation h. Other (Please specify) ❷ **New products or services** over the next years ■ Which information from Support Center(s) is used in decision making ❸ **Client profile** ❹ **Client interaction** ■ Which documented processes, documented responsibilities (a. Establish Customer and Call Center/Help Desk Agent Identity b. Establish Customer Interaction Objective c. Address Customer Interaction Objective d. Close Interaction e. Escalate Interaction f. Transfer Interaction/Conference g. Identify and Address Customer Complaint h. Collecting Demographic/Survey Information) ❺ **Metrics** (a. Performance b. Service Quality c. Productivity d. Cost & Control) ❻ **Organizational management** (Recruitment, training, appraisal) ❼ **Infrastructure** ❽ **Operations** ❾ **Formal process** (a. Incident Management b. Problem Management c. Change Management d. Service Level Management)

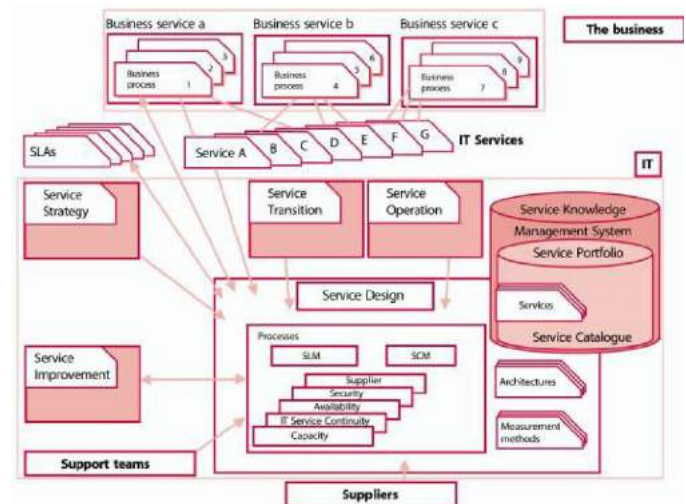
• **ITIL service** = {assets, requirements, people, process} => Deliverables • **Operate, react, improve** = {incident management, asset lifecycle management, change management}

ITIL v3

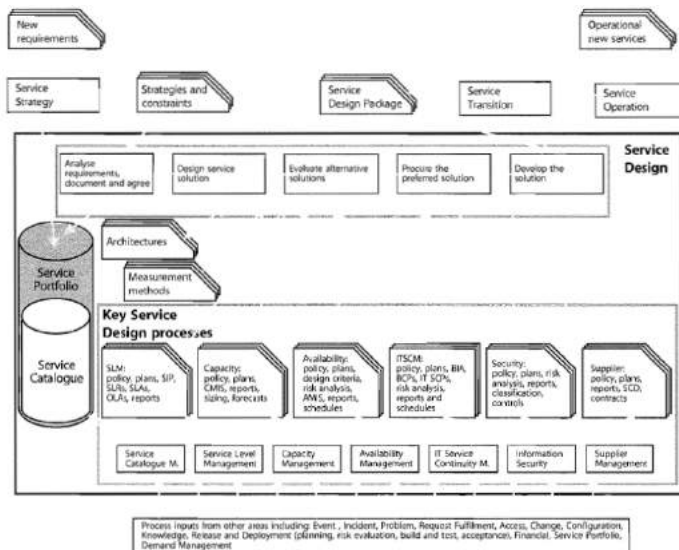


Service Design

Service Design Scope



Service Design Big Picture



Key Processes

1 Service Catalogue Management 2 Service Level Management 3 Capacity Management 4 Availability Management 5 IT Service Continuity Management 6 Information Security Management 7 Supplier Management

Service Components

1 Service Catalogue Management 2 Business Process 3 Service 4 Infrastructure 5 Environment 6 Data 7 IT Service Continuity Management 8 Applications 9 Support Services 10 OLA and contracts 11 Support Teams 12 Suppliers

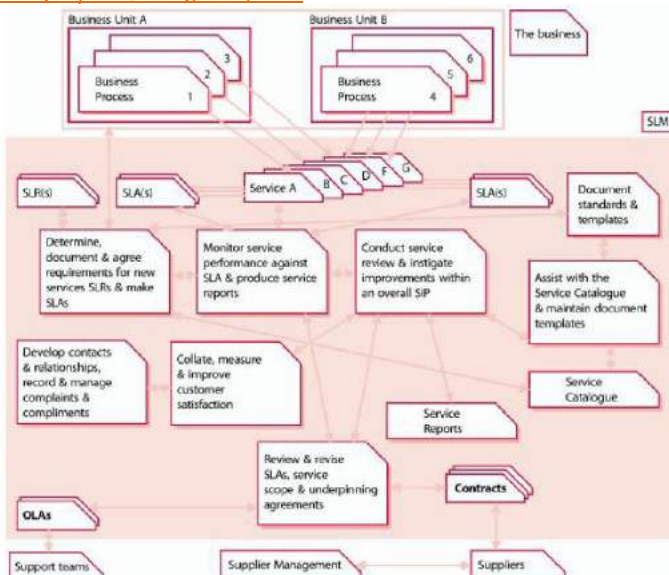
Service Level Agreement SLA

Parties in the agreement	Security procedures
Definitions of terminology	Audit procedures
Term/duration	Roles and responsibilities
Scope/subject	Optional services
Limitations	Reporting
Service level objectives	Administration
Service level indicators	Review/update
Nonperformance impact	Property
Maintenance	Legal
Pricing mechanism	Approvals
Billing and terms of payment	

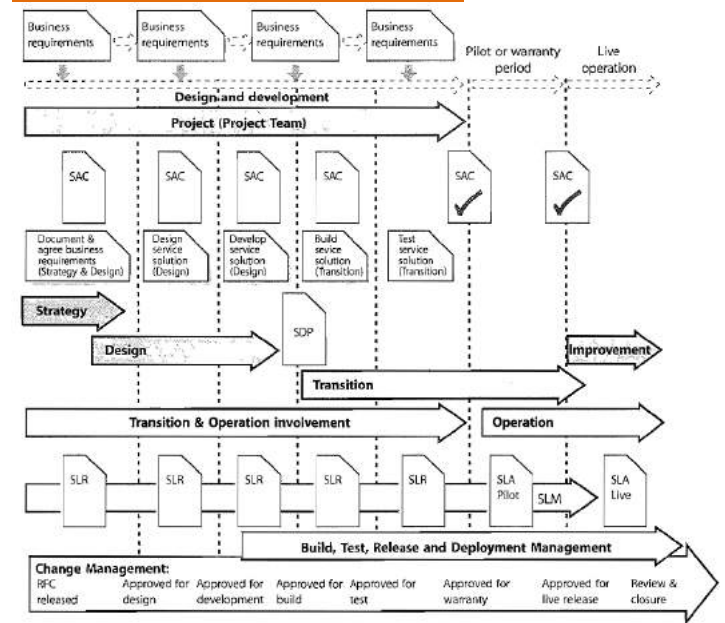
Service Requirements

1 Facilities & functionality requirements 2 Business processes, dependencies, priorities, criticality and impact 3 Business cycles and seasonal variations 4 Management information 5 Service management information 6 Service transaction volume 7 Business transaction levels, service transaction levels, users numbers & types

SLR (requirements), SLA, OLA



Alignment Services to Business Requirements



SAC = Service Acceptance Criteria SDP = Service Design Package

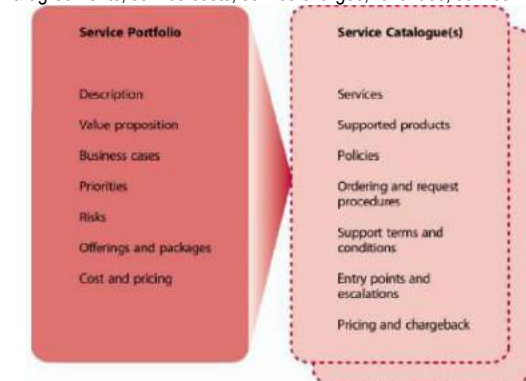
Service Level Definition CSF, KGI, KPI

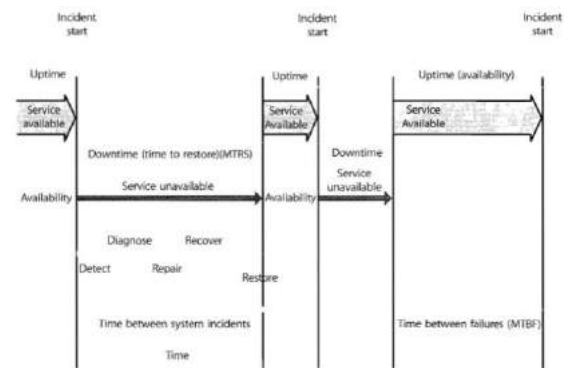
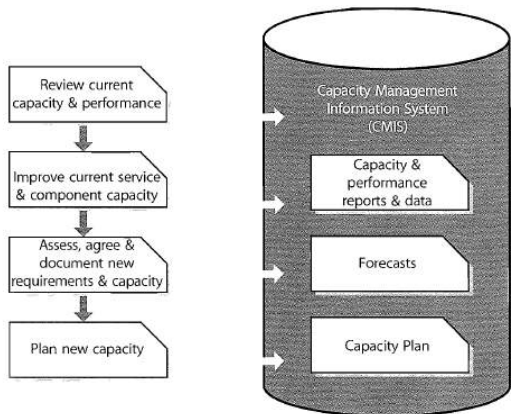
Critical Success Factors	Key Goal Indicators	Key Performance Indicators
<ul style="list-style-type: none"> Service levels are expressed in end-user business terms, whenever possible. Root cause analysis is performed when service level breaches occur. Skills and tools are available to provide useful and timely service level information. The reliance of critical business processes on IT is defined and covered by SLAs. IT management accountabilities and responsibilities are linked to service levels. The IT organisation can identify sources of cost variances. Detailed and consistent explanations for cost variances are provided. A system for tracking and following individual changes is available. 	<ul style="list-style-type: none"> Sign-off by strategic business unit that service levels are aligned with key business objectives. Customer satisfaction that the service level meets expectations. Actual-to-budget cost ratio in line with service levels. Percent of all critical business processes relying on IT covered by SLAs. Percent of SLAs reviewed at the agreed interval or following major change. Service level partners sign off service level monitoring information provided. Percent of IT services which meet SLAs. 	<ul style="list-style-type: none"> Time lag of resolution of a service level change request. Frequency of customer satisfaction surveys. Time lag to resolve a service level issue. Number of times that root cause analysis of service level procedure and subsequent resolution is completed within required period. Significance of amount of additional funding needed to deliver the defined service level.

Service Portfolio, Service Catalogue

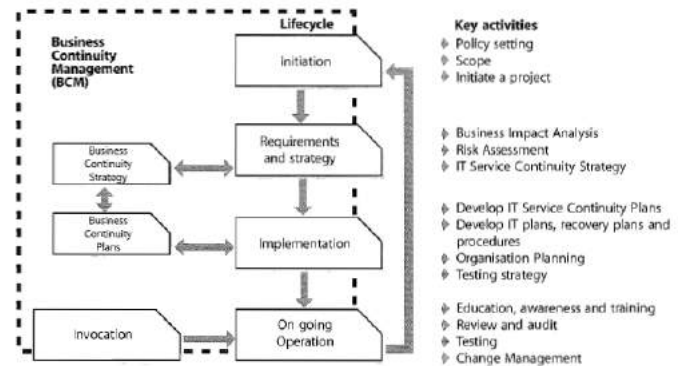
Service Portfolio = Service Pipeline + Catalogue + Retired Services

Service Portfolio Information = Service name, description, status, classification and criticality, applications used, data/ data schema used, business process supported, business owners, business users, IT owners, service warranty level, SLA and SLR references, supporting services, supporting resources, dependent services, supporting OLAs, contracts & agreements, service costs, service charges, revenues, service metrics

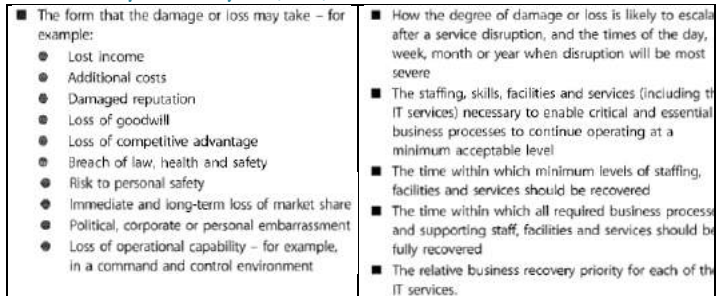




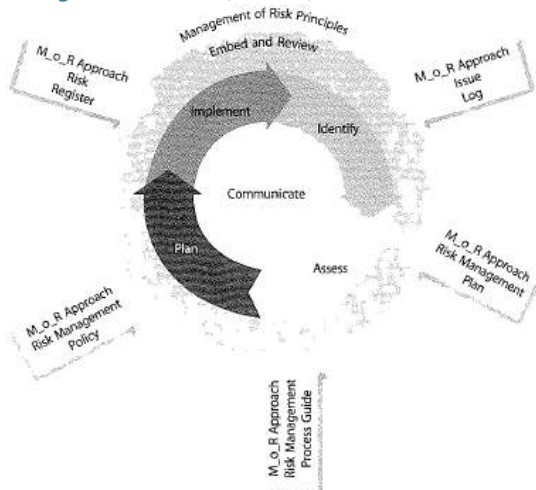
Service Continuity Management



Business Impact Analysis (BIA)



Management of Risk (M_O_R)

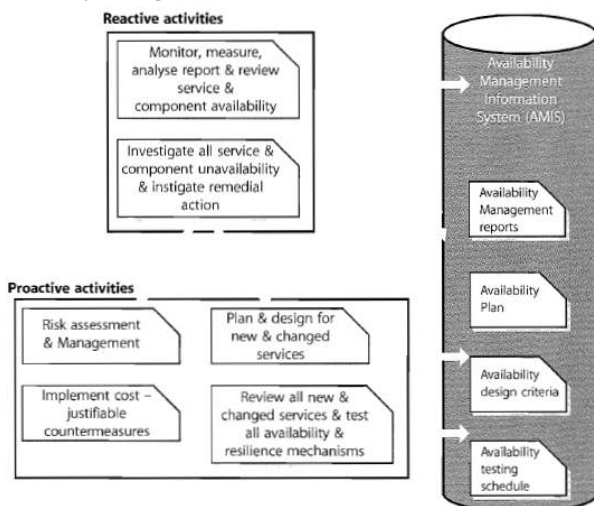


Plans to include with BCP

Inputs, Outputs, KPI, CSF

Inputs <ul style="list-style-type: none"> Business information (strategy, plan, financials, requirements) Service & IT Information Component performance & capacity information Service Performance Issues Service Information Financial, change, performance information CMS (relationships business services, supporting services, technology) Workload info 	Outputs <ul style="list-style-type: none"> Capacity Management Information System (CMIS) Capacity Plan Service Performance Information & Reports Workload analysis & reports Ad-hoc capacity & performance report Forecasts & predictive reports Thresholds, alerts and events
KPI <ul style="list-style-type: none"> Accurate business forecasts Knowledge of current, future technologies Demonstrated cost effectiveness Matching capacity to business needs 	CSF <ul style="list-style-type: none"> Same as KPI

Availability Management



Availability

(Agreed Service Time (AST) - downtime)

$$\text{Availability (\%)} = \frac{\text{Agreed Service Time (AST)}}{\text{Agreed Service Time (AST)}} \times 100 \%$$

Reliability

$$\text{Reliability (MTBSI in hours)} = \frac{\text{Available time in hours}}{\text{Number of breaks}}$$

$$\text{Reliability (MTBF in hours)} = \frac{\text{Available time in hours} - \text{Total downtime in hours}}{\text{Number of breaks}}$$

MTBSI = Mean Time between Service Incidents MTBF = Mean Time between Failures

Maintainability

$$\text{Maintainability (MTRS in hours)} = \frac{\text{Total downtime in hours}}{\text{Number of service breaks}}$$

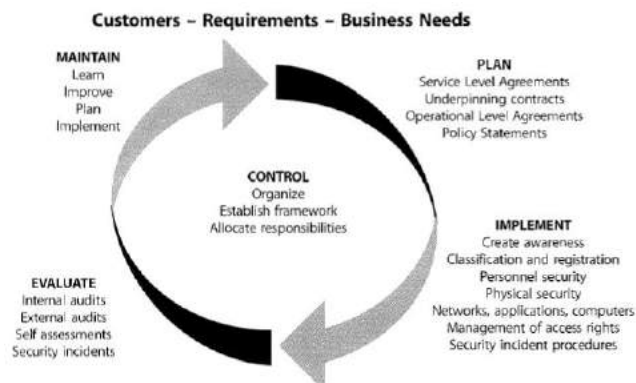
MTRS = Mean time to restore service

Incidents Life Cycle

<ul style="list-style-type: none"> ■ Emergency Response Plan: to interface to all emergency services and activities ■ Damage Assessment Plan: containing details of damage assessment contacts, processes and plans ■ Salvage Plan: containing information on salvage contacts, activities and processes ■ Vital Records Plan: details of all vital records and information, together with their location, that are critical to the continued operation of the business ■ Crisis Management and Public Relations Plan: the plans on the command and control of different crisis situations and management of the media and public relations 	<ul style="list-style-type: none"> ■ Accommodation and Services Plan: detailing the management of accommodation, facilities and the services necessary for their continued operation ■ Security Plan: showing how all aspects of security will be managed on all home sites and recovery sites ■ Personnel Plan: containing details of how all personnel issues will be managed during a major incident ■ Communication Plan: showing how all aspects of communication will be handled and managed with all relevant areas and parties involved during a major incident ■ Finance and Administration Plan: containing details of alternative methods and processes for obtaining possible emergency authorization and access to essential funds during a major incident.
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Information Security Management

Framework

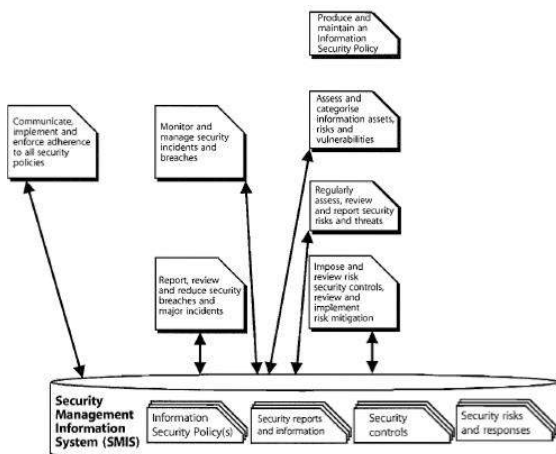


<ul style="list-style-type: none"> ■ An Information Security Policy and specific security policies that address each aspect of strategy, controls and regulation ■ An Information Security Management System (ISMS), containing the standards, management procedures and guidelines supporting the information security policies ■ A comprehensive security strategy, closely linked to the business objectives, strategies and plans 	<ul style="list-style-type: none"> ■ An effective security organizational structure ■ A set of security controls to support the policy ■ The management of security risks ■ Monitoring processes to ensure compliance and provide feedback on effectiveness ■ Communications strategy and plan for security ■ Training and awareness strategy and plan.
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Security Policies

<ul style="list-style-type: none"> ■ An overall Information Security Policy ■ Use and misuse of IT assets policy ■ An access control policy ■ A password control policy ■ An e-mail policy ■ An internet policy ■ An anti-virus policy 	<ul style="list-style-type: none"> ■ An information classification policy ■ A document classification policy ■ A remote access policy ■ A policy with regard to supplier access of IT service information and components ■ An asset disposal policy.
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Process



Controls for threats

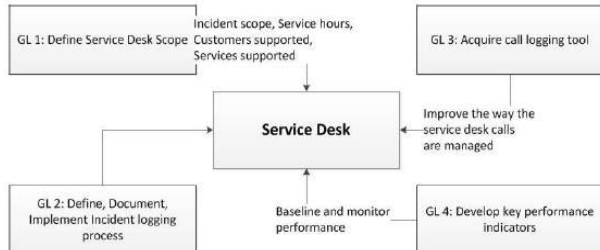


Service Delivery

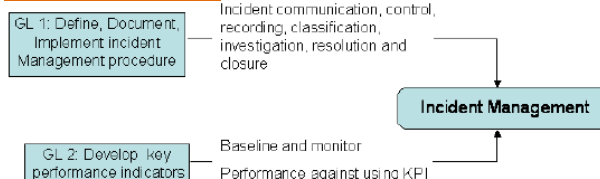
Service Desk



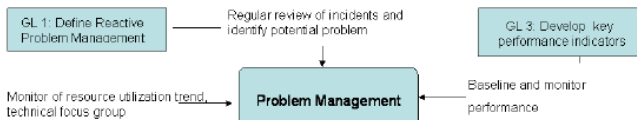
Service Desk guidelines



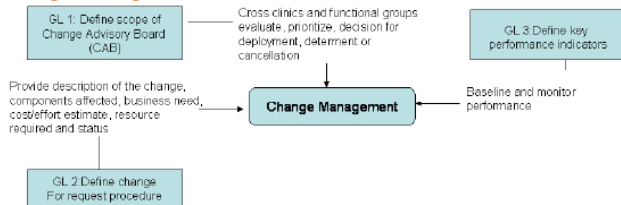
Incident Management



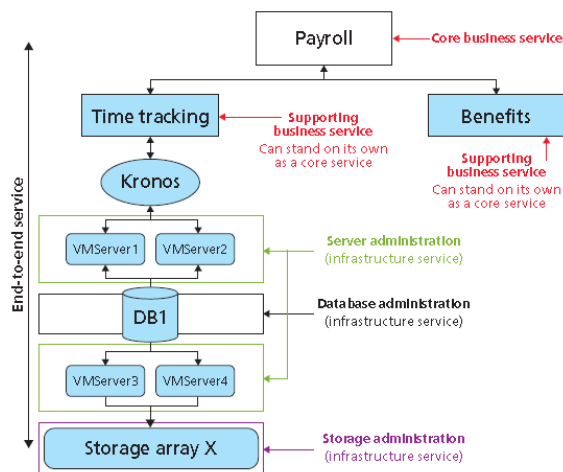
Problem Management



Change Management



End-to-end Service



ITIL Service Delivery processes

- 1 Service Level Management
- 2 IT Financial Management
- 3 Capacity Management
- 4 Availability Management
- 5 IT Service Continuity Management

ITIL Service Level Management SLA, OLA, UC

- **SLA (Service Level Agreement)** –written agreement between service provider and the Customer, that documents agreed Service Levels for a Service, not legal contract!
- **OLA (Operational Level Agreement)** –internal agreement covering the delivery of services which support the IT organization in their delivery of services, not legal contract!
- **UC (Underpinning Contract)** –contract with an external supplier covering delivery of services that support the IT organization in their delivery of services, legal contract!

SLA Template

- 1 Objective(s) of the SLA
- 2 Focus of the SLA
- 3 SLA reporting periods
- 4 Validation triggers
- 5 Monitoring frequency
- 6 Escalation process (Thresholds + Actions)

OLA Template

- 1 General Overview
- 2 Service and Charges
 - 2.1-Scope
 - 2.2-Charges (if applicable)
 - 2.3-Service Dependencies & Underpinning Contracts
 - 2.4-Assumptions
- 3 Parties Responsible
- 4 Service Provider Requirements (Roles and Responsibilities)
- 5 Incident and Service Request Processing
 - 5.1-Service Requests [Work Requests (if applicable), Standard Service Requests, Non-standard Service Requests/Ad-hoc Work Requests]
 - 5.2-Service Change Request
 - 5.3 Incident Management [Normal Incident Processing, Major Incident Handling]
 - 5.4 Problem Management
 - 5.5 Service Maintenance/Change Management
 - 5.6 Service Exceptions
- 6 Reporting

Lifecycle of Service Continuity Management

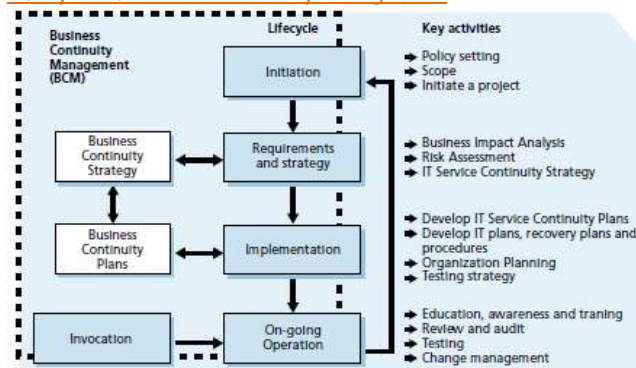
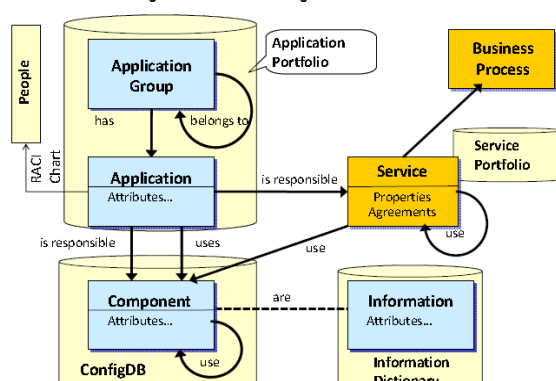


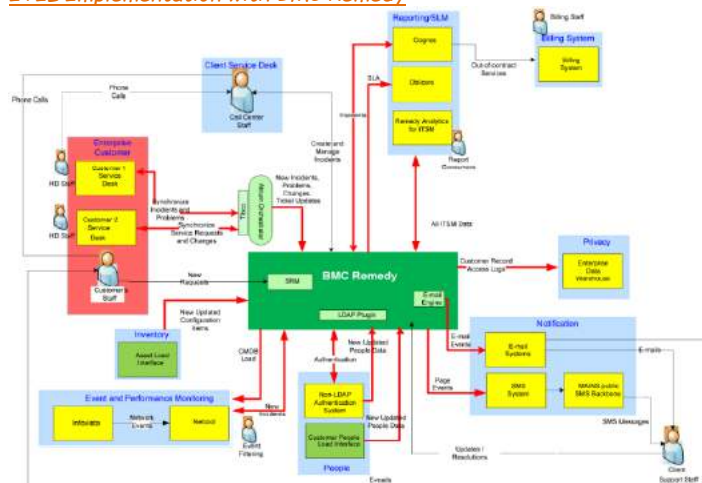
Figure 4.7 Lifecycle of IT service continuity management

Resource Management Infrastructure

Figure 3—Resource Management Infrastructure



ITIL Implementation with BMC Remedy



Microsoft Operations Framework (MOF)

Based on [ITIL v2](#) - While ITIL deliberately aims to be platform-agnostic, MOF is designed by Microsoft to provide a common management framework for its products. Microsoft has mapped MOF to ITIL as part of their documentation of the framework.

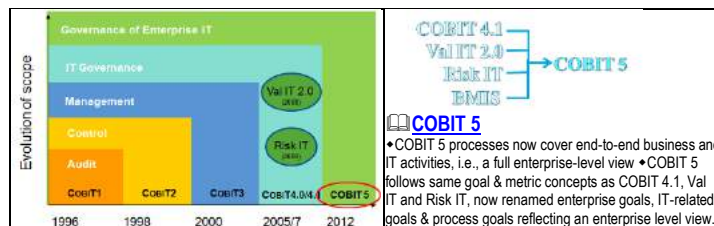


IT Governance

COBIT 4 domains

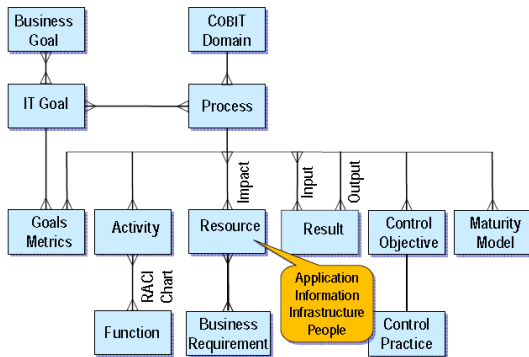
- 1 Plan & organize
- 2 Acquire & implement
- 3 Deliver & support
- 4 Monitor & evaluation

COBIT 5



COBIT Components

Figure 1—COBIT Components

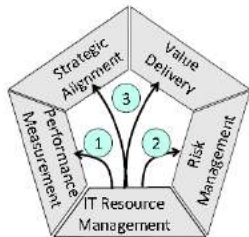


COBIT Domains and Processes

I-PLANNING & ORGANISATION 1.0 Define a Strategic IT Plan 2.0 Define the Information Architecture 3.0 Determine Technological Direction 4.0 Define the IT Org. & Relationships 5.0 Manage the IT Investment 6.0 Communicate Mgt Aims & Direction 7.0 Manage Human Resources 8.0 Ensure Compliance with Ext. Requirements 9.0 Assess Risks 10.0 Manage Projects 11.0 Manage Quality II-ACQUISITION & IMPLEMENTATION 1.0 Identify Automated Solutions 2.0 Acquire and Maintain Application SW 3.0 Acquire and Maintain Tech Infrastructure 4.0 Develop and Maintain Procedures 5.0 Install and Accredited Systems 6.0 Manage Changes	III-DELIVERY & SUPPORT 1.0 Define and Manage Service Levels 2.0 Manage Third-Party Services 3.0 Manage Performance and Capacity 4.0 Ensure Continuous Service 5.0 Ensure Systems Security 6.0 Identify and Allocate Costs 7.0 Educate and Train Users 8.0 Assist and Advise Customers 9.0 Manage the Configuration 10.0 Manage Problems and Incidents 11.0 Manage Data 12.0 Manage Facilities 13.0 Manage Operations IV-MONITORING & EVALUATION 1.0 Monitor the Processes 2.0 Assess Internal Control Adequacy 3.0 Obtain Independent Assurance 4.0 Provide for Independent Audit
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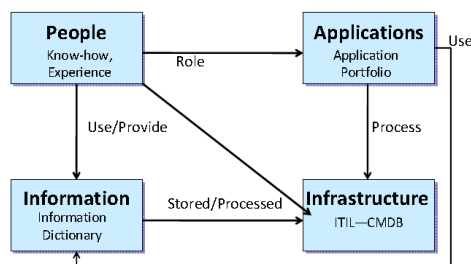
COBIT Relationship of Business Areas

Figure 4—Relationship of Business Areas



COBIT Interdependence of IT Resources

Figure 2—Interdependencies of IT Resources



FI 3 Lines of Defense

❶ Controls in place for day-to-day business
 ❷ Committees & functions in place for oversight to effectively operate internal control framework
 ❸ Independent assurance from committee of non-executive directors & internal audit function that reports to that committee