

# Skills and Knowledge Inventories (SKI) for Enterprise Risk Management Area of Practice

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This resource document is to assist members practicing in enterprise risk management in gauging their Skills and Knowledge for ERM. The Skills and Knowledge Inventory (SKI) should not be construed as a definitive and complete description of the all the competencies required for members practicing in this area.

The familiarity or adherence to the document is not a necessary condition to meet the CIA’s Continuing Professional Development (CPD) Qualification Standard. This document will not be used by the CIA (specifically, the Committee on Professional Conduct or the Disciplinary Tribunal) as a standard to discipline members.

**Definition of Enterprise Risk Management**

The process by which an organization in any industry assesses, controls, exploits, finances, and monitors risks from all sources for the purpose of increasing value to its stakeholders.

The letter in each box indicates the level of skills and knowledge of a Member working in a given role. The level may vary from that indicated depending on the specific requirements of any practitioner’s role. The letter codes are defined as follows:

**Table I-a**  
**Letter Codes**

	Blank Box	No specific requirements identified for that subject.
<b>A</b>	Basic knowledge and general awareness	General awareness of the basic facts and also of the broad implications of the subject.
<b>W</b>	Wide knowledge	Deep understanding of the subject area and its implications, as well as its potential interaction with other subjects.
<b>D</b>	Detailed knowledge and experience	Ability to effectively apply the subject in practice, with detailed knowledge of the facts, and ability to adjust the approach based on circumstances, particularly for unusual situations.

**Table I-b**  
**Skills and Knowledge Subjects for Various Enterprise Risk Management Practitioner Categories**

	A	B	C
Skills and Knowledge Subjects	Risk Oversight	Risk Management	Risk Quantification
1 Quantitative analysis	<b>W</b>	<b>W</b>	<b>D</b>
2 Fundamental risk management concepts	<b>D</b>	<b>W</b>	<b>A</b>
3 Financial markets and products	<b>W</b>	<b>D</b>	<b>W</b>
4 Valuation, capital, and risk models	<b>A</b>	<b>D</b>	<b>D</b>
5 Current-and-emerging-market issues	<b>W</b>	<b>D</b>	<b>A</b>
6 Data quality and process control	<b>A</b>	<b>D</b>	<b>D</b>

**Table II**

**Additional Information Regarding Skills and Knowledge Subjects**

<b>Skills and Knowledge Specifics</b>	
1	<b>Quantitative analysis:</b> Basic probability & statistics, regression and time series analysis, quantitative techniques for risk measurement (including Monte Carlo methods, volatility forecasting models, Value at risk (VaR), tail value at risk (TVaR)/conditional tail expectation, expected policyholder deficit), risk aggregation and diversification, risk-adjusted returns, sensitivity analysis.
2	<b>Fundamental risk management concepts:</b> ERM control cycle (including risk identification, risk evaluation, risk appetite, risk limits, early warning indicators, risk mitigation, risk monitoring and reporting), risk conduct, Board governance.
3	<b>Financial markets and products:</b> Corporate finance, accounting frameworks and standards, insurance and financial products (including life/health/wealth/property & casualty insurance), futures & forwards, equity options/swaps/other derivatives, commodities, currencies, corporate bonds & interest rates, basic understanding of arbitrage arguments and risk treatment programs (e.g., hedging, ALM, reinsurance, pooling mechanisms), industry rating agencies.
4	<b>Valuation, capital, and risk models:</b> Internal and external measures of security (e.g., capital adequacy assessment, solvency criteria), capital funding alternatives (including capital fungibility), capital composition, capital allocation, tools for capital relief, measuring cost of capital, model risk management, business planning, and stress testing.
5	<b>Current-and-emerging-market issues:</b> Jurisdiction and industry-specific laws and regulation, regulatory guidance, reports from professional organizations, competitive landscape.
6	<b>Data quality and process control:</b> Data sources, data characteristics (accuracy, completeness, relevance, consistency, reliability, limitations), process design control and effectiveness.

**Table III**

**Additional Information Regarding ERM Practitioner Categories**

<b>A</b>	ERM practitioner identifies, monitors, reports, and escalates risk issues to a board and/or senior management committee.
<b>B</b>	ERM practitioner shapes the risks of the business portfolio and determines risk mitigation tactics.
<b>C</b>	ERM practitioner equipped with highly technical skills enabling complex risk quantification to support decision making.

**Table IV**

**Suggested Resources for Skills and Knowledge Subjects**

Members are reminded that they must decide for themselves whether the material presented in the reference list is relevant to his/her own development. In doing so, the member should consider that the list is meant to accommodate practitioners of various experience levels and with widely different development requirements.

1	<b>Quantitative analysis</b>		
	<i>Value at Risk: The New Benchmark for Managing Financial Risk</i>	Jorion, P.	ISBN: 978-0071464956
	<i>Measuring Market Risk</i>	Dowd, K.	ISBN: 978-0470013038
	<i>Introduction to Credit Risk Modeling</i>	Bluhm, Overbeck and Wagner	ISBN: 978-1584889922
	<i>Monte Carlo Methods and Models in Finance and Insurance</i>	Korn, Korn, and Kroisandt	ISBN: 978-1420076189
	<i>Market Consistency: Model Calibration in Imperfect Markets</i>	Kemp, Malcolm	ISBN: 978-0470770887
	<i>Black-Scholes and Beyond: Option Pricing Models</i>	Chriss , Neil A.	ISBN: 978-0786310258
	<i>Analysis of Financial Time Series</i>	Tsay, Ruey S.	ISBN: 978-0470414354
	<i>The Handbook of Fixed Income Securities</i>	Fabozzi, Frank J.	ISBN: 978-0071768467
	<i>Interest Rate Models – Theory and Practice: With Smile, Inflation and Credit</i>	Brigo, Damiano and Mercurio, Fabio	ISBN: 978-3540221494
	<i>Volatility Correlation – The Perfect Hedger and the Fox</i>	Rebonato, Riccardo	ISBN: 978-0470091395
	Correlations and dependencies in economic capital models	Shaw and Spivak	<a href="http://www.actuaries.org.uk/search/site/correlations_and_dependencies_spivak">http://www.actuaries.org.uk/search/site/correlations_and_dependencies_spivak</a>
<i>Research Paper on Risk Aggregation and Diversification</i>	CIA	<a href="http://www.cia-ica.ca/docs/default-source/2016/216037e.pdf">http://www.cia-ica.ca/docs/default-source/2016/216037e.pdf</a>	
2	<b>Fundamental risk management concepts</b>		
	<i>Financial Enterprise Risk Management</i>	Sweeting, Paul	ISBN: 978-0521111645

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Skills and Knowledge Inventory – Enterprise Risk Management

	<i>Counterparty Credit Risk and Credit Value Adjustment: A Continuing Challenge for Global Financial Markets</i>	Gregory, Jon	ISBN: 978-1118316672
	<i>Risk Management for Insurers</i>	Doff, René	ISBN: 978-1782722229
	<i>Enterprise Risk Management: From Incentives to Controls</i>	Lam, James	ISBN: 978-1118413616
	<i>Corporate Value of Enterprise Risk Management: The Next Step in Business Management</i>	Segal, Sim	ISBN: 978-0470882542
	<i>Risk Management: Foundations for a Changing Financial World</i>	Haslett, Walter V.	ISBN: 978-0470903391
	<i>The Top Ten Operational Risks: A Survival Guide for Investment Management Firms &amp; Hedge Funds</i>	Miller and Lawton	ISBN: 978-1456367879
	<i>Modern Risk Management: A History</i>	Field, Peter	ISBN: 978-1904339052
	<i>Advanced Financial Risk Management</i>	Van Deventer, Imai and Mesler	ISBN: 978-1118278543
	Principles for an Effective Risk Appetite Framework (Nov 2013)	Financial Stability Board	<a href="http://www.financialstabilityboard.org/wp-content/uploads/r_131118.pdf">http://www.financialstabilityboard.org/wp-content/uploads/r_131118.pdf</a>
	ASOP 46: Risk Evaluation in Enterprise Risk Management	Actuarial Standards Board (U.S.)	<a href="http://www.actuarialstandardsboard.org/standards-of-practice/">http://www.actuarialstandardsboard.org/standards-of-practice/</a>
	ASOP 47: Risk Treatment in Enterprise Risk Management	Actuarial Standards Board (U.S.)	<a href="http://www.actuarialstandardsboard.org/standards-of-practice/">http://www.actuarialstandardsboard.org/standards-of-practice/</a>
<b>3</b>	<b>Financial markets and products</b>		
	<i>Corporate Finance</i>	Berk and DeMarzo	ISBN: 978-0132992473
	<i>Organizational Behavior: A Strategic Approach</i>	Hitt, Miller and Colella	ISBN: 978-1118809068
	<i>Strategic Management: Concepts: Competitiveness and Globalization</i>	Ireland, Hitt and Hoskisson	ISBN: 978-1285425184
	<i>Real Options: Managerial Flexibility and Strategy in Resource Allocation</i>	Trigeorgis, Lenos	ISBN: 978-0262201025

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Skills and Knowledge Inventory – Enterprise Risk Management

	<i>Options, Futures and Other Derivatives</i>	Hull, John C.	ISBN: 978-0131499089
	Financial Economics	The Actuarial Foundation	<a href="http://www.actuarialfoundation.org/publications/economic_textbook.shtml">http://www.actuarialfoundation.org/publications/economic_textbook.shtml</a>
	Derivatives Best Practices	Office of the Superintendent of Financial Institutions	<a href="http://www.osfi-bsif.gc.ca/Eng/Docs/b7_derivatives_1997.pdf">http://www.osfi-bsif.gc.ca/Eng/Docs/b7_derivatives_1997.pdf</a>
4	<b>Valuation, capital and risk models</b>		
	<i>How to Measure Anything: Finding the Value of Intangibles in Business</i>	Hubbard, D.W.	ISBN: 978-1118539279
	<i>Practical Financial Optimization: Decision Making for Financial Engineers</i>	Zenios, Stavros A.	ISBN: 978-1405132015
	<i>Managing Investment Portfolios: A Dynamic Process</i>	Maginn, Tuttle, McLeavy and Pinto	ISBN: 978-0470080146
	<i>ORSA: Design and Implementation</i>	Ozdemir, Bogie	ISBN: 978-1782722083
	Stochastic Modeling: Theory and Reality from an Actuarial Perspective	International Actuarial Association	<a href="http://share.actuaries.org/Documentation/StochMod_2nd_Ed_print_quality.pdf">http://share.actuaries.org/Documentation/StochMod_2nd_Ed_print_quality.pdf</a>
	How Model Risk Devastated an Organization	Segal, Sim	<a href="https://www.soa.org/Library/Newsletters/The-Actuary-Magazine/2013/june/act-2013-vol10-iss3-segal.pdf">https://www.soa.org/Library/Newsletters/The-Actuary-Magazine/2013/june/act-2013-vol10-iss3-segal.pdf</a>
	Model Risk – Daring to open up the black box	Institute and Faculty of Actuaries	<a href="http://imrmcon.org/wp-content/uploads/2015/04/Nirav-Morjaria_model-risk-working-party-paper.pdf">http://imrmcon.org/wp-content/uploads/2015/04/Nirav-Morjaria_model-risk-working-party-paper.pdf</a>
5	<b>Current and emerging market issues</b>		
	<i>The Black Swan: The Impact of the Highly Improbable</i>	N. N. Taleb	ISBN: 978-0812973815
	The Solvency II Actuary	K. Morgan and A. Olesen	<a href="http://www.actuaries.org/ASTIN/Colloquia/Manchester/Papers/morgan_olesen_paper_final.pdf">http://www.actuaries.org/ASTIN/Colloquia/Manchester/Papers/morgan_olesen_paper_final.pdf</a>

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	Research Paper on Operational Risk (Nov 2014)	CIA	<a href="http://www.cia-ica.ca/docs/default-source/2014/214118e.pdf">http://www.cia-ica.ca/docs/default-source/2014/214118e.pdf</a>
	Swiss Re SONAR – New emerging risk insights (2015)	Swiss Re	<a href="http://media.swissre.com/documents/SONAR_2015_WEB.pdf">http://media.swissre.com/documents/SONAR_2015_WEB.pdf</a>
	Model Validation for Insurance Enterprise Risk and Capital Models	CIA	<a href="http://www.cia-ica.ca/docs/default-source/2014/214092e.pdf">http://www.cia-ica.ca/docs/default-source/2014/214092e.pdf</a>
	Report on the CIA ORSA Survey conducted in April 2015	CIA	<a href="http://www.cia-ica.ca/docs/default-source/2016/216036e.pdf">http://www.cia-ica.ca/docs/default-source/2016/216036e.pdf</a>
6	<b>Data quality and process control</b>		
	ASOP 23: Data Quality	Actuarial Standards Board (U.S.)	<a href="http://www.actuarialstandardsboard.org/wp-content/uploads/2014/07/asop023_097.pdf">http://www.actuarialstandardsboard.org/wp-content/uploads/2014/07/asop023_097.pdf</a>
	ASOP 38: Using Models Outside the Actuary's Area of Expertise (Property & Casualty)	Actuarial Standards Board (U.S.)	<a href="http://www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop038_155.pdf">http://www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop038_155.pdf</a>
	Report of the Data Quality Working Party	Francis, Campbell, Rothwell, Sheaf & Prevosto	<a href="http://www.actuaries.org.uk/documents/report-data-quality-working-party-2006">http://www.actuaries.org.uk/documents/report-data-quality-working-party-2006</a>

To assist in keeping the above reference list current and relevant to CIA Members, we encourage practitioners to share with the Committee additional documents and references not included in the above list. Please send the information to [ski@cia-ica.ca](mailto:ski@cia-ica.ca).

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**Additional Resources for ERM**

1	<b>Quantitative analysis</b>		
	Validating a Liability Model	Richard D. Olswang (Financial Reporting Section Monograph)	<a href="https://www.soa.org/library/monographs/other/m-as99-1_VIII.pdf">https://www.soa.org/library/monographs/other/m-as99-1_VIII.pdf</a>
2	<b>Fundamental risk management concepts</b>		
	Guidance on Supervisory Interaction with Financial Institutions on Risk Culture	Financial Stability Board	<a href="http://www.financialstabilityboard.org/2013/11/guidance-on-supervisory-interaction-with-financial-institutions-on-risk-culture-consultative-document/">http://www.financialstabilityboard.org/2013/11/guidance-on-supervisory-interaction-with-financial-institutions-on-risk-culture-consultative-document/</a>
	Risk Management Assessment: Non-Life Insurance Companies	Moody's 3/07	<a href="https://www.moody.com/login.aspx?ReturnUrl=http://v2.moody.com%2Fcust%2Fgetdocumentbynotesdocid%2Easp%3Fcriteria%3Dpbc%5F100557">https://www.moody.com/login.aspx?ReturnUrl=http://v2.moody.com%2Fcust%2Fgetdocumentbynotesdocid%2Easp%3Fcriteria%3Dpbc%5F100557</a>
3	<b>Financial markets and products</b>		
	A Practical Approach to Gains Analysis Revisited	Andrew T. Smith (Pension Section News 9/93)	<a href="http://www.soa.org/library/newsletters/pension-section-news/1993/september/psn9309.pdf">http://www.soa.org/library/newsletters/pension-section-news/1993/september/psn9309.pdf</a>
	Derivatives, Practices and Principles	Group of Thirty	<a href="http://www.group30.org/rpt_29.shtml">http://www.group30.org/rpt_29.shtml</a>
	Pricing Risk on Longevity Bonds	Cairns, Blake, Dawson, Dowd	<a href="http://www.pensions-institute.org/workingpapers/wp0508.pdf">http://www.pensions-institute.org/workingpapers/wp0508.pdf</a>
	Modelling Mortality Risk with Extreme Value Theory: The Case of Swiss Re's Mortality-Indexed Bonds	Bleeders and Colarossi	<a href="http://www.ressources-actuarielles.net/EXT/ISFA/1226.nsf/0/b1f2f14dd874fe65c1256fd400410b51/\$FILE/Modelling%20Mortality%20Risk%20with%20extrem%20value%20theory.pdf">http://www.ressources-actuarielles.net/EXT/ISFA/1226.nsf/0/b1f2f14dd874fe65c1256fd400410b51/\$FILE/Modelling%20Mortality%20Risk%20with%20extrem%20value%20theory.pdf</a>

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	Winner's curse. The unmodelled impact of competition. Report of the Winner's Curse GIRO Working Party.	Tony Jordan; Mark Rothwell	<a href="http://www.actuaries.org.uk/search/site/Winner's%20Curse%20The%20Unmodelled%20Impact%20of%20Competition">http://www.actuaries.org.uk/search/site/Winner's%20Curse%20The%20Unmodelled%20Impact%20of%20Competition</a>
4	<b>Valuation, capital and risk models</b>		
	Model Risk	Durman	SOA syllabus and resource page
5	<b>Current and emerging market issues</b>		
	The Effect of Deflation or High Inflation on the Insurance Industry	Society of Actuaries, CAS and CIA	<a href="https://www.soa.org/research/research-projects/finance-investment/research-effect-deflation.aspx">https://www.soa.org/research/research-projects/finance-investment/research-effect-deflation.aspx</a>
6	<b>Data quality and process control</b>		

**OSFI Guidelines**

Corporate Governance

[http://www.osfi-bsif.gc.ca/Eng/Docs/CG\\_Guideline.pdf](http://www.osfi-bsif.gc.ca/Eng/Docs/CG_Guideline.pdf)

Cyber-Security Self-Assessment Guidance

<http://www.osfi-bsif.gc.ca/Eng/Docs/cbrsk.pdf>

A-4 Capital Management

[http://www.osfi-bsif.gc.ca/Eng/Docs/a4\\_gd.pdf](http://www.osfi-bsif.gc.ca/Eng/Docs/a4_gd.pdf)

E-18 Stress Testing

<http://www.osfi-bsif.gc.ca/eng/docs/e18.pdf>

E-19 ORSA

<http://www.osfi-bsif.gc.ca/Eng/Docs/e19.pdf>