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Operational Risk Capital Management within Banks according to Basel II (Loss Distribution Approach: Analysis and Risk Professional Perspectives**)**

Theses of the PhD Dissertation

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Table of Contents

A. Introduction

Basel committee (annexure I) defines operational risk as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. Operational risk was not a serious challenge before high-profile cases started to change the landscape. In the past, regulators mainly focused on market and credit risks simply because losses experienced in those sectors were significant. This research intends to; a) throw light on the Basel committee's standards with regards to operational risk, b) analysis of both the academic and banker's opinion, c) analysis of various methods to calculate capital charges, their effectiveness, and d) aims to seek the risk expertise opinion on operational risk management and their preferred model under the Advanced Measurement Approaches "AMA" through questionnaires.

Under the AMA financial institutions are required to develop their own internal measurement methods that estimate the expected and unexpected operational losses based on the combined use of internal and relevant external data. Moreover, the approach should be comparable to internal rating approaches used for credit risk at one year holding period and 99.9th percentile confidence interval. And the bank should demonstrate that the approach is robust to capture potentially severe 'tail' loss events.

The key purpose of choosing the right economic capital methodology is to ensure that it covers all material sources of risk. This requirement is a precondition for providing reliable risk estimates for capital management and risk-based performance measurement. Since operational losses are an important source of risk, the quantification of operational risk (OR) has to be part of the bank's economic capital calculation. Regulatory capital requirements under Pillar I of the Basel II Accord (2006) has given a strong additional incentive for the development of a quantitative OR methodology. One of the popular methods under the AMA is the loss distribution approach (LDA). Under the LDA, banks quantify the frequency and severity of operational risk losses distribution for each risk cell (business line/event type) over a 1-year time horizon. The key steps towards implementation of LDA are as follows:

Key steps toward LDA, Source: Jos´e Aparicio, and Eser Keskiner (2004)

The main objective of an LDA model is to provide realistic risk estimates for the bank and its business units based on loss distribution that accurately reflect the underlying data. In addition to this, saving capital by moving to advanced methods and deploying the sophisticated measurement tools is another motive for banks. The LDA is the one of the most advanced methods envisaged so far and I believe was the most exhilarating area for further research according to Jos´e Aparicio, and Eser Keskiner (2004).

According to Bank of Japan (2005), the most commonly used operational risk quantification method is known as the "loss distribution approach." This approach has been

exhaustively studied by actuaries, mathematicians, and statisticians well before the concept of operational risk came into existence, and given the characteristics and challenges of the data, we can resolve many issues by using an LDA approach (Kabir Dutta, and Jason Perry, 2007). Table 1.1 shows advantages and disadvantages of using the LDA:

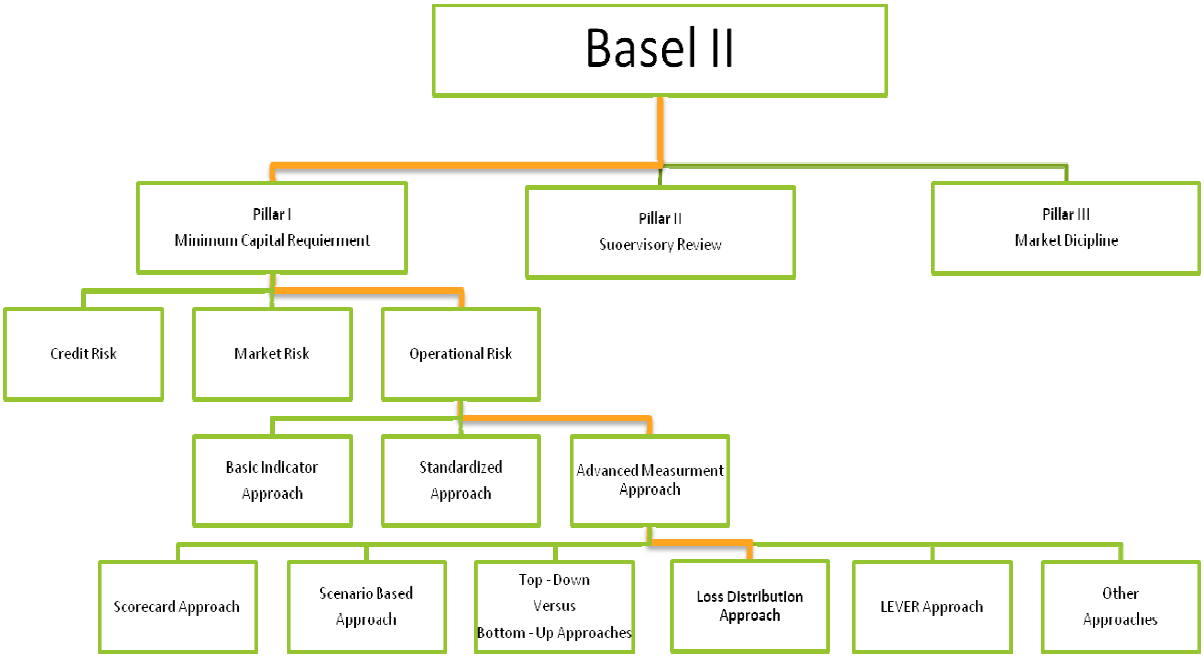
Advantages	Disadvantages
a) A popular method under the AMA, b) A powerful tool to quantify operational risk loss data c) Covers Severity and Frequency of losses, d) Enable to optimize risk transfer options, e) Lower amount of Capital charges, f) More risk sensitive than other approaches, g) Provides a framework for addressing extreme outcomes, h) Successfully implemented in Insurance, i) One of the most important methodologies suggested by Basel II Committee.	a) Backward looking approach , b) Only rely of loss data, c) Require substantial data Management, d) Underestimate the necessary capital charge when only when calibrated only on internal data, and e) Very sophisticated model where some of the banks face with difficulties in implementation.

Table 1.1- LDA Advantages and Disadvantages, Developed based on K.Dutta, and J. Perry, 2007

B. Rationale of the research

Within banks and other financial institutions there is now an increasing pressure to manage operational risk. Apart from regulatory requirements, this pressure is also due to the increasing sophistication of financial products and systems. Increasing dependency of financial systems on Information technology has made banks more vulnerable towards cyber-attacks, system failures and fraud.

A key element of Operational Risk Management is to measure the size and scope of the firm's risk exposures to allocate an amount of capital to safeguard the bank. However, so far there is no clear established or single approach to measure operational risk on a firm – wide basis. Instead, there are several methods used.



Theoretical Scope of the Research: Loss Distribution Approach (LDA) under Advance Measurement Approach (AMA), Source: author's own work

C. Research Objectives

The key objective of this dissertation is to assess various methods in computing operational risk capital charges with focus on Advanced Measurement Approach "AMA". Most importantly, the objective is to seek the opinion of Risk experts / practitioners in Operational Risk Management and their most preferable method under advanced measurement approach. There is a particular focus in the questionnaire on whether the Loss Distribution Approach is an improved mechanism under Advanced Measurements approach or not. By reviewing similar research conducted in the past and through seeking the risk professional's opinion, the objectives of this research will be achieved.

D. Research Method and Framework

Since most of the discussions are based on research conducted by experts on the field of operational risk and opinion of risk professionals, it is possible to say the research method is a qualitative and quantitative based. A questionnaire is also prepared to collect data from risk professionals and various banks regarding their view on operational risk management approaches used and roadblocks faced by them. The researcher has developed a questionnaire in order to collect quantitative and qualitative data. The questionnaire is in English medium with close-ended questions using a 5 Point Likert Scale.

The questionnaire comprised of 48 questions which included, demographic details of respondents as well as the perception of operations risk and role of Basel II in the banking environment. Out of 48 questions, some of them had sub-questions also to cover up as many concepts as possible. In order to support the objectives of this research, seven hypotheses were made and tested.

The population was Risk Professionals who work in the UAE Banks with the total of n= 100 bankers completed the questionnaire during the year 2011.

Scope of this research is limited to UAE banking system and in regards to Operational Risk Management.

E. Literature Review – A synopsis

Based on the review of the literature, LDA seems to be one of the best approaches to quantify operational risk losses and calculate capital charges under AMA. It is also preferred by several researchers and banking industry professionals in the last decade (See below table).

No.	AMA and use of LDA
1	Toshihiko Mori, and Eiji Harada (2001), The last approach [LDA]is considered as a future option[To calculate capital under AMA]
2	Padraic Walsh (2003), The loss distribution approach is theoretically the most robust method developed to date.
3	Padraic Walsh (2003), The loss distribution approach provides a framework for addressing extreme outcomes.
4	ITWG (2003), The Industry Technical Working Group shares a common view that loss data should really be the foundation of an LDA-based AMA approach.
5	Klugman et al. (2004) , [LDA] is a good source for various loss models
6	Jos´eAparicio, and EserKeskiner (2004), This is the most advanced method [LDA] envisaged so far and we believe the most exciting area for further research

7	Fitch (2004), The vast majority of banks hoping to adopt AMA plan to use a loss distribution approach to their capital charge.
8	M.R.A. Bakker(2004), The Loss Distribution Approach (LDA) uses frequency and severity distributions based on operational losses to quantify operational risk and is at this moment one of the most used and discussed (see for instance Cruz (2002) and Frachot, Georges, and Roncalli (2001)) approach under the AMAs to measure operational risks.
9	Chartis (2005), In annual Chartis Customer Survey of over 130 financial institutions 58% of respondents indicated that they will be using a combination of the LDA (Loss Distribution Approach) and COSO approach (Committee of Sponsoring Organisations of the Tread way Commission)
10	Bank of Japan (2005), The most commonly used operational risk quantification method is known as the "loss distribution approach."
11	KabirDutta, and Jason Perry (2007), Given the characteristics and challenges of the data, we can resolve many issues by using an LDA approach
12	KabirDutta, and Jason Perry(2007), The LDA has been exhaustively studied by actuaries, mathematicians, and statisticians well before the concept of operational risk came into existence

Source: author's own work

F. Data Analysis and Hypothesis Testing

The total number of respondents that participated in the research is 100. To analyze the collected information, different methods such as Univariate and Bivariate (Cross Tabs) analysis are used.

One-way analysis of variance (ANOVA) is used to test the difference between the means of the groups of variables (multiple testing). This is done at the 0.05 level of significance. In addition to the above a "Pearson" correlation test was applied using SPSS to two hypotheses (i.e. H_6 and H_7). The summary of the analysis is provided below.

a) Univariate statistics: Univariate method for analyzing data on a single variable at a time has been used in this section.

Characteristics	**% of respondents**				
Age	**21-30**	**31-40**	**40 years and above**		
	41	32	27		
Gender	**Male**		**Female**		
	82		18		
Qualification	**Senior Secondary**	**Graduate**	**Post-graduate**	**Masters**	**Other**
	2	38	45	7	8
Current Position	**Chief Risk Officer**	**Risk Manager**	**Operational Risk Manager**	**Operational Risk Analyst**	**Operational Risk Officer**
	11	30	32	18	9
Experience of Risk Management.	**>3**	**3>5**	**5>10**	**10<**	
	30	42	26	2	
Type of bank	**Retail**	**Commercial**	**Investment**	**Merchant**	
	49	45	4	2	
Characteristics	**% of respondents**				
	Not at all	To a lesser degree	To a fair degree	To a high degree	Totally
Credit Risk	0	39	33	27	1
Market Risk	6	32	36	20	6
liquidity risk	10	29	30	29	2
Country risk	6	23	32	26	13
reputation risk	9	25$	28	22	16

Legal Risk	6	22	32	26	14
Operational risk	12	18	31	30	9

Source: author's own work

To what degree has your organization implemented the following as primary factors of operational risk?

Characteristics	% of respondents				
	Not at all	To a lesser degree	To a fair degree	To a high degree	Totally
People	0	34	29	35	2
Processes	5	22	33	27	13
System	18	21	29	23	9
External factors	20	26	28	20	6

Source: author's own work

To what degree has your organization recognized the following people exposures as an important part of operational risk?

Characteristics	% of respondents				
	Not at all	To a lesser degree	To a fair degree	To a high degree	Totally
Incompetence	3	31	30	32	4
Negligence	10	25	29	20	16
human error	5	22	32	26	15
low morale	12	18	32	30	8
high staff turnover	1	36	29	33	1
employees fraudulent/criminal activities	1	35	29	34	1

Source: author's own work

To what degree has your organization recognized the following process exposures as an important part of operational risk?

Characteristics	% of respondents				
	Not at all	To a lesser degree	To a fair degree	To a high degree	Totally
Errors in procedure/methodologies	25	38	16	16	5
Execution error	0	25	31	21	23
Documentation errors	12	13	24	32	19
Product complexity	6	23	35	24	12
Security risk	7	18	35	24	16

Source: author's own work

To what degree has your organization recognized the following system exposures as an important part of operational risk?

Characteristics	% of respondents				
	Not at all	To a lesser degree	To a fair degree	To a high degree	Totally
System infiltration	12	16	29	27	16
System failures	24	29	29	14	4
Fraud	2	18	35	29	16
Programming errors	3	21	34	27	15
Information risk	2	18	35	24	21
Telecommunication risk	8	10	37	33	12
Obsolescence of systems	8	21	33	22	16
Implementing a formal risk management process	5	16	38	29	12
Adopted a specific definition for	0	19	36	29	16

operational risk					
Risk identification	8	18	35	27	12
Risk evaluation	10	19	27	24	20
Risk control	1	30	34	20	15
Risk financing	0	19	26	32	23
Recognize the importance of aligning an operational risk management process with its strategy and objectives	5	30	34	18	13
Involve internal audit to manage operational risk?	1	20	24	33	22
Involved business managers in an operational risk management process?	0	30	36	22	20
Operational Risk definition based on Basel II	10	19	33	25	13
LDA is a statistical/actuarial approach for computing aggregate loss distributions	1	9	39	35	16
LDA is better than the other methods to quantify operational risk while using AMA.	3	9	38	36	14
Bank uses LDA to identify and estimate frequency and severity of losses	33	34	19	8	6
bank uses the methods available through LDA to check data completeness of loss data among the participating members	22	49	18	5	6
There is an effective tracking method at the bank that works well with LDA	45	26	15	8	6
The collected data works with LDA and this tells you your data collection method is effective	27	49	18	4	2
There are differences I notice across different business lines at our bank and other similar institutions	1	9	39	35	16
Arriving at the appropriate threshold to capture operational loss and near misses is very important.	3	9	38	36	14
Operational events across the various business lines at your bank are handled according to what AMA recommends	3	19	33	24	21
The ratio of supervisors to staff at your bank is correct.	4	22	35	22	17
Your bank has a unit that handles confidential client information	6	8	36	34	16
Your bank defines operational risk according to what AMA recommends.	12	28	32	17	11
You justify your bank's pursuing of quantification of operational risk as a positive measure	15	9	39	35	16
If there is going to be a loss at your bank, it would be because of inadequate or failed internal process.	3	9	38	36	14
If there is going to be a loss at your bank, it would be because of people or system failure.	12	28	32	17	11
If there is going to be fraud at your bank, it would be internal.	1	9	40	35	15
The bank gathers more than one year's data	2	6	42	37	13
bank has the ability to withstand business disruption	5	9	36	32	18

You model extreme events at your bank according to what AMA recommends	26	44	14	6	10
There are technologies you incorporate in your decision making process that enables your bank to reduce risk	2	14	28	31	25
You promote sound internal policies and control procedures.	0	11	39	30	20
You motivate investment in operational risk infrastructure to reduce operational risk at your bank.	4	22	35	22	17
Your bank relies on internal data, external data, and scenario analysis.	6	8	36	34	16
Your bank has adequate insurance coverage or loss mitigation processes in place	12	28	32	17	11
Your bank handles frequency distribution and severity distribution according to what AMA recommends.	34	26	13	18	9
You run statistical simulation to produce a loss distribution.	12	28	32	17	11
You rely on KRIs while calculating the cost of operational risk at your bank	1	9	40	35	15
If you belong to any group of banks, capital flows among the members freely.	20	6	42	37	13
Risk indicators play a role in your monitoring and gathering of internal, external, current and historical data	5	9	36	32	18

Source: author's own work

b) Bivariate statistics: Bivariate Statistical procedures used to describe the relationship between two variables with a special focus on LDA. The primary focus is on the extent to which they covary, or vary together.

i. Age group

Description	Level	Age Group (%)			Total
		21-30	31-40	+40	
1) LDA is a statistical/actuarial approach for computing aggregate loss distributions	Not at all	2.4	0	0	1.0
	To a lesser degree	12.2	9.4	3.7	9.0
	To a fair degree	41.5	34.4	40.7	39.0
	To a high degree	26.8	40.6	40.7	35.0
	Totally	17.1	15.6	14.8	16.0
Total		**100**	**100**	**100**	**100**
2) LDA is better than the other methods to quantify operational risk while using AMA.	Not at all	31.7	21.9	48.1	33.0
	To a lesser degree	39.0	40.6	18.5	34.0
	To a fair degree	14.6	25.0	18.5	19.0
	To a high degree	9.8	6.3	7.4	8.0
	Totally	4.9	6.3	7.4	6.0
Total		**100**	**100**	**100**	**100**
3) The bank uses LDA to identify and	Not at all	29.3	18.8	14.8	22.0
	To a lesser degree	51.2	50.0	44.4	49.0

estimate frequency and severity of losses?	To a fair degree	9.8	18.8	29.6	18.0
	To a high degree	7.3	3.1	3.7	5.0
	Totally	2.4	9.4	7.4	6.0
Total		**100**	**100**	**100**	**100**
4) The bank uses the methods available through LDA to check data completeness of loss data among the participating members?	Not at all	46.3	50.0	37.0	45.0
	To a lesser degree	29.3	21.9	25.9	26.0
	To a fair degree	12.2	15.6	18.5	15.0
	To a high degree	4.9	12.5	7.4	8.0
	Totally	7.3	0	11.1	6.0
Total		**100**	**100**	**100**	**100**
5) There is an effective tracking method at the bank that works well with LDA	Not at all	24.4	25.0	33.3	27.0
	To a lesser degree	53.7	56.3	33.3	49.0
	To a fair degree	14.6	15.6	25.9	18.0
	To a high degree	4.9	3.1	3.7	4.0
	Totally	2.4	0	3.7	2.0
Total		**100**	**100**	**100**	**100**

Source: author's own work

ii. Gender

Description	**Level**	**Gender (%)**		**Total**
		Male	Female	
1) LDA is a statistical/actuarial approach for computing aggregate loss distributions	Not at all	1.2	0	1.0
	To a lesser degree	11.0	0	9.0
	To a fair degree	37.8	44.4	39.0
	To a high degree	35.4	33.3	35.0
	Totally	14.6	22.2	16.0
Total		**100**	**100**	**100**
2) The bank uses LDA to identify and estimate frequency and severity of losses?	Not at all	24.4	11.1	22.0
	To a lesser degree	56.1	16.7	49.0
	To a fair degree	14.6	33.3	18.0
	To a high degree	1.2	22.2	5.0
	Totally	3.7	16.7	6.0
Total		**100**	**100**	**100**
3) The bank uses the methods available through LDA to check data completeness of loss data among the participating members?	Not at all	50.0	22.2	45.0
	To a lesser degree	25.6	27.8	26.0
	To a fair degree	12.2	27.8	15.0
	To a high degree	8.5	5.6	8.0
	Totally	3.7	16.7	6.0
Total		**100**	**100**	**100**
4) There is an effective tracking method at	Not at all	26.8	27.8	27.0
	To a lesser degree	53.7	27.8	49.0

the bank that works well with LDA	To a fair degree	14.6	33.3	18.0
	To a high degree	3.7	5.6	4.0
	Totally	1.2	5.6	2.0
Total		**100**	**100**	**100**
5) The collected data works with LDA and this tells you your data collection method is effective.	Not at all	1.2	0	1.0
	To a lesser degree	11.0	0	9.0
	To a fair degree	37.8	44.4	39.0
	To a high degree	35.4	33.3	35.0
	Totally	14.6	22.2	16.0
Total		**100**	**100**	**100**

Source: author's own work

iii. Qualifications

Description	Level	Qualification (%)					Total
		SS	G	PG	M	O	
1) LDA is a statistical/actuarial approach for computing aggregate loss distributions	Not at all	0	0	2.2	0	0	1.0
	To a lesser degree	0	13.2	6.7	0	12.5	9.0
	To a fair degree	50	44.7	33.3	57.1	25.0	39.0
	To a high degree	50	23.7	40.0	42.9	50.0	35.0
	Totally	0	18.4	17.8		12.5	16.0
Total		**100**	**100**	**100**	**100**	**100**	**100**
2) The bank uses LDA to identify and estimate frequency and severity of losses?	Not at all	50	21.1	26.7	0	12.5	22.
	To a lesser degree	0	47.4	51.1	57.1	50.0	49.
	To a fair degree	50	15.8	13.3	42.9	25.0	18.
	To a high degree	0	7.9	2.2	0	12.5	5.0
	Totally	0	7.9	6.7	0	0	6.0
Total		**100**	**100**	**100**	**100**	**100**	**100**
3) The bank uses the methods available through LDA to check data completeness of loss data among the participating members?	Not at all	0	52.6	46.7	28.6	25.0	45.0
	To a lesser degree	0	21.1	31.1	14.3	37.5	26.0
	To a fair degree	50 .	13.2	8.9	42.9	25.0	15.0
	To a high degree	50 .	5.3	6.7	14.3	12.5	8.0
	Totally	0	7.9	6.7	0	0	6.0
Total		**100**	**100**	**100**	**100**	**100**	**100**
4) There is an effective tracking method at the bank that works well with LDA	Not at all	0	26.3	33.3	14.3	12.5	27.0
	To a lesser degree	0	52.6	48.9	42.9	50.0	49.0
	To a fair degree	100.	13.2	15.6	28.6	25.0	18.0
	To a high degree	0	5.3	0	14.3	12.5	4.0
	Totally	0	2.6	2.2	0	0	2.0
Total		**100**	**100**	**100**	**100**	**100**	**100**

5) The collected data works with LDA and this tells you your data collection method is effective.	Not at all	0	0	2.2	0	0	1.0
	To a lesser degree	0	13.2	6.7	0	12.5	9.0
	To a fair degree	50.	44.7	33.3	57.1	25.0	39.
	To a high degree	50.	23.7	40.0	42.9	50.0	35.
	Totally	0	18.4	17.8	0	12.5	16.
Total		**100**	**100**	**100**	**100**	**100**	**100**

Source: author's own work

iv. Current position

Description	**Level**	**Current Position (%)**					**Total**
		CRO	RM	ORM	ORA	ORO	
1) LDA is a statistical/actuarial approach for computing aggregate loss distributions	Not at all	0	0	3.1	0	0	1.0
	To a lesser degree	9.1	13.3	6.3	0	22.2	9.0
	To a fair degree	27.3	33.3	28.1	61.1	66.7	39.0
	To a high degree	36.4	33.3	50.0	22.2	11.1	35.0
	Totally	27.3	20.0	12.5	16.7	0	16.0
Total		**100**	**100**	**100**	**100**	**100**	**100**
2) The bank uses LDA to identify and estimate frequency and severity of losses?	Not at all	45.5	20.0	15.6	22.2	22.2	22.0
	To a lesser degree	36.4	43.3	56.3	55.6	44.4	49.0
	To a fair degree	9.1	23.3	15.6	11.1	33.3	18.0
	To a high degree	9.1	3.3	6.3	5.6	0	5.0
	Totally	0	10.0	6.3	5.6	0	6.0
Total		**100**	**100**	**100**	**100**	**100**	**100**
3) The bank uses the methods available through LDA to check data completeness of loss data among the participating members?	Not at all	36.4	36.7	43.8	55.6	66.7	45.0
	To a lesser degree	27.3	30.0	37.5	5.6	11.1	26.0
	To a fair degree	0	13.3	9.4	33.3	22.2	15.0
	To a high degree	27.3	6.7	6.3	5.6	0	8.0
	Totally	9.1	13.3	3.1	0	0	6.0
Total		**100**	**100**	**100**	**100**	**100**	**100**
4) There is an effective tracking method at the bank that works well with LDA	Not at all	54.5	30.0	21.9	16.7	22.2	27.0
	To a lesser degree	27.3	40.0	59.4	61.1	44.4	49.0
	To a fair degree	18.2	23.3	15.6	11.1	22.2	18.0
	To a high degree	0	0	3.1	11.1	11.1	4.0
	Totally	0	6.7	0	0	0	2.0
Total		**100**	**100**	**100**	**100**	**100**	**100**
5) The collected data works with LDA and this tells you your data collection method is effective.	Not at all			3.1			1.0
	To a lesser degree	9.1	13.3	6.3		22.2	9.0
	To a fair degree	27.3	33.3	28.1	61.1	66.7	39.0
	To a high degree	36.4	33.3	50.0	22.2	11.1	35.0
	Totally	27.3	20.0	12.5	16.7	0	16.0
Total		**100**	**100**	**100**	**100**	**100**	**100**

Source: author's own work

v. Experience in risk management

Description	Level	Experience in Risk Management (%)				Total
		>3	3>5	5>10	+10	
1) LDA is a statistical/actuarial approach for computing aggregate loss distributions	Not at all	0	0	3.8	0	1.0
	To a lesser degree	16.7	4.8	7.7	0	9.0
	To a fair degree	36.7	40.5	42.3	0	39.0
	To a high degree	30.0	35.7	38.5	50.0	35.0
	Totally	16.7	19.0	7.7	50.0	16.0
Total		**100**	100.0	100.0	100.0	100.0
2) The bank uses LDA to identify and estimate frequency and severity of losses?	Not at all	20.0	28.6	15.4	0	22.0
	To a lesser degree	63.3	42.9	38.5	100.0	49.0
	To a fair degree	13.3	11.9	34.6	0	18.0
	To a high degree		9.5	3.8	0	5.0
	Totally	3.3	7.1	7.7	0	6.0
Total		**100**	100.0	100.0	100.0	100.0
3) The bank uses the methods available through LDA to check data completeness of loss data among the participating members?	Not at all	43.3	59.5	26.9	0	45.0
	To a lesser degree	40.0	11.9	34.6	0	26.0
	To a fair degree	6.7	11.9	30.8	0	15.0
	To a high degree	3.3	9.5	7.7	50.0	8.0
	Totally	6.7	7.1	0	50.0	6.0
Total		**100**	100.0	100.0	100.0	100.0
4) There is an effective tracking method at the bank that works well with LDA	Not at all	33.3	33.3	11.5	0	27.0
	To a lesser degree	40.0	52.4	50.0	100.0	49.0
	To a fair degree	16.7	9.5	34.6	0	18.0
	To a high degree	6.7	2.4	3.8	0	4.0
	Totally	3.3	2.4	0	0	2.0
Total		**100**	100.0	100.0	100.0	100.0
5) The collected data works with LDA and this tells you your data collection method is effective.	Not at all	0	0	3.8	0	1.0
	To a lesser degree	16.7	4.8	7.7	0	9.0
	To a fair degree	36.7	40.5	42.3	0	39.0
	To a high degree	30.0	35.7	38.5	50.0	35.0
	Totally	16.7	19.0	7.7	50.0	16.0
Total		**100**	100.0	100.0	100.0	100.0

Source: author's own work

vi. Type of the banks

Description	Level	Type of the banks (%)				Total
		RB	CB	IB	MB	
1) LDA is a statistical/actuarial	Not at all	0	2.2	0	0	1.0

approach for computing aggregate loss distributions	To a lesser degree	4.1	13.3	0	50.0	9.0
	To a fair degree	42.9	37.8	25.0	0	39.0
	To a high degree	36.7	31.1	50.0	50.0	35.0
	Totally	16.3	15.6	25.0	0	16.0
Total		**100**	**100**	**100**	**100**	**100**
2) The bank uses LDA to identify and estimate frequency and severity of losses?	Not at all	16.3	26.7	50.0	0	22.0
	To a lesser degree	44.9	55.6	25.0	50.0	49.0
	To a fair degree	26.5	8.9	25.0	0	18.0
	To a high degree	4.1	4.4	0	50.0	5.0
	Totally	8.2	4.4	0	0	6.0
Total		**100**	**100**	**100**	**100**	**100**
3) The bank uses the methods available through LDA to check data completeness of loss data among the participating members?	Not at all	42.9	48.9	25.0	50.0	45.0
	To a lesser degree	22.4	31.1	0	50.0	26.0
	To a fair degree	18.4	11.1	25.0	0	15.0
	To a high degree	8.2	4.4	50.0	0	8.0
	Totally	8.2	4.4	0	0	6.0
Total		**100**	**100**	**100**	**100**	**100**
4) There is an effective tracking method at the bank that works well with LDA	Not at all	26.5	26.7	25.0	50.0	27.0
	To a lesser degree	42.9	57.8	25.0	50.0	49.0
	To a fair degree	22.4	11.1	50.0	0	18.0
	To a high degree	6.1	2.2	0	0	4.0
	Totally	2.0	2.2	0	0	2.0
Total		**100**	**100**	**100**	**100**	**100**
5) The collected data works with LDA and this tells you your data collection method is effective.	Not at all	0	2.2	0	0	1.0
	To a lesser degree	4.1	13.3	0	50.0	9.0
	To a fair degree	42.9	37.8	25.0	0	39.0
	To a high degree	36.7	31.1	50.0	50.0	35.0
	Totally	16.3	15.6	25.0	0	16.0
Total		**100**	**100**	**100**	**100**	**100**

Source: author's own work

Testing of Hypothesis: Below are the hypotheses testing:

Hypothesis Number I:

- **Null Hypothesis (H_0):** There is no significant difference among different age groups regarding LDA is an improved mechanism for determining and working on operational risk.
- **Alternate Hypothesis (H_A):** There is a significant difference among different age groups regarding LDA is an improved mechanism for determining and working on operational risk.

In order to determine whether there is a significant difference among different age groups regarding LDA is an improved mechanism for determining and working on operational risk, a kruskal – wallis test was applied using SPSS.

H I- Ranks			
	Age	N	Mean Rank
LDA is better than the other methods to quantify operational risk while using AMA.	21-30 years	41	49.95
	31-40 years	32	55.23
	40 years and above	27	45.72
	Total	100	
HI- Test Statistics [a,b]			
LDA is better than the other methods to quantify operational risk while using AMA.			
Chi-square (1.74.3)	Df (2)	Asymp. Sig. (.418)	
a. Kruskal Wallis Test - b. Grouping Variable: Age			

H_1: Ranks and test statistics - Source: author's own work

From the table above we can observe that the value of chi square statistic is 1.743 and its corresponding p value is 0.418>0.05. Since the p value is more than 0.05 we can conclude that there is no significant difference among different age groups regarding LDA is an improved mechanism for determining and working on operational risk. We fail to reach significance; thus the decision is to retain the null hypothesis.

Hypothesis Number II:

- **Null Hypothesis (H_0):** There is no significant difference in grading between different types of banks regarding operational risk.
- **Alternate Hypothesis (H_A):** There is a significant difference in grading between different types of banks regarding operational risk.

In order to determine whether there is a significant difference in grading between different types of banks regarding operational risk, a kruskal – wallis test was applied using SPSS.

H II- Ranks				
	Indicate the type of bank that you are representing		N	Mean Rank
Operational risk	Dimension 1	Retail	49	51.47
		Commercial	45	50.01
		Investment	4	56.25
		Merchant	2	26.25
		Total	100	
H II- Test Statistics [a,b]				
Operational risk				
Chi-square (1.735)	df (3)		Asymp. Sig. (.629)	
a. Kruskal Wallis Test - b. Grouping Variable: Indicate the type of bank that you are representing				

H_2: Ranks and test statistics - Source: author's own work

From the table above we can observe that the value of chi square statistic is 1.735 and its corresponding p value is 0.629>0.05. Since the p value is more than 0.05 we can conclude that there is no significant difference in grading between different types of banks regarding operational risk. We fail to reach significance; thus the decision is to retain the null hypothesis.

Hypothesis Number III:

- **Null Hypothesis (H_0):** There is no significant difference in grading between different types of banks and their capability for handling operational risk.

- **Alternate Hypothesis (H_A):** There is a significant difference in grading between different types of banks and their capability for handling operational risk.

In order to determine whether there is a significant difference in grading between different types of banks and their capability for handling operational risk, a kruskal – wall is test was applied using SPSS.

H III- Ranks				
	Indicate the type of bank that you are representing		N	Mean Rank
To what degree does your organisation recognize the importance of aligning an operational risk management process with its strategy and objectives?	Dimension 1	Retail	49	47.58
		Commercial	45	54.64
		Investment	4	38.63
		Merchant	2	52.50
		Total	100	

H III- Test Statistics [a,b]		
To what degree does your organisation recognize the importance of aligning an operational risk management process with its strategy and objectives?		
Chi-square (2.262)	df (3)	Asymp. Sig. (.520)
a. Kruskal Wallis Test - b. Grouping Variable: Indicate the type of bank that you are representing		

H_3: Ranks and test statistics - Source: author's own work

From the table above we can observe that the value of chi square statistic is 2.262 and its corresponding p value is 0.520>0.05. Since the p value is more than 0.05 we can conclude that there is no significant difference in grading between different types of banks and their capability for handling operational risk. A one way analysis of variance of applied using SPSS in order test this hypothesis. We fail to reach significance; thus the decision is to retain the null hypothesis.

Hypothesis Number IV

- **Null Hypothesis (H_0):** There is no significant difference between different types of banks and their data management technology.
- **Alternate Hypothesis (H_A):** There is a significant difference between different types of banks and their data management technology.

In order to determine whether there is a significant difference between different types of banks and their data management technology, a kruskal – wallis test was applied using SPSS.

H IV- Ranks				
	Indicate the type of bank that you are representing		N	Mean Rank
Your bank relies on internal data, external data, and scenario analysis.	Dimension 1	Retail	49	51.05
		Commercial	45	50.61
		Investment	4	50.00
		Merchant	2	35.50
		Total	100	

H IV- Test Statistics [a,b]		
Your bank relies on internal data, external data, and scenario analysis.		
Chi-square (.609)	df (3)	Asymp. Sig. (.894)
a. Kruskal Wallis Test - b. Grouping Variable: Indicate the type of bank that you are representing		

H_4: Ranks and test statistics - Source: author's own work

From the table above we can observe that we can observe that the value of chi square statistic is 0.609 and its corresponding p value is 0.893>0.05. Since the p value is more than 0.05 we can conclude that there is no significant difference between different types of banks and their data management technology. We fail to reach significance; thus the decision is to retain the null hypothesis.

Hypothesis Number V:

- **Null Hypothesis (H_0):** There is no significant difference between different types of banks in acceptance of recommendation from agencies like AMA.
- **Alternate Hypothesis (H_A):** There is a significant difference between different types of banks in acceptance of recommendation from agencies like AMA.

In order to determine whether there is a significant difference between different types of banks in acceptance of recommendation from agencies like AMA, a kruskal – wallis test was applied using SPSS.

H V- Ranks				
	Indicate the type of bank that you are representing		N	Mean Rank
Your bank defines operational risk according to what AMA recommends.	Dimension 1	Retail	49	51.59
		Commercial	45	49.06
		Investment	4	53.63
		Merchant	2	50.00
		Total	100	

H V- Test Statistics [a,b]		
Your bank defines operational risk according to what AMA recommends.		
Chi-square (.244)	df (3)	Asymp. Sig. (.970)
a. Kruskal Wallis Test - b. Grouping Variable: Indicate the type of bank that you are representing		

H_5: Ranks and test statistics - Source: author's own work

From the table above we can observe that we can observe that the value of chi square statistic is 0.244 and its corresponding p value is 0.970>0.05. Since the p value is more than 0.05 we can conclude that there is no significant difference between different types of banks in acceptance of recommendation from agencies like AMA. We fail to reach significance; thus the decision is to retain the null hypothesis.

Hypothesis Number VI:

- **Null Hypothesis (H_0):** Quantifying operational risk cannot prevent banks from financial losses.
- **Alternate Hypothesis (H_A):** Quantifying operational risk can prevent banks from financial losses.

A Pearson correlation test was applied using SPSS to assess whether quantifying operational risk can prevent financial losses.

H VI - Correlations			
		Operational risk	Risk financing
Operational risk	Pearson Correlation	1	.079
	Sig. (2-tailed)		.433
	N	100	100
Risk financing	Pearson Correlation	.079	1
	Sig. (2-tailed)	.433	

H VI - Correlations			
		Operational risk	Risk financing
Operational risk	Pearson Correlation	1	.079
	Sig. (2-tailed)		.433
	N	100	100
Risk financing	Pearson Correlation	.079	1
	Sig. (2-tailed)	.433	
	N	100	100

H_6: Ranks and test statistics - Source: author's own work

From the table above we can observe that the correlation coefficient is 0.079 and its corresponding p value is 0.433>0.05. Since the p value is more than 0.05, null hypotheses can be accepted and quantifying operational risk cannot prevent banks from financial losses. We fail to reach significance; thus the decision is to retain the null hypothesis.

Hypothesis Number VII:

- **Null Hypothesis (H_0):** LDA is not the most appropriate method to quantify operational risk data.
- **Alternate Hypothesis (H_A):** LDA is the most appropriate method to quantify operational risk data.

A Pearson correlation test was applied using SPSS to assess whether LDA is the most appropriate method to quantify the operational risk data.

H VII - Correlations			
		Operational risk	LDA is better than the other methods to quantify operational risk while using AMA.
Operational risk	Pearson Correlation	1	.172
	Sig. (2-tailed)		.088
	N	100	100
LDA is better than the other methods to quantify operational risk while using AMA.	Pearson Correlation	.172	1
	Sig. (2-tailed)	.088	
	N	100	100

H_7: Ranks and test statistics - Source: author's own work

From the table above we can observe that the correlation coefficient is 0.172 and its corresponding p value is 0.088>0.05. Since the p value is more than 0.05, null hypotheses can be accepted and LDA is not the most appropriate method to quantify operational risk data. We fail to reach significance; thus the decision is to retain the null hypothesis.

There results of hypotheses show that all the null hypotheses were accepted.

G. Conclusions and Recommendations

The purpose of this research was to study the computing operational risk capital charges using different methodologies within banks according to Basel II with special focus on LDA. There are a lot of risks that banking organizations go through on a daily basis. The study therefore sought to assess various methods for quantifying operational risk loss data and compute required capital charges within a bank when historical data loss data is limited.

To achieve the objectives of this research, in addition to qualitative approach a quantitative research approach was employed where managers working in different banking organization of entities participated in the research. It was established that the risk types in banks include credit risk, market risk, liquidity risk interest rate risk, country risk, reputation risk, legal risk and operational risk. Factors of operational risk as found in the study include people, processes, systems and external factors like political pressure, natural disasters and fraud among others. There are also a number of exposures that were found to be part of operational risk. The exposures include people exposure, systems exposures and systems exposures.

Operational risk resulting from people is as a result of incompetence, negligence, human error, low morale, high staff turnover and fraudulent activities of bank employees. Concerning process exposures, it was established that process exposures leading to operational risk include errors in procedure/methodologies, execution errors, documentation errors, product complexity and security risk. System infiltration, system failures, fraud, programming errors, information risk, telecommunication risk and obsolescence of systems were found to be system exposures leading to operational risk.

Implementation of a formal risk management process is critical to averting the threats that area associated with operational risk. In addition, it is also very important to align operational risk management process with its strategy and objectives because such approach would ensure success in operational risk management. The study established that entities put in place a separate operational risk management structure in order to deal with risk effectively. It was established that arriving at the appropriate threshold to capture operational loss and near misses is very important and that operational events across the various business lines in banks are handled according to what AMA recommends.

It is important to ensure that the ratio of supervisors to staff in a bank is correct in order to curb operational risk that could result from lack of proper supervision of employees. Many banks have a unit that handles confidential client information and they tend to define operational risk according to what AMA recommends.

Majority of respondents justify their bank's pursuing of quantification of operational risk as a positive measure and they unanimously agreed that if there to be a loss at their bank, it would be because of inadequate or failed internal process. Putting in place internal process in the banks to deal will all sorts of risk is therefore quite necessary in trying to contain risk especially operational risk. Promoting sound internal policies and control procedures is effective in managing operational risk in the banking industry.

The management fraternity can therefore play a very significant role in motivating investment in operational risk infrastructure to reduce operational risk at the bank. Many banking institutions according to this study rely on KRIs while calculating the cost of

operational risk at the bank and that risk indicators play a role in monitoring and gathering of internal, external, current and historical data.

Concerning the hypotheses, it was found out that, LDA is an improved mechanism but not the only preferred model for determining and working on operational risk, operational risk is one of the biggest risks for banks, bank has suitable capability for handling operational risk, data management and technology can help in reduction of operational risk. It was also found out that recommendation from agencies like AMA are taken seriously by banks and adhered to. Experience of the respondents on the subject of the study, which is quantifying operational risk within banks according to Basel II was instrumental in ensuring accuracy of the data collected. The same applies to the age and academic qualification of the respondents.

Based on the literature review, data analysis and hypotheses testing researcher is in a position to state the following theses:

No.	Thesis statement
Thesis I	There is a significant difference in agreement among different age groups regarding LDA is an improved mechanism for determining and working on operational risk. That means the senior and junior bankers have a different view on LDA. Most of the young and well qualified bankers preferred risk modeling.
Thesis II	There is a significant difference in grading between different types of banks regarding operational risk. Risk is a mainly derived by Board of Director and it is a top down approach. The stronger risk culture /knowledge among Board member the stronger risk management framework and activity in a bank.
Thesis III	There is a significant difference in grading between types of Banks and their capability for handling operational risk. This is highly depending on the availability of risk infrastructure including human resources.
Thesis IV	There is a significant difference between different types of banks and their Data management technology.
Thesis V	There is a significant difference between the types of banks in acceptance of recommendation from agencies like AMA. This is highly depending on readiness of the banks around the globe in regards to implementation of AMA.
Thesis VI	Quantifying operational risk cannot prevent banks from financial losses. That means banks should not be rely on data quantifying to prevent them from the financial loss but also there must be a comprehensive risk management framework.
Thesis VII	LDA is not the only appropriate methods to quantify operational risk data. In spite of several researches and recommendation from various risk professionals [Toshihiko Mori, and Eiji Harada (2001), Padraic Walsh (2003), ITWG (2003), Klugman et al. (2004), Jos´eAparicio, and Eser Keskiner (2004), Fitch (2004), M.R.A. Bakker(2004), Chartis (2005), Bank of Japan (2005), Kabir Dutta, and Jason Perry (2007), and Basel Committee)] there is no strong evidence to say that LDA is the most appropriate model in quantifying operational risk data.

These statements - **Source:** author's own work

K. Further Recommendation

Quantifying operational risk within banks according to Basel II is a very important subject, whose finding can be quite important to different players in the banking industry.

However, due to the nature of risk and the risk they pose to banking organization, future scholars should consider conducting research to ascertain the impact of information technology in operational risk management. Such study would present important information that would provide the effectiveness of ICT in operational risk management. In addition, further research should also be conducted to establish factors affecting operational risk in the banking industry in their order of priority. This can be important in trying to manage and reduce operational risk in the banking industry.

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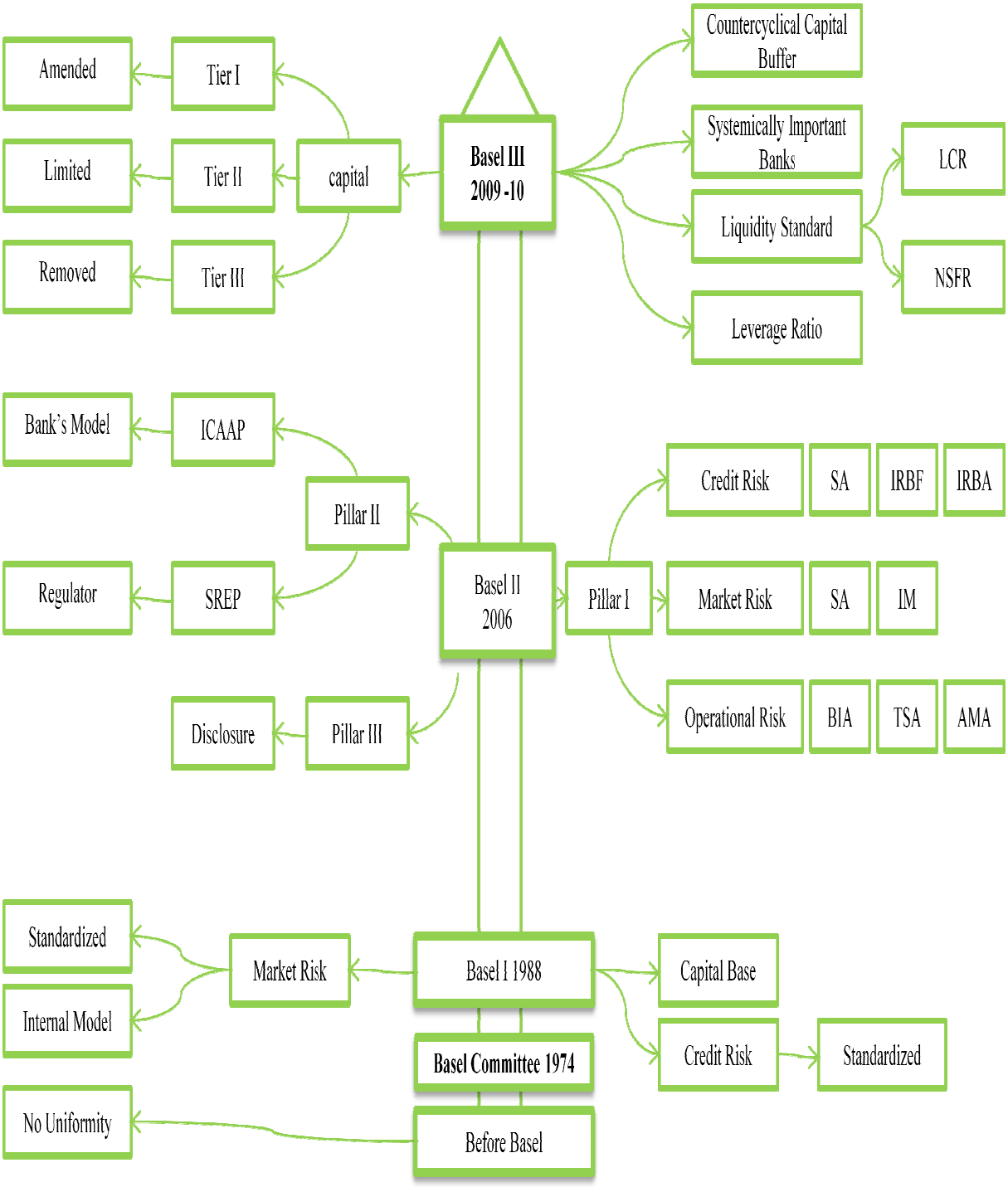
Annexure I: Basel history and key elements



Source: Basel committee history and key elements, (Developed based on BCBS No. 4(1988), 24(1996), 128(2006), 189(2010)

Annexure II: Author's Working experience, publications, seminar, and conference

1. Academic background: more than 10 years teaching finance and banking for undergraduate and postgraduate. Several position such as VP Finance and Admin, Head of Business School in IAU university Dubai, UAE.
2. Banking - More than 10 years in banking. Currently Heading Operational and Market Risk and Basel implementation of Commercial Bank International, UAE.
3. Book -Operational Risk Management – Advanced Measurement Approach (2010)
4. Basel II a need for Banking Industry, Bank Quarterly Magazine, No. 43, 2008
5. Risk Management in Banking Industry, Bank Quarterly Magazine, No. 40, 2007
6. Basel II and Banking industry, Bank Quarterly Magazine, No. 39, 2007
7. Operational Risk Management, Bank Quarterly Magazine, No. 38, 2006 (A professional magazine in banking in Persian language)

Conferences (As a Key Speaker)

No.	Description	Title	Date	Place
1	Risk Management Workshop	Market Risk Management	2012	Tehran - Iran
2	Risk Management Workshop	Basel III	2012	Tehran - Iran
3	Operational Risk Management Forum	Advanced Measurement Approach	2012	Dubai - UAE
4	Risk Management Forum	Risk and Capital Management	2012	Tehran - Iran
5	One Day Seminar on Credit Risk	Towards Internal Rating Based Approach	2011	Dubai – UAE
6	MENA CIO Summit 2011	Basel III impact on Banking Technology	2011	Dubai - UAE
7	The 6th E. commerce Conf.	Risk and Pricing in Banking	2010	Tehran - Iran
8	A comprehensive seminar on Basel II-IRB	IRB: How to implement?	2010	Dubai - UAE
9	The 4th International e. Banking Conf. Tehran	E. Banking Strategy	2010	Tehran - Iran
10	One day Seminar	Operational Risk Management	2010	Isfahan – Iran
11	Three days special Basel II seminar for top Iranian Bankers	Basel II implementation – Challenges and opportunities	2008	Tehran - Iran
12	The second international conf. in e. commerce (Key speaker)	Principles of Risk Management in e. Banking (Basel Committee standards)	2008	Tehran - Iran
13	The first International Conference in Risk Management (Key speaker)	Basel II and Banking Industry	2007	Tehran - Iran

Source: author's own work