

2003. 3

• •

BIS

2006 . BIS 8%

9.6% 가 . ,

2000

가 .

RBC(Risk-Based Capital)

RBC

EU

EU

RBC

RBC

가

가 .

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가

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RBC

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2003

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.....	17
1.	17
가.	17
.	18
2.	20
.....	22
1.	22
2.	25
가.	25
.	28
.	29
.	30
.	33
.....	36
1.	36
가.	36
.	38
.	41
. RBC	43
2.	45
가.	47
. (Qualifying Criteria)	86
3.	88
가.	89

.	.....	102
4.	.....	110
가.	.....	110
.	.....	111
.	.....	113
.		114
.	(m onitoring)	115
.		116
.		117
.		117
.		118
.		119
1.		119
가.		119
.		121
.		122
.	가	127
2.		128
가.		128
.		129
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.		131
.		132
3.		133
가.		134
.		136
.		137
.		138
.		148

.		150
4.		151
가.		151
.		153
.		154
.		157
.		158
1.		158
2.		164
3.		166
	.....	168
< >	()	171
< >	.....	232
< >	.....	236
< >	가 (5)	247

< -1>	.....	23
< -2>	.....	24
< -3>	.....	25
< -1>	.....	40
< -2>	.....	43
< -3>	()	44
< -4>	.....	44
< -5>	(BIS)	50
< -6>	.....	51
< -7>	()	53
< -8>	()	54
< -9>	λ A	65
< -10>	λ A	66
< -11>	.....	66
< -12>	(UL)	67
< -13>	(UL)	68
< -14>	가 (fraud)	70
< -15>	가 (5% 1%)	74
< -16>	가 (5% 1%)	74
< -17>	(:)	76
< -18>	()	79
< -19>	.....	79
< -20>	.....	83
< -21>	.....	84
< -22>	(:)	84

< -1>	.....	42
< -2>	.....	47
< -3>	.....	52
< -4>	.....	64
< -5>	가	70
< -6>	가	71
< -7>	.....	73
< -8>	(, 1,000)	75
< -9> 40	()	76
< -10>	(, 1,000)	78
< -11>	.....	81
< -12>	((LDA))	82
< -13>	(EVT)	82
< -14>	.....	90
< -15>	.....	104
< -16>	.....	106
< -17>	.....	108
< -18>	.....	110
< -1>		156



1.

□

- 가 BIS NAIC RBC .
- BIS 8% 2006 9.6% 가 .
- , 2000 .
- .
- RBC(Risk-Based Capital) , .
- RBC EU .
- .

EU

RBC

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RBC

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30% 가

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• 1976 1991 16 290 ,
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52.6% .
• , , ,
49.7% .

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· BIS “

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(Internal Process) (People) (System)

(External Event) ”

, (legal risk)가

(strategic and

reputational risk) .

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BIS

()	()	()	
(People)		,	-
		,	
		()	(,)
			- , ,
	, ,	, ,	-
		, ,	
(Process)	, ,	, ,	-
		,	
		, ,	
(System)			- ,
/			- ,
		()	- 3 , ,

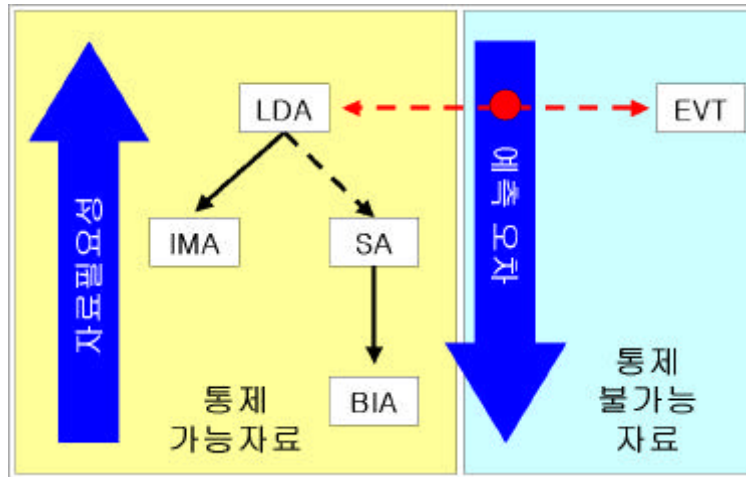
□

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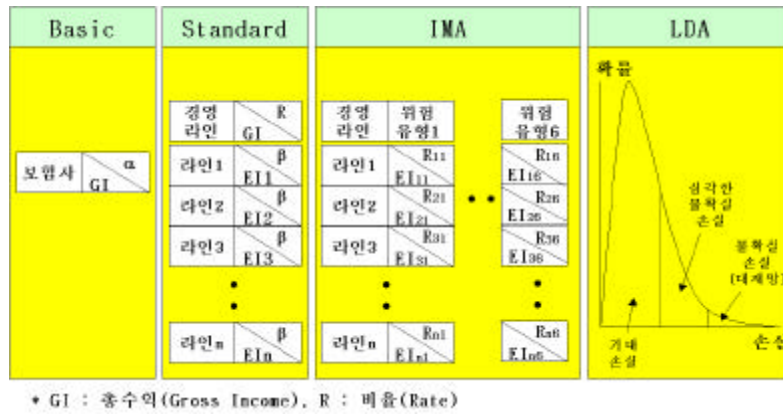
가

•

(BIA),
(SA), (IMA), (LDA) 가
(EVT) 가
가 .
(LDA) (EVT)



가 ,



- (Basic Indicator Approaches) (Gross Income)

$$= G \times \alpha, \quad G : \text{Gross Income},$$

α :

- (Standardised Approaches)

가

$$= \sum_{i=1}^n EI_i \times \beta_i, \quad EI : \text{Exposure Indicator}, i :$$

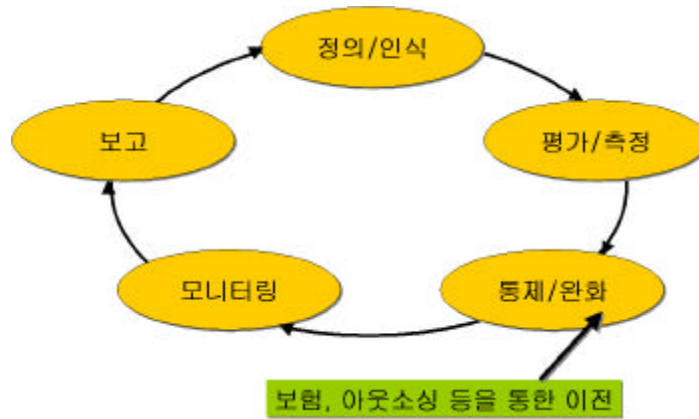
$$\beta_i () : 20\%$$

$$\beta_i = \left[\frac{(MRC_i \times 20\%) \times (i(\%))}{(i)} \right],$$

MRC : (Minimum Regulatory Capital)

□

- 가
가 .
- , 가 ,
, , ,
가 .



- (ORMU: Operational Risk Management Unit)
,
가 (CRO: Chief
Risk Officer)
• - , IT
, , (ORMU), , -

가 , .

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가 .

4.

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- , , .

• 30.4% .

33.4% .

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- , (People) ,

- 가 ,
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• , 2006 BIS 가 .

• BIS (SA) 20% 가 , BIS

8% 1.6%(=8%×20%)가 가 9.6% 가 .

• 1.6% 가 가 , 가 .

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• 2003 8 가 .

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BIS

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RBC(Risk-Based Capital)

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	()	(%)
가 /	47	22.7
	41	19.8
	40	19.3
	37	17.9
	16	7.7
	15	7.2
	5	2.4
	-	-
	6	2.9
	207	100.0
	83	
	290	

: A. M. Best Company, "Best's Insolvency Study: Life Health Insurers," 1976-1991.

(Process)

3

(People)

(External Event)

(External Event)

(External Event)

(People),

(Process),

(People & External Event),

(External Event),

(External Event)

< -2>

109

52.6%

53 25.6%

< -2>

	()	(%)
(People)	41	19.8
(Process)	37	17.9
(People, External Event)	16	7.7
(External)	15	7.2
(External)	-	-
	109	52.6
가 /	47	22.7
	40	19.3
	5	2.4
	6	2.9
	98	47.4
	207	100.0
	83	
	290	

: A. M. Best Company, "Best's Insolvency Study: Life/Health Insurers," 1976-1991.

(People), (People &

External Event), (External Event),

(Process), (External Event)

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49.7% .
 , ,
 60 20.7%
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	()	(%)
(People)	42	14.5
(People, External Event)	38	13.1
(External)	25	8.6
(Process)	22	7.6
(External)	17	5.9
	144	49.7
가 /	86	29.7
	25	8.6
	19	6.6
	16	5.5
	146	50.4
	290	100.0
	114	
	404	

: A. M. Best Company, "Special Report: Solvency Study of the Excess & Surplus Lines Industry," 1995. 9.

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2003 8

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(board or senior management risk)

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가 가 , , 가 , . , , Citibank Travelers Insurance Prudential 가 . Credit Suisse Winterthur Insurance NatWest Legal & General(L&G) 175.5 (172) . 1998 7 Lloyd's TSB Scottish Widows 70 . NatWest가 Scotland

Royal Bank

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Lloyd's TSB

1988 Abbey Life

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Lloyd's TSB Scottish Widows

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1999 8 , MetLife

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MetLife 1980

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(vanishing premium) MetLife

1980

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가 .

30%

가 .3)

(financial technology)

가 ,

가 .

(Basel) “

” , 가

(legal risk)가 .

가

(strategic and reputational risk) .

’

가 .

2) Basel Committee on Banking Supervision, “Consultative Document Operational Risk,” May 2001, pp. 1-26.

3) Marcelo Cruz, “Developing an Operational VAR Model using EVT,” Risk Waters Group. 2001, pp. 129-139.

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(financial technology)

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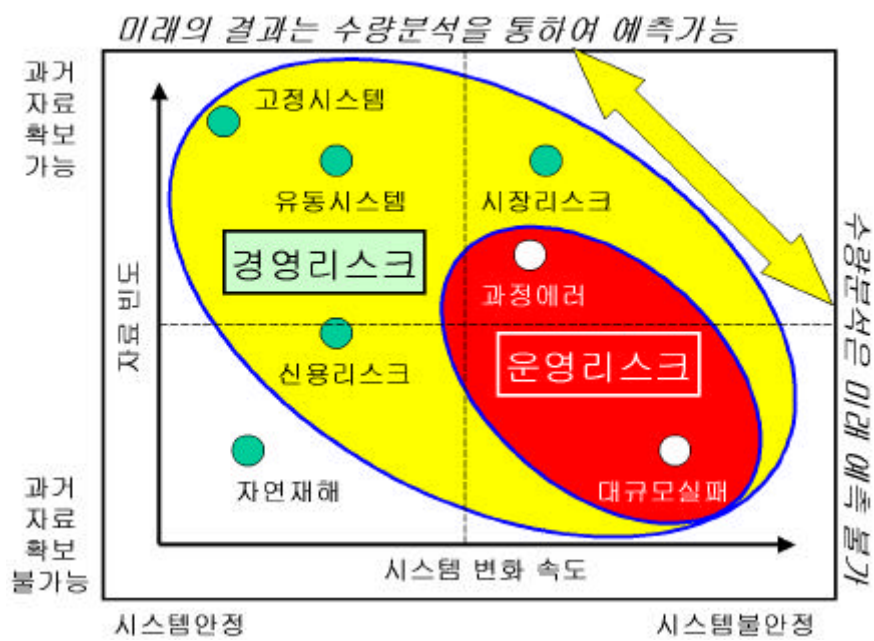
()	()	()	
O1- (People)		,	, ,) ()
		,	
		()	
			, ,
	, , , ,	, ,	,
		, ,	
O2- (Process)	, ,	, ,	
		,	
		,	
O3- (System)			,
O4- /			,
			3 , ,
		()	

5) BIS Working Paper, “Insurance of Operational Risk under the New Basel Capital Accord,” November 2001, pp. 1-32. : This working paper submitted by Insurance Companies.

•

- 6) Basel Committee on Banking Supervision, "Consultative Document Operational Risk", May 2001, pp. 1-26.
- 7) BIS working paper, "Insurance of Operational Risk under the New Basel Capital Accord", November 2001, pp. 1-32. : This working paper submitted by Insurance Companies.

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 ()
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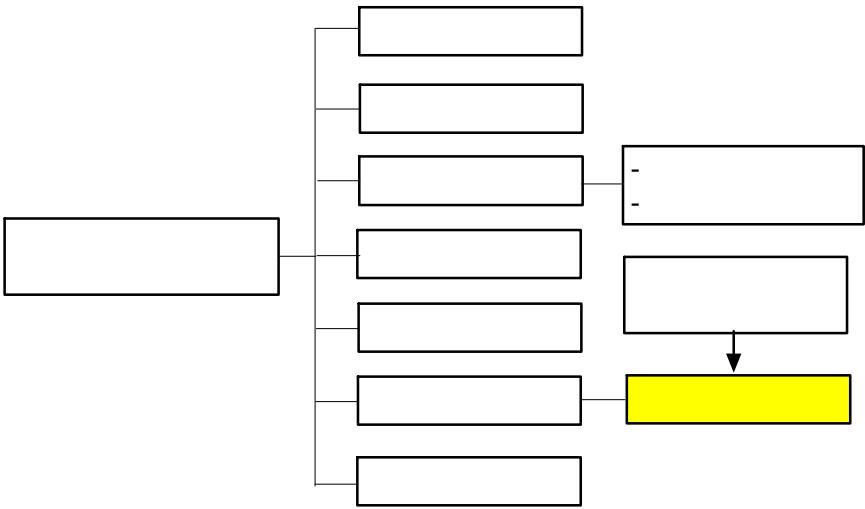
< -1> , Y
 , X
 가

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가

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. RBC

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RBC

C5), (C2), (C3)
0.3% , 0.2%
2
2.0%
RBC
2
8) < -4> . (
) , 1 28.0 30.3
, 2 1,924.3
2 가, 가
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2.

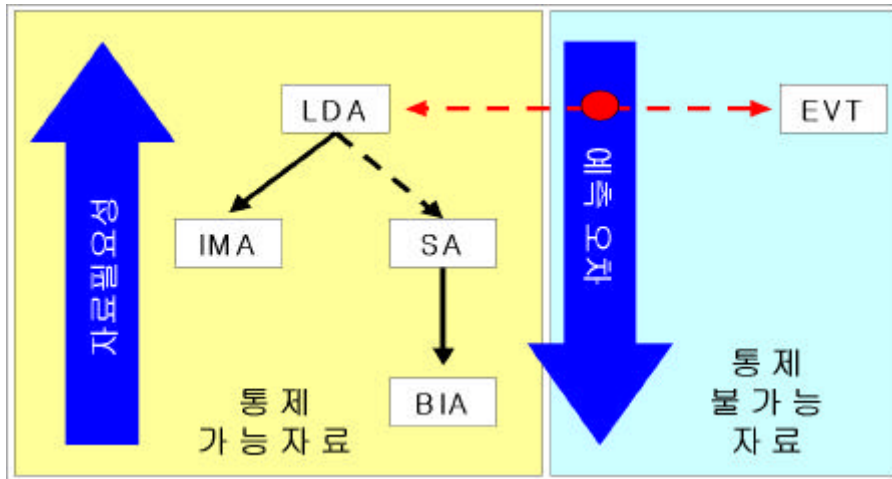
가 가 3가 . ,
(Basic Indicator Approach), (Standardis
-ed Approach), (IMA: Internal Measurement Appro
-ach) . ,
(Loss Distribution Approach) ,
가
(Extreme Value
Theory)

8) 3

(Floor), (Scorecard Approaches), , 가 .
가
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가
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(BIA), (SA), (IMA), (LDA)
가 (EVT)
가
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(BIA),
(SA), (IMA)
가
(BIA), (SA),
(IMA)
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(LDA), (EVT)

< -2>



BIA(Basic Indicator Approach)

SA(Standardized Approach)

가

IMA(Internal Measurement Approach) LDA(Loss Distribution Approach)

LDA

EVT(Extreme Value Theory) 가

가.

1) (BIA: Basic Indicator Approaches)

9) ("α")

9) = + (-

.
.
(GI : Gross Income) ,
.
(k) = GI × α , GI : Gross Income()
α
.
(QIS : Quantitative Impact Survey)
140 1998 2000
.
(MRC : Minimum Regulatory Capital)
12% 가 α

$$\alpha_{i,t} = \frac{(12\% \times MRC_{i,t})}{GI_{i,t}}, \quad i : , t :$$

GI : Gross Income(), *MRC* :

α
17% 20% α

)

2) (SA: Standardised Approaches)

가 , . < -5> ,

β “Working Paper on the
Regulatory Treatment of Operational Risk(WP)”
(GI : Gross Income) .

$$(k) = \sum_{i=1}^n EI_i \times \beta_i$$

$i :$

$$\beta_i = \left[\frac{(MRC_i \times 20\%) \times (i(\%))}{(i)} \right]$$

$MRC :$ (Minimum Regulatory Capital)
 $EI :$ (Exposure Indicator)

,
(GI : Gross Income) , ,
β .
 ,
 ,

가 .

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.

< -5> (BIS)

	1)		2)
			β 1 (8 12%)
		(VaR)	β 2 (15 23%)
			β 3 (17 25%)
			β 4 (13 20%)
			β 5 (12 18%)
			β 6 (6 9%)
			β 7 (8 12%)

: 1) [(custody)]

,

2) β , 가 20% 가

3 .

, 7가 . ,

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				$\beta 1$
		'	PF	$\beta 2$
		(PF)		$\beta 3$
		,		$\beta 4$
				$\beta 5$
		,		$\beta 6$
				$\beta 7$

3) (IMA : Internal Measurement Approaches)¹⁰⁾

,

가

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/

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(GI : Gross Income) .

/

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10) Kenji Nishiguchi and Hiroshi Kawai, Sumitomo Mitsui, "Banking Corporation Internal Measurement Approach(additional handout)," November 2001, pp 1-12.

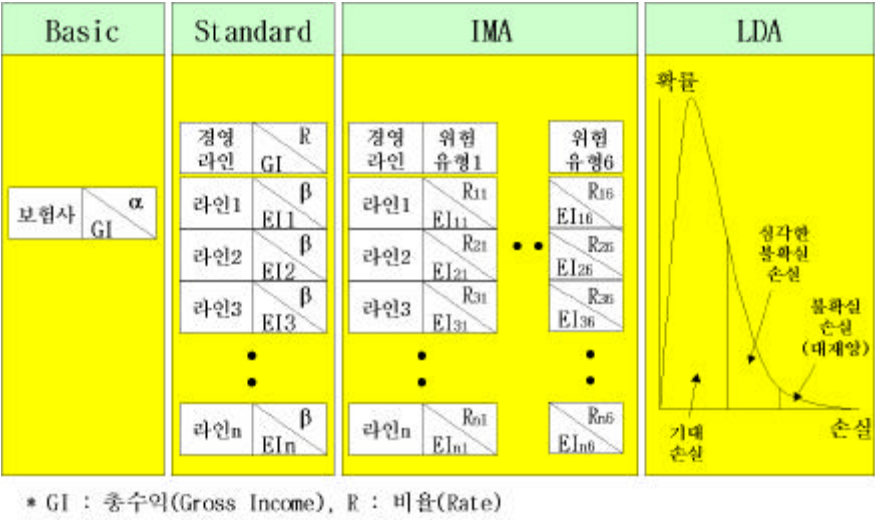
$$(k) = \sum_{i=1}^n \sum_{j=1}^n EI_{ij} \times R_{ij}$$

i :
, *j* :

EI :
(Exposure Indicator)

R :
(Risk Event)

<
 -3>



<
 -3>

가

< -7>

(People), (Process), (System), (External Event)

가

가

< -7> 4가

	Code	Events(Level 1)
OP1 ()	EL1	(Internal Fraud)
	EL2	(Employment Practices and Workplace Safety)
	EL3	(Clients, Products and Business Practices)
OP2()	EL4	(Execution, Delivery, and Process Management)
OP3()	EL5	(Business Disruption and System Failures)
OP4 ()	EL6	(External Fraud)
	EL7	(Damage to Physical Assets)

* OP1 : (People), OP2 : (Process),
OP3 : , OP4 : , EL :
Event Line

< -8>

< -8> ()

	Code		Events(Level 2)
OP1 ()	EL1	EL11	(Unauthorized Activity)
		EL12	, (Theft and Fraud)
	EL2	EL21	(Employee Relations)
		EL22	(Safe Environment)
		EL23	(Diversity and Discrimination)
	EL3	EL31	(Suitability, Disclosure, and Fiduciary)
		EL32	(Improper Business or Market Practices)
		EL33	(Product Flaws)
		EL34	(Selection, Sponsorship, and Exposure)
		EL35	(Advisory Activity)
OP2 ()	EL4	EL41	(Transaction Capture, Execution, and Maintenance)
		EL42	, (Monitoring and Reporting)
		EL43	(Customer Intake and Documentation)
		EL44	(Customer/ Client Account Management)
		EL45	(Trade Counterparties)
		EL46	(Vendors and Suppliers)
OP3 ()	EL5	EL51	(Systems)
OP4 ()	EL6	EL61	, (Theft and Fraud)
		EL62	(Systems Security)
	EL7	EL71	(Disasters and Other Events)

* OP1 : (People) , OP2 : (Process) ,
OP3 : , OP4 : , EL :
Event Line

(AMA : Advanced Measurement Approaches)

가 “ ”

(WP 1 , 99.9%

)

(EI : Exposure Indicator)

(PE : Probability of Loss Event)

(LGE : Loss Given that

Event)

(EI), (PE) (LGE)

(EL : Expected Loss)

Y . Y

$$(K) = \lambda \times EL \times (1 + A / \sqrt{n})$$

λ

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A

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n

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A λ .

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A λ

Generic Model

Foundation Model .

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Foundation

Model 가 가

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Generic Model .

Foundation Model 가

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가

Foundation Model .

(1)

CP2(Consultative Paper 2, 2001, Jan)

IMA .

$$(k) = \gamma \times EI \times PE \times LGE$$
$$(K) = \lambda \times EI \times PE \times LGE \times RPI$$

Foundation Model

.

(K)	<i>EI</i>	<i>PE</i>	<i>LGE</i>	<i>RPI</i>
	<i>EL</i>			$1 + A / \sqrt{n}$

(EL : Expected Loss)

.

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가 , ,

(EI : Exposure Indicator)

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, 가 , 가 가 ,

. (PE : Probability of Loss Event)

, $(N \times \mu)$ 가
 , $EI \times PE \times LGE$ EI
 PE ,
 EI PE
 .

$$EI \times PE \times LGE = (N \times \mu) \times n/N \times \mu_L / \mu$$
$$= (\times \times)$$
$$= n \mu_L = EL ()$$

$n :$, $N :$

$\mu_L :$, $\mu :$

(λ)
 λ (EL)
 .

$1 + A / \sqrt{n}$
 $1 + A / \sqrt{n}$ (RPI : Risk Profile Index)
 (RPI) (EI)
 . “ . ”
 , (severity)
 (frequency)
 , (μ_L , σ_L)가
 .
 가

A .

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A 가 .

, (n)가 (EL)

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$1/\sqrt{n}$

.

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$A \quad \lambda$ (Foundation Model)

$A \quad \lambda$.

Foundation Model

, $A \quad \lambda$ 가 .

.

, $EI \times PE \times LGE = EL$. ,

, (EL) 가 .

, (EL)

, (EI),

. , Foundation Model

가

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 (2) ()¹¹⁾
 Sumitomo Mitsui
 Banking Corporation 가
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 Foundation
 Model A λ 가 ,
 가 .
 (K)
 $\lambda \times EL \times (1 + A / \sqrt{n})$, λ A
 . (EL)
 (n)
 i j (K)
 .

$$(K) = \lambda_j \times EL_j \times (1 + A_j / \sqrt{n_j})$$

$i :$, $j :$

11) Foundaton Model
 Sumitomo Mitsui Banking Corporation 가 .

λ_{ij} A_{ij} . EL_{ij}
 n_{ij} .
가 ,
i j
 $UL_{ij}(\quad)$.
. UL_{ij} .
(UL) .
i j
 λ_{ij} A_{ij} .

$$\sum_i \sum_j UL_{ij} = \sum_i \sum_j \lambda_j \times EL_{ij} \times (1 + A_{ij} / \sqrt{n_{ij}})$$

$$i : \quad , \quad j :$$

UL_{ij}
(LDA)
. $\lambda_j \times EL_{ij} \times (1 + A_{ij} / \sqrt{n_{ij}})$
(K) . i , j
. UL_{ij} ,
 EL_{ij} , n_{ij}
 λ_{ij} A_{ij}
. (λ_j , A_{1j} , A_{2j} - - -)
.

$$\begin{aligned} &: A_{ij} = a_j \times \sigma_{ij}/\mu_{ij} \\ a_j : & \quad , i : \quad , j : \end{aligned}$$

$$\sigma_{ij}/\mu_{ij}$$

$$\begin{aligned} \sum_i \sum_j UL_{ij} &= \sum_i \sum_j \lambda_j \times EL_{ij} \times (1 + a_j \times \sigma_{ij}/\mu_{ij}/\sqrt{n_{ij}}) \\ a_j : & \quad , i : \quad , j : \end{aligned}$$

$$a_j, \qquad \sigma_{ij}/\mu_{ij} \qquad \lambda_j$$

$$(UL_{ij}),$$
$$(EL_{ij})$$

$$(n_{ij}) \qquad .$$

$$\begin{aligned} \sum_i \sum_j UL_{ij}/EL_{ij} &= \sum_i \sum_j \lambda_j \times a_j \times \sigma_{ij}/\mu_{ij}/\sqrt{n_{ij}} \\ a_j : & \quad , i : \quad , j : \end{aligned}$$

$$< \qquad -4 > \qquad .$$

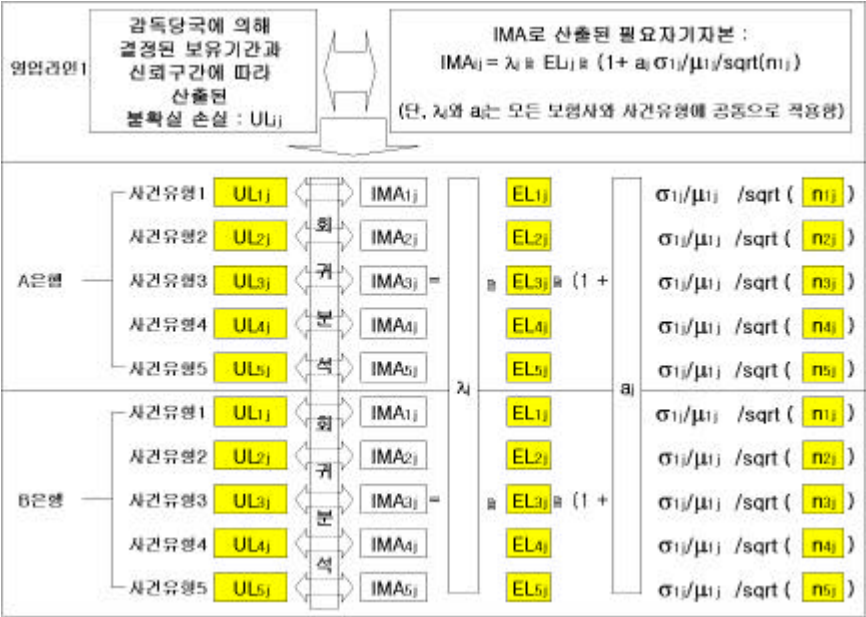
$$1 \qquad (UL_{ij}) \qquad A$$

B

가

가

< -4 >



(3) (SA) (IMA)

Sumitomo Mitsui Banking Corporation (

1) .

(UL) 가

λ A

λ A 0.93

가 .

< -9> λ A (:)

	UL _{i1} (1y:99.9%)	n _{i1}	EL _{i1}		λ _i	A _{i1}
1	4,468	16	365		19.46	2.11
2	****	**	***		19.46	6.02
3	****	**	***		19.46	0.90
4	123,688	76	1,440		19.46	15.31
5	****	**	***		19.46	1.96
6	****	**	***		19.46	11.95
7	5,240	2,428	864		19.46	23.84
8	****	**	***		19.46	8.69

A_{i1}

0.90 23.84 ,

A_{i1}

A_{i1}

(IMA)

(IMA) 가 .

$$(IMA) = \lambda \times EL \times (1 + A / \sqrt{n})$$
 가 ,

λ A

가 .

< -10> λ A (:)

	λ _i	A _{il}		λ _i	A _{il}
1	19.46	2.11		25.12	2.54
2	19.46	6.02		25.12	5.95
3	19.46	0.90		25.12	2.31
4	19.46	15.31		25.12	16.34
5	19.46	1.96		25.12	2.04
6	19.46	11.95		25.12	14.32
7	19.46	23.84		25.12	18.54
8	19.46	8.69		25.12	6.82

(SA) β
12% 20% 가 .
2
가 .

< -11>

	EL()	n		EL()	n
1	301,287	5		54,528	5
2	8,666	200		32	20
3	60	3		6,589	82
4	1,880,360	30		32,497	11
5	8,920	15		859	55
6	200	5		3,421	4
7	912,204	920		5,124	56
8	5,890	46		495	64
	3,111,697	1,178		95,602	96

* EL : , n :

(GI : Gross Income)
1,500,000 , 200,000 가

(IMA)

(IMA)

< -12>

(UL)

	λ_i	A_{ii}	EL()	n	IMA(=UL)()
1	19.46	2.11	301,287	5	11,395
2	19.46	6.02	8,666	200	240
3	19.46	0.90	60	3	2
4	19.46	15.31	1,880,360	30	138,873
5	19.46	1.96	8,920	15	261
6	19.46	11.95	200	5	25
7	19.46	23.84	912,204	920	31,704
8	19.46	8.69	5,890	46	261
Total			3,117,587	1,224	182,763

(IMA)

182,763

(UL/ EL) 58.6

(SA)

180,000

(=1,500,000 × 12%).

(IMA)

9,173

(IMA)

(UL/ EL) 88.6

(SA)

40,000

(=200,000 × 20%).

(SA) ;		
	= 1,500,000	× 12%
	= 180,000	
	= 200,000	× 20%
	= 40,000	

< -13>			(UL)		
	λ_i	A_{ii}	EL()	n	IMA(=UL)()
1	25.12	2.54	54,528	5	2,926
2	25.12	5.95	32	20	2
3	25.12	2.31	6,589	82	208
4	25.12	16.34	32,497	11	4,838
5	25.12	2.04	859	55	28
6	25.12	14.32	3,421	4	701
7	25.12	18.54	5,124	56	448
8	25.12	6.82	495	64	23
Total			103,545	297	9,173

가 가 ,

. (IMA) 182,763 9,173
191,935 . (SA)
180,000 40,000 220,000 .

(IMA) ;		
	= 182,763	
	= 9,173	

(IMA) (SA)

, $\text{Max}[\lambda \times EL \times (1 + A/\sqrt{n}), \beta_1 \times EI]$ 가
220,000 .

$(SA) = 220,000$ $(IMA) = 191,935$ $(K) = \text{Max}[SA, IMA] = 220,000$
--

4) (LDA : Loss Distribution Approaches)¹²⁾

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 (1)
 가 (
 가)
)
 가 가
 . 가 ,
 가 . 가 40
 ,
 . 1,110,949 , 1,250
 .

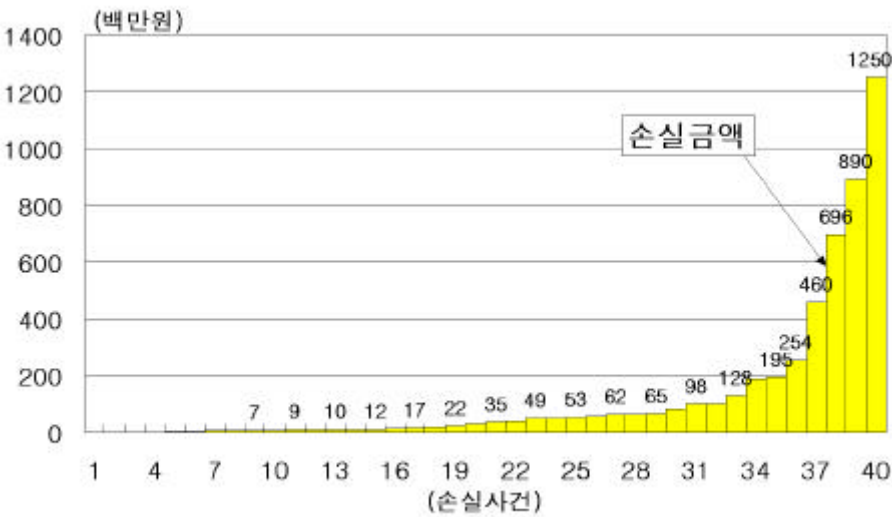
12) Gerhard Courage, "Loss Distribution Approach", Allianz, 2001.

< -14> 가 (fraud)

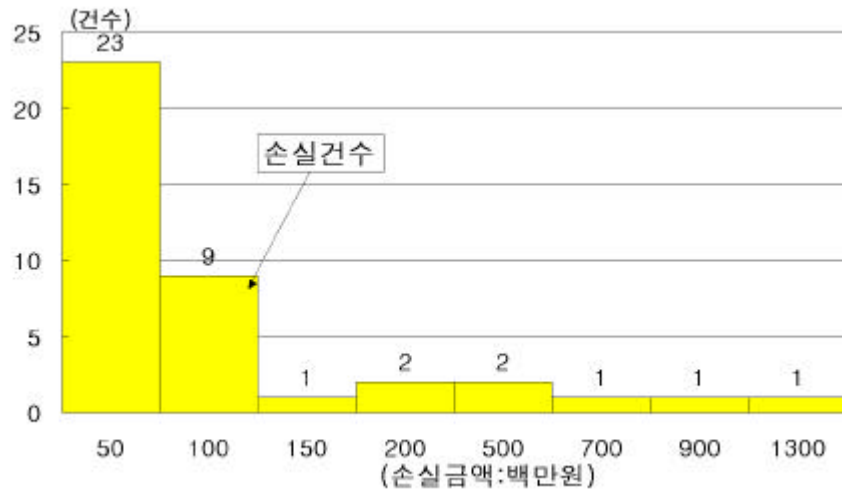
	가	
	1,110,949()	1,250,000,000()
	40	
	4,999,573,570()	
가	124,989,339()	259,890,649()

40 , 50
가 124,989,339 ,
259,890,649
1,000

< -5> 가



< -6> 가



< -5> 가
가 . < -6> 가
가

가

13)

40

가

13) (Monte-Carlo Simulation) 2

, (graduation), , (Markov Chain)

(ChiSquare)¹⁴⁾

- (Kolmogorov-Smirnov)¹⁵⁾ .

(-)

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, 1,000 . 가 40
40

,

1,000 .

,

, 40 가

가 ,

, 1,000 가

14)

. ,

$(\sum(O_i - E_i)^2/E_i)$.

15) 가 5 . -

가

가

가 5 가 .

$(F_0(X))$, 가 $(F_e(X))$

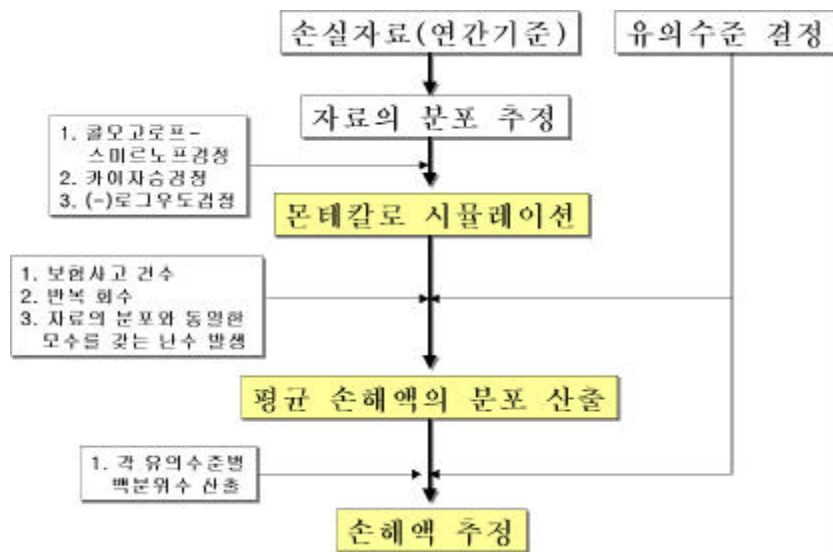
, (D) 가 (D α) ,

$D = \text{Max } |F_0(X) - F_e(X)| < D_\alpha$ 가 .

95% 99%

(percentile)

< -7>



가 , 가 (H_0)

, < -15>

가 가 가 가

가 가 가

(-)

가 (-)

, < -16> (-)

29.79 , 10.46

()

가

1,000

95% 99%

< -15> 가 (5% 1%)

			(-)
	5%	1%	
	85.11 (H ₀) *	85.11 (H ₀) **	720.21 **
	3.42 (H ₀)	3.42 (H ₀)	29.79
	276.23 (H ₀) *	276.23 (H ₀) **	44.44 **
	8.26 (H ₀)	8.26 (H ₀)	10.46

: * 5% 가 , ** 1%
가 . 5% 8(=n-k-1=9-0-1)
15.51 , 1% 20.09 .

1) : $\mu=124,989,339$, $\sigma=259,890,648$
2) : $\mu=17.1$, $\sigma=1.8415680$
3) : $\alpha=1.0000000$, $\theta=540391283$
4) : $\alpha=0.2312941$, $\theta=540391283$

< -16> 가 (5% 1%)

	- (K-S)			(-) (Min)
	K-S (D)			
		5% (0.215)	1% (0.257)	
	0.339	(H ₀)*	(H ₀)**	720.21 **
	0.076	(H ₀)	(H ₀)	29.79
	0.632	(H ₀)*	(H ₀)**	44.44 **
	0.197	(H ₀)	(H ₀)	10.46

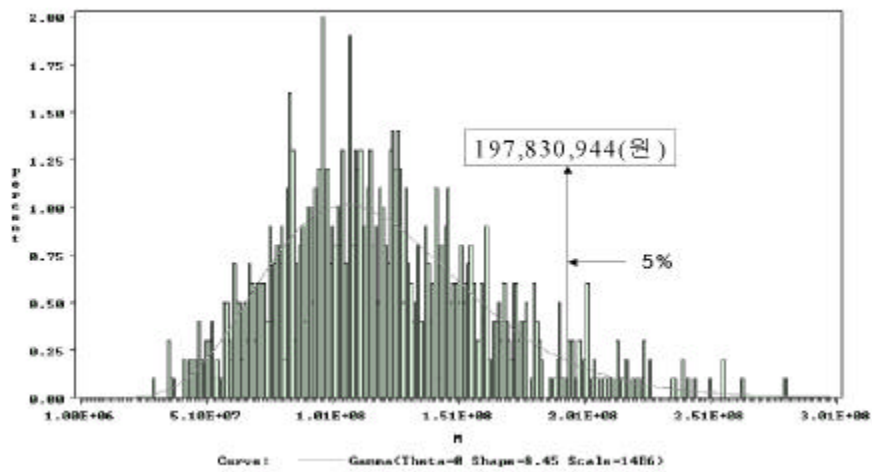
: * 5% 가 , ** 1%
가 . 5% K-S 0.215 ,
1% K-S 0.257 .

(1) 가

가 가

. , 가
1,000
1,000 가
1,000 , 1,000
가
95% 99%
95%
197,830,944()

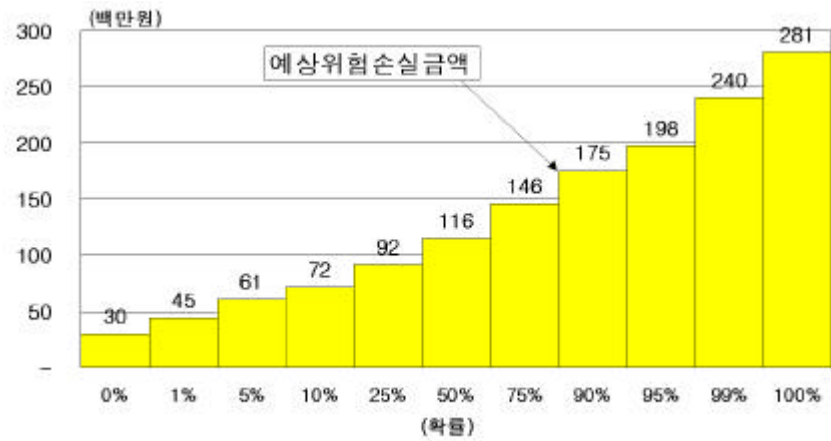
< -8 > (, 1,000)



40

0% 30 100% 281 .

< -9> 40 ()



< -17> , 가 124,989,339
95%
58.3%가 197,830,944 .

< -17> (:)

	75%	90%	95%	99%
30	145,423,921 (16.3)	187,028,546 (49.6)	209,886,360 (67.9)	257,958,174 (106.4)
40	146,050,601 (16.9)	175,266,315 (40.2)	197,830,944 (58.3)	240,344,241 (92.3)
60	139,983,771 (12.0)	164,166,700 (31.3)	180,693,038 (44.6)	208,331,024 (66.7)
80	137,316,184 (9.9)	157,200,480 (25.8)	167,311,189 (33.9)	196,997,742 (57.6)
100	137,085,993 (9.7)	153,193,032 (22.6)	160,845,832 (28.7)	184,986,104 (48.0)
150	134,029,942 (7.2)	147,524,431 (18.0)	157,058,512 (25.7)	172,981,146 (38.4)
200	132,955,413 (6.4)	143,552,908 (14.9)	150,020,816 (20.0)	167,977,734 (34.4)

95%

가 가 . 99% 58.3%

92.3% 가 .

가 40 .

40 , 가

가 . 가

가 .

가

가

가 95%

가 30

67.9% , 40 58.3%, 60 44.6%,

150 200 25.7% 20.0% .

가

가 , .

(2) 가 ()

가 ,

가 .

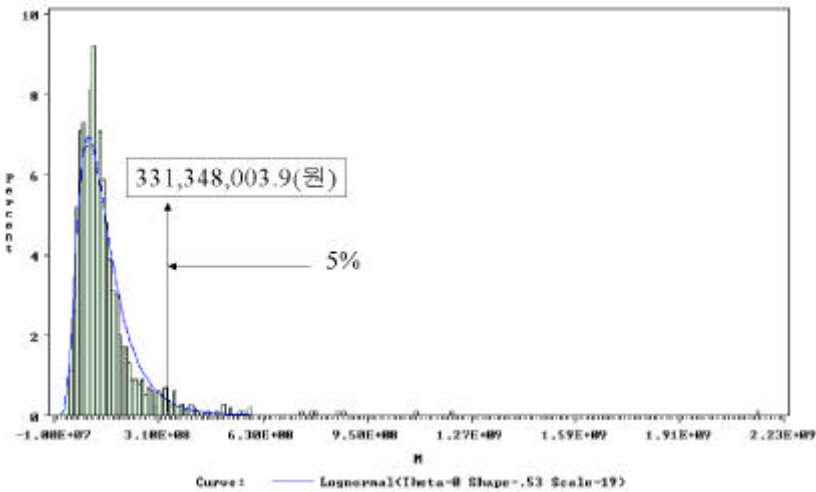
가 가

, 가 . 가

가

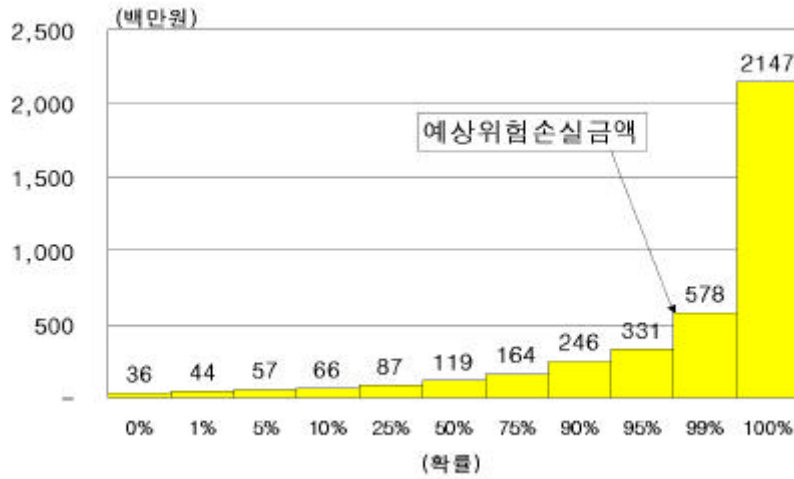
1,000

< -10> (, 1,000)



95%
331,348,003() . 40
0% 36 100%
2,147 가
가 . 95%
가 가 58.3%가
197,830,944 ,
165.1%가 331,348,004 .
95% ,
58.3% 가 가 , 가
165.1% 가 .

< -18> ()



99%

92.3%

가

362.4%

가

< -19>

	75%	90%	95%	99%
30	169,953,198 (35.97)	253,941,483 (103.17)	357,117,815 (185.72)	723,693,004 (479.00)
40	164,269,895 (31.43)	246,410,850 (97.15)	331,348,003 (165.10)	577,940,912 (362.39)
60	166,418,375 (33.15)	232,119,318 (85.71)	311,551,637 (149.26)	543,413,990 (334.77)
80	165,503,875 (32.41)	224,153,419 (79.34)	268,553,060 (114.86)	462,117,855 (269.73)
100	164,418,050 (31.55)	215,053,917 (72.06)	259,430,091 (107.56)	397,685,232 (218.18)
150	163,431,963 (30.76)	210,346,869 (68.29)	248,911,899 (99.15)	365,439,951 (192.38)
200	163,219,994 (30.59)	202,347,492 (61.89)	231,676,713 (85.36)	329,004,847 (163.23)

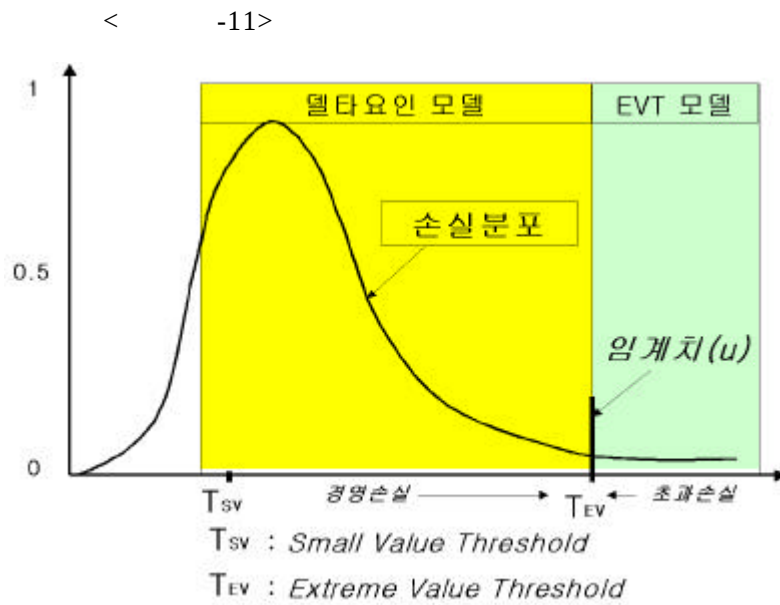
가 . 가
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5) (EVT: Extreme Value Theory)¹⁶⁾

가
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 (Genoa)
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 < -11> 가
 가
 (LDA)
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 가 .
 가
 (severity)
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16) Jack L. King, "Operational Risk: EVT Models," Genoa(UK) Limited, 2001.
 Bahram Mirzai, "Operational Risk Quantification and Insurance," Swiss
 Re FSBG, 2001.

Fisher-Tippet



가

(Delta Factor Model Loss Distribution Approach)

(Extreme Value Model)

가

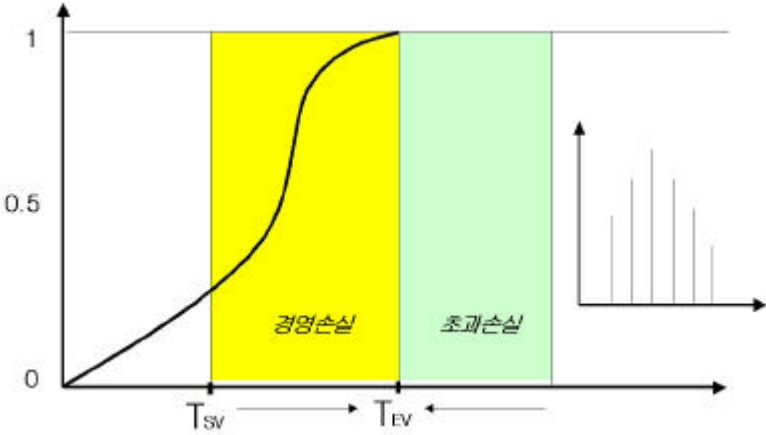
(threshold value)

(LDA)

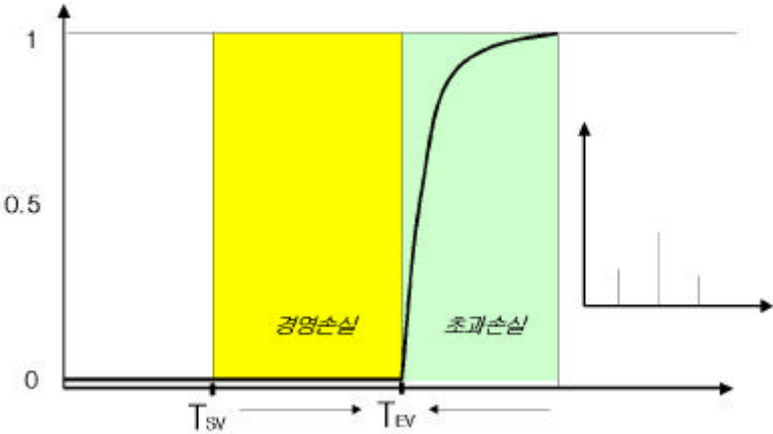
<

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< -12> (LDA)



< -13> (EVT)



(LDA)

(N, F)

$(N_{T_{EV}}, F_{T_{EV}})$

$$: N_{total} = N + N_{TEV}$$
$$: F_{total} = \frac{N}{N_{total}} F + \frac{N_{TEV}}{N_{total}} F_{TEV}$$

(EVT)

(Genoa)

17)

가

99%

가

< -20>, < -21>

< -20>

	1,000
(260)	260,000
	200,000
	100 basis point
가	200
	52,000,000
	12%
	6,240,000

17) Jack L. King, "Operational Risk: EVT Models", Genoa(UK) Limited, 2001.

< -21>

	3%
	30
	7,800
	200
	1,560,000
()가 500	
	5,529,860

< -22>

가
가
가

< -22> (:)

	가 (-)		가 (-GPD)			
90%	7,911	1,757,224	30	2,557,100	7941	4,314,324
95%	7,940	1,771,004	32	3,262,250	7972	5,033,254
99%	8,020	1,816,982	35	7,846,340	8055	9,663,322
99.9%	8,068	1,834,619	39	14,381,519	8107	16,216,138

* 12% 6,240,000 가 ,
GPD(Generalized Pareto Distribution) 가 .

$$GPD(x) = \left((1 + \xi \frac{x - threshold}{\beta})^{-\frac{1}{\xi}} \right)$$

가

가

가

6) (Floor)

(Floor)

2

7) (Scorecard Approaches)

가

· (Qualifying Criteria)

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1) (BIA)

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(Operational Risk Sound Practices)”

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2) (SA)

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(inputs)

(track)

3) (IMA)

(PE LGE)

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(PE) (LGE)

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1995 , 1998 Bankers Trust가 Procter &
Gamble 10 ,

Dexia Bank

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30.4%

33.4%

가

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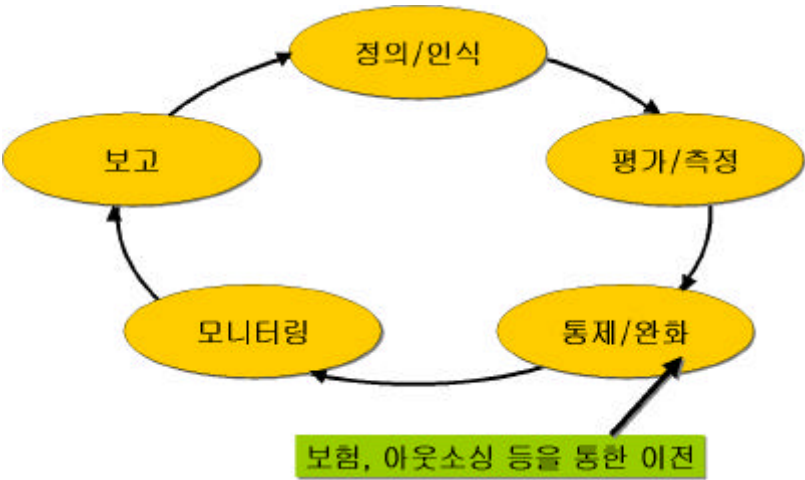
2006

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1)

30% 가 .

가

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2001

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가 (legal risk)가 , 가 (strategic and reputational risk)

가

4가

(People), (Process), (System), (External Eve-
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가 (self-assessment)¹⁸⁾:

가 .

가 ,

(risk mapping): , ,

(mapping)

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(key risk indicators):

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(score cards): 가 (score)

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(threshold) (limit): 가

18) 가 < > , 5

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(Bankers Blanket Bond)
(Financial Institution Bond)

(Computer Crime Policy)

TWX

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(Unauthorized Trading Policy)

(Property Insurance Policy)

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 (Business Interruption Policy)
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 (Bankers Professional Indemnity)
 (Errors & Omissions Policy)
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 (Commercial General(comprehensive)
 Liability Policy)
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 (Employment Practice Liability Policy)
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 (Directors and Officers Liability Policy)
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 (Electronic Insurance Policy)
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2001

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Banker Trustster

D. G. Hoffman

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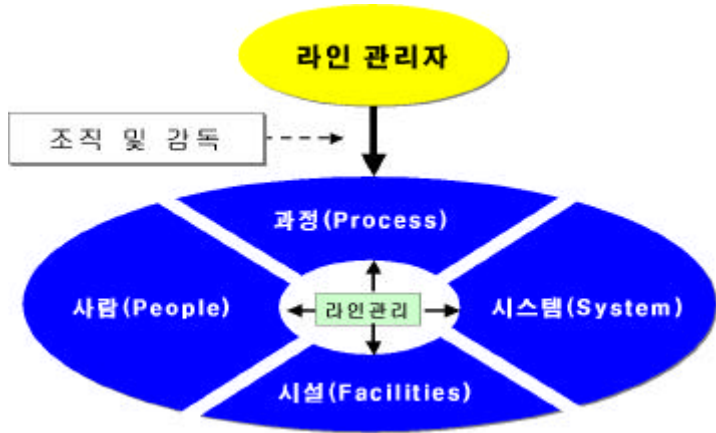
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Coopers British Bankers' Association, International
Swaps & Derivatives Association, Robert Morris Associates
1999 ,

(Chief Risk Officer : CRO)

가

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(Operational Risk Management Unit : ORMU)

. < -16>

가 , 가

(ORMU) 가

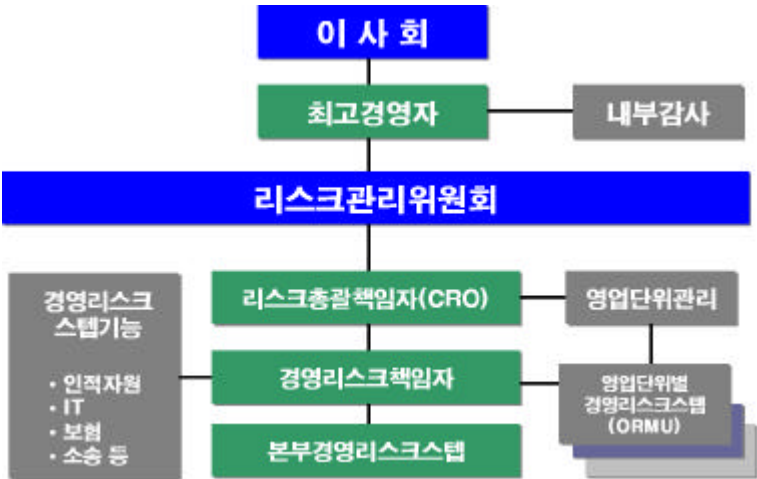
가

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가

(ORMU)

< -16>



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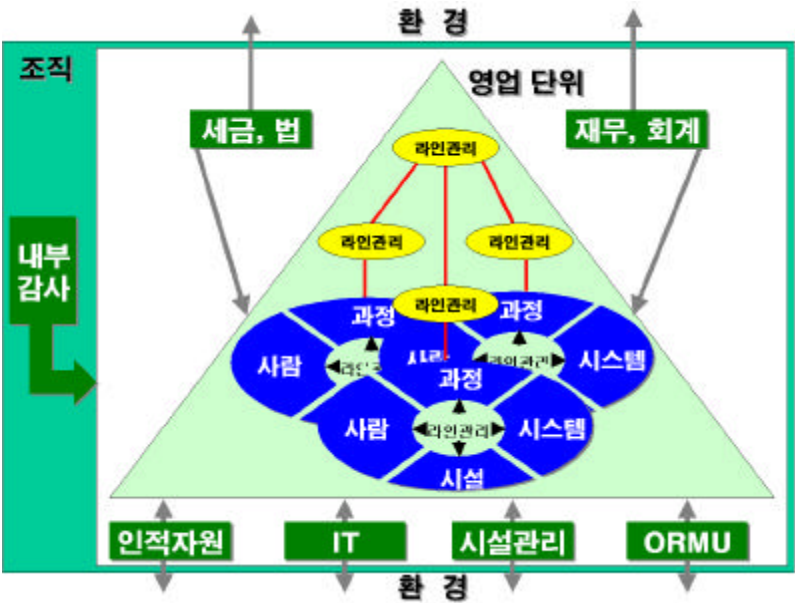
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3)

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가

가

(ORMU)

-18>

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20)

가.

가

85.7%가

가

88.9%

가

1)

가

가)

가

30.4%

33.4%

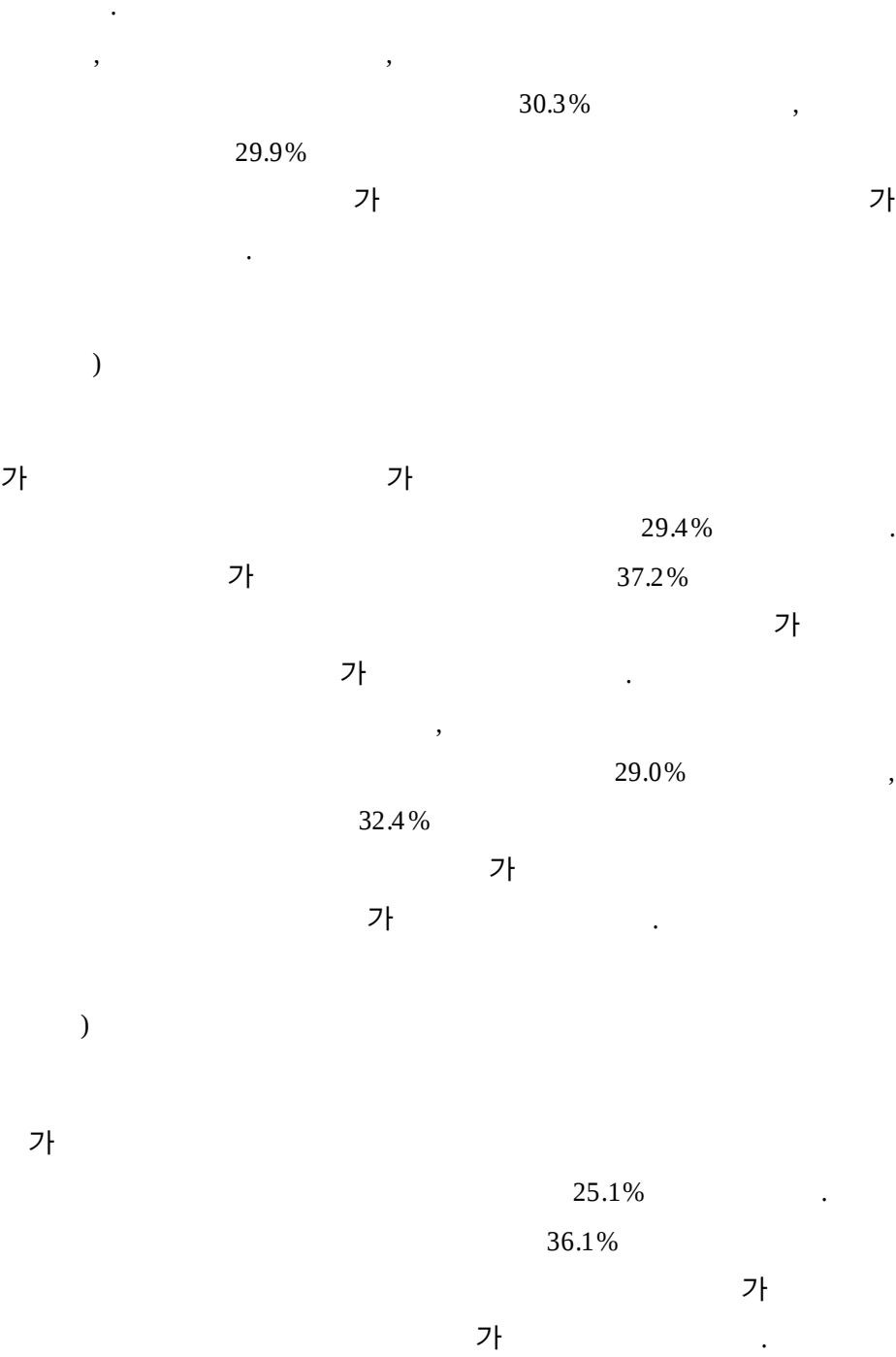
가

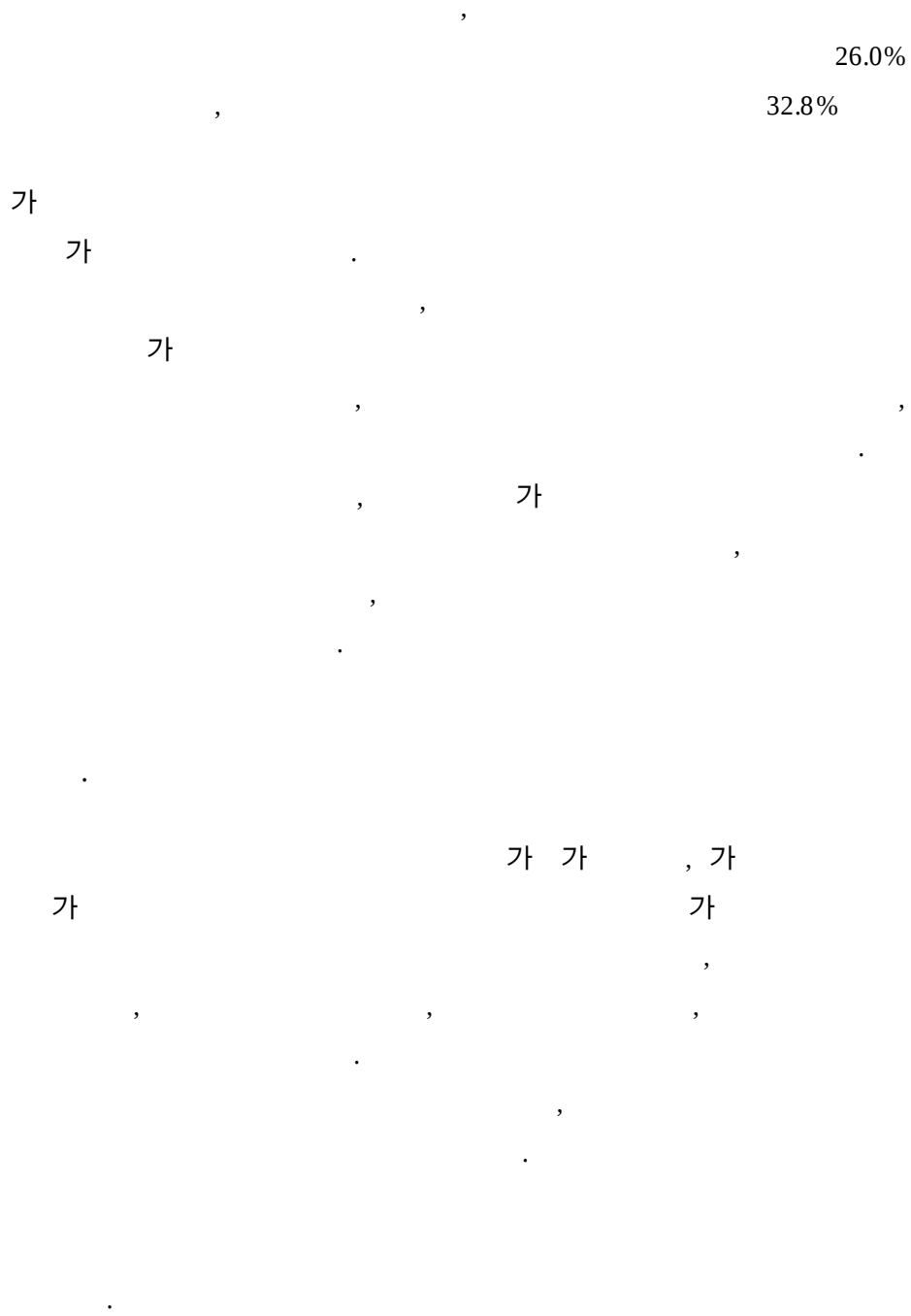
가

20)

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1)

가)

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가

가

18.5%

,

14.8%,

가 66.7%

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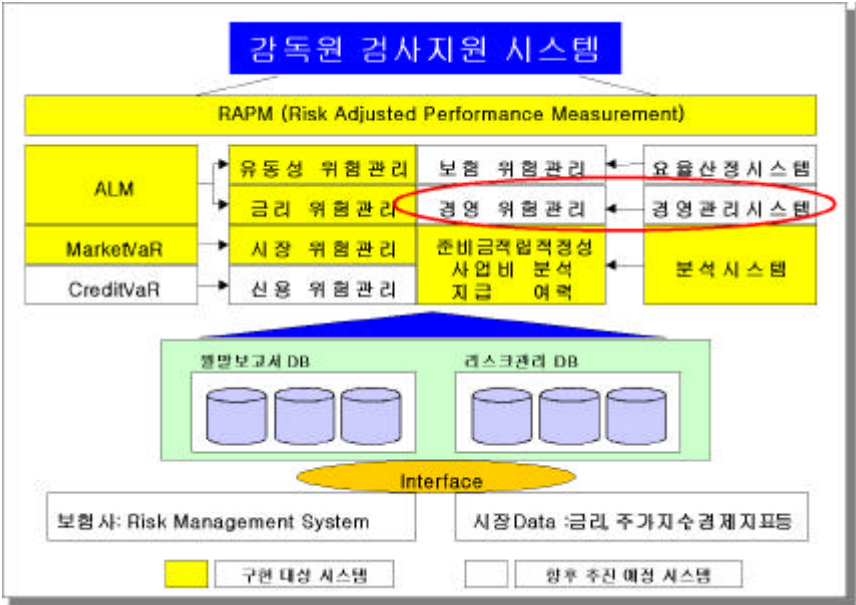
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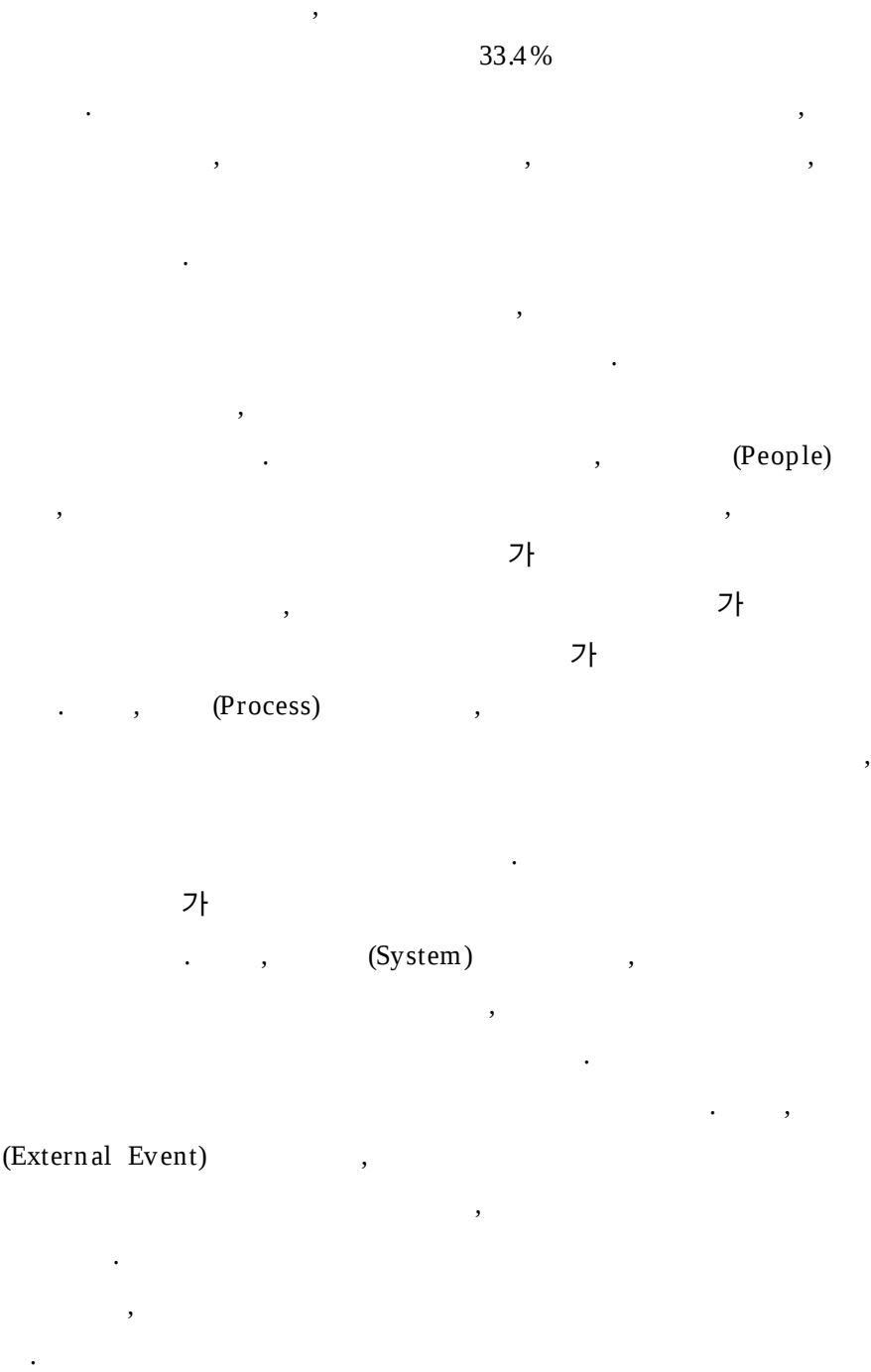
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Issues for Financial Institutions," 2001.

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	70	50	120
	43	27	70
	61.4%	54.0%	58.3%

가

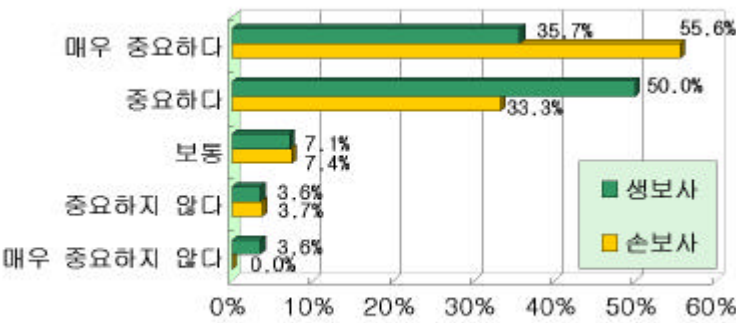
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1)

가)

가
35.7%가 “ ” , 50.0%가 “ ”
. 85.7%가 가 ,
“ ”가 55.6%, “ ”가 33.3%
88.9% .
가

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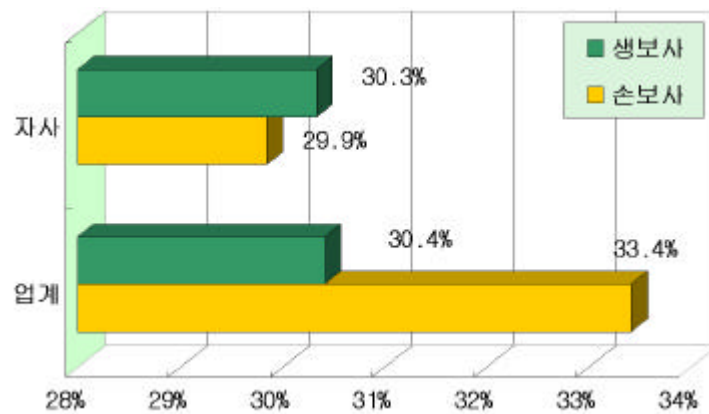
30.4%

33.4%

가

가

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29.9% 가 가 .

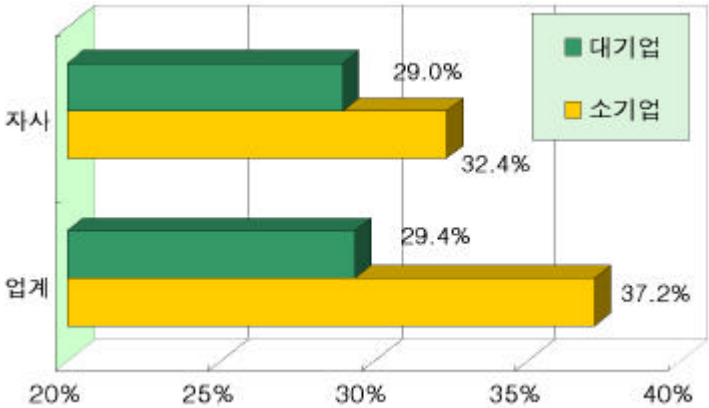
(2)

가 . < -3> 가

29.4% 가 37.2%

가 가 .

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29.0%

32.4%

가

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(3)

가

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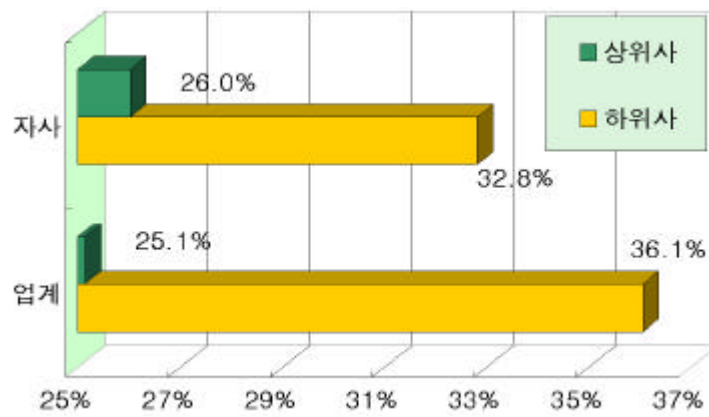
25.1%

36.1%

가

가

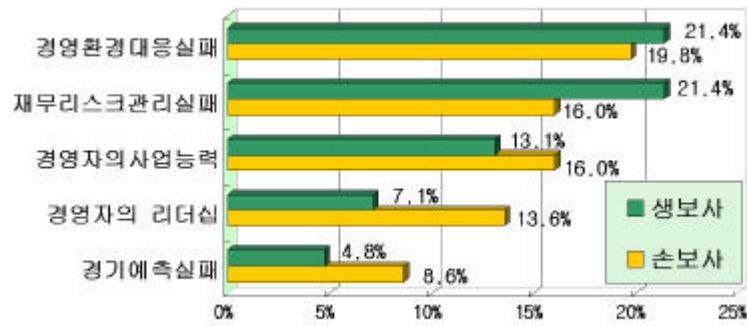
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2)

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가

“ ”가 17.9%, “ ”가 42.9%

가

가

18.5%

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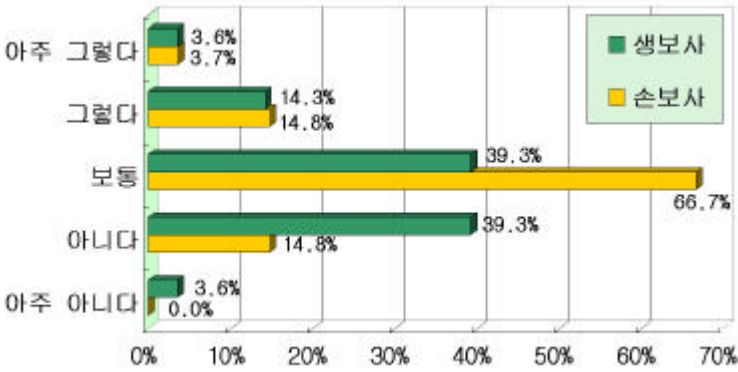
14.8%,

가 66.7%

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< -6>



16.3%(
14.5%+ 1.8%) .
30.1%(25.5%+ 3.6%)

< -2> 21)

		1.8%		3.6%
		1.8%	5.5%	
		25.5%	47.3%	14.5%

21) 가) , 가 (

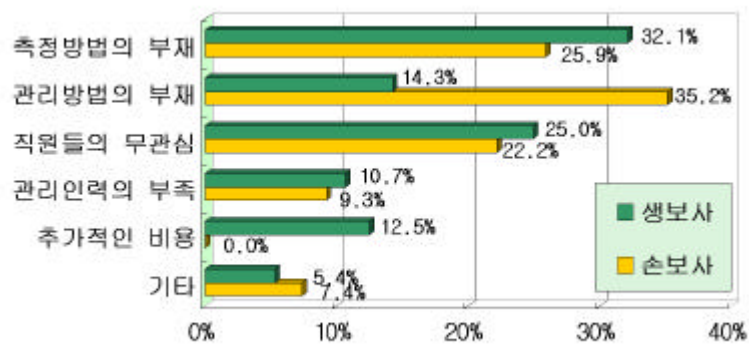
(2)

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가

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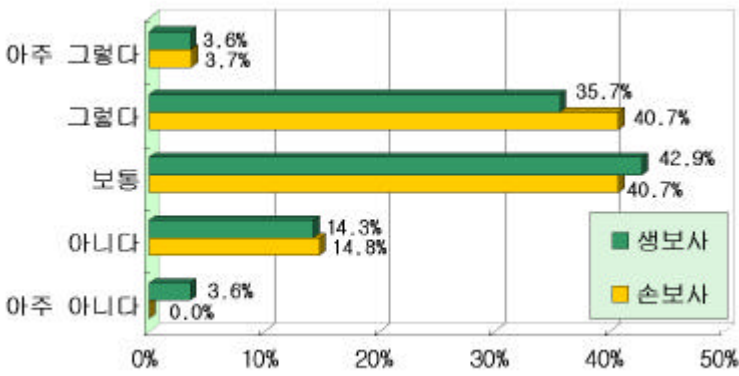
) (People)

(1)

가 . < -8> ,

39.3% ” ” 17.9%
” “가 44.4% ” “가 14.8%

< -8>



21.7%(14.5%+

7.3%) . 10.8%(9.1%+
1.8%) .

가 가

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		7.3%	7.3%	1.8%	
		12.7%	27.3%	1.8%	
		9.1%	18.2%	14.5%	

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		1.8%		3.6%	
			1.8%	5.5%	
		14.5%	40.0%	32.7%	

34.5%(32.7%+ 1.8%) .

가

가

가

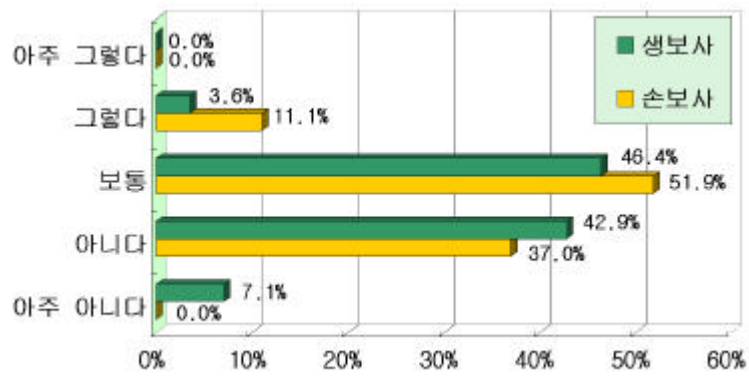
가

가

“ ”가 50.0%, “ ” 3.6%, 11.1% . “ ”가 37.0%

< -10>

가



가

가

12.7%(

3.6%+ 9.1%) .

12.7%(1.8%+ 10.9%) .

가

가

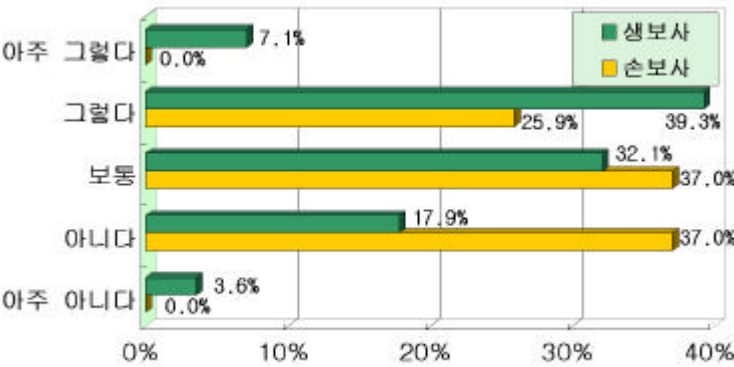
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가		9.1%	23.6%	10.9%	
		5.5%	16.4%	27.3%	
		1.8%	1.8%	3.6%	

(4)

가

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“ ”가

46.4%

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“

”가 25.9%

“ ” 21.5%

37.0% .

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가

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42.8%(25.5%+ 7.3%) .

12.7%(3.6%+ 9.1%) .

가 .

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		7.3%	12.7%	9.1%	
		5.5%	20.0%	9.1%	
		3.6%	9.1%	25.5%	

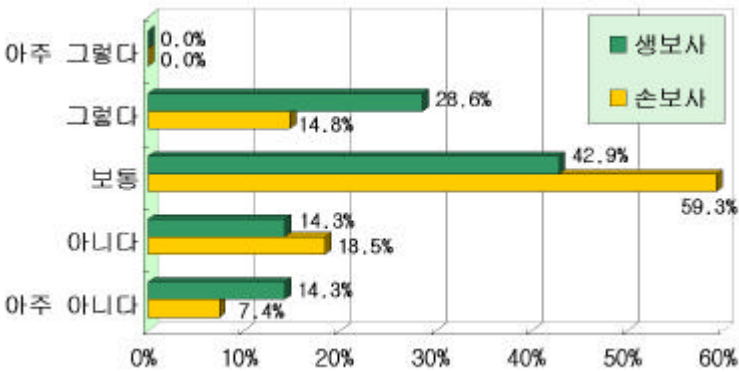
(5)

. < -12> , “ ”
 가 28.6%, “ ”가 28.6%

. “ ”가 14.8% ,

“ ”가 25.9% .
가

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, 가

30.0%(12.7%+ 7.3%) .
7.2%(3.6%+ 3.6%) .

가 .

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		7.3%	16.4%	3.6%	
		5.5%	20.0%	25.5%	
		3.6%	5.5%	12.7%	

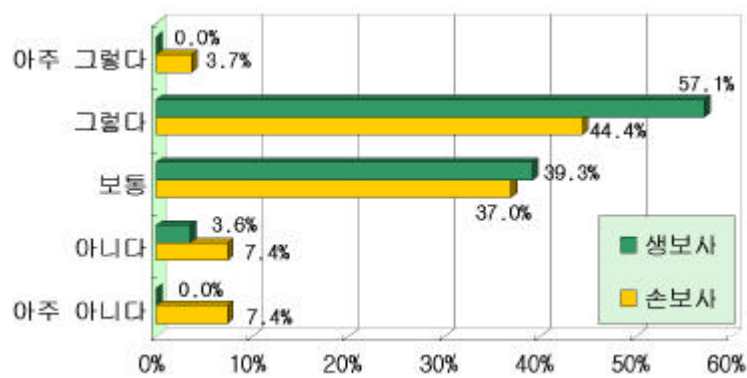
) (Process)

(1)

가

,
“가 57.1%, “ ”가 3.6%
“ ” 14.8%
“ ”가 48.1%

< -13>



가

41.8%(41.8%+ 0.0%)

12.7%(9.1%+ 3.6%)

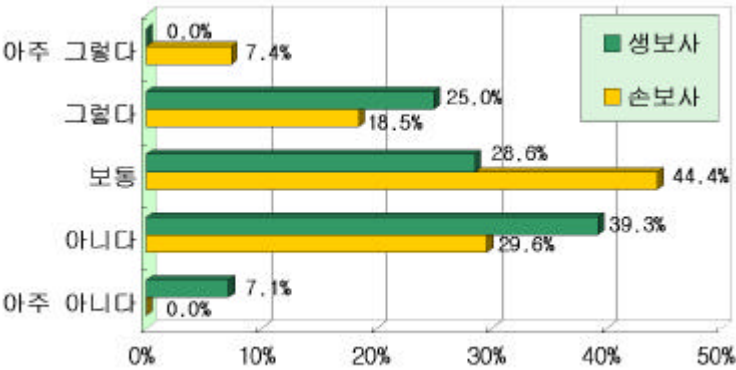
< -8>

		0.0%	1.8%	3.6%	
				7.3%	
		9.1%	36.4%	41.8%	

(2) 가

가 가 ,
가

< -14> 가



가

25.0%

46.4%

25.9%

29.6%

) (System)

(1)

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“ ”

50.0%

, “ ”

3.6%

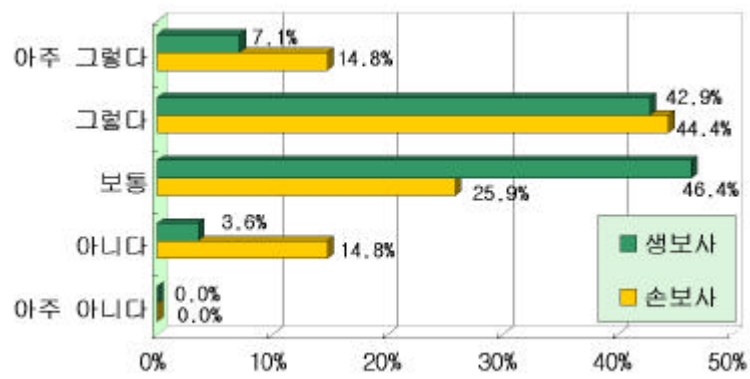
“ ”

59.2%

, “ ”

14.8%

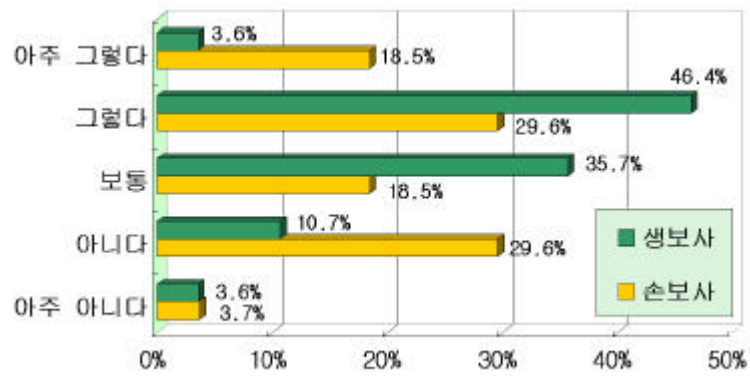
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(2)

“ ”
“ ”
50.0% , “ ” 14.3%
“ ”
48.1% , “ ” 33.3%

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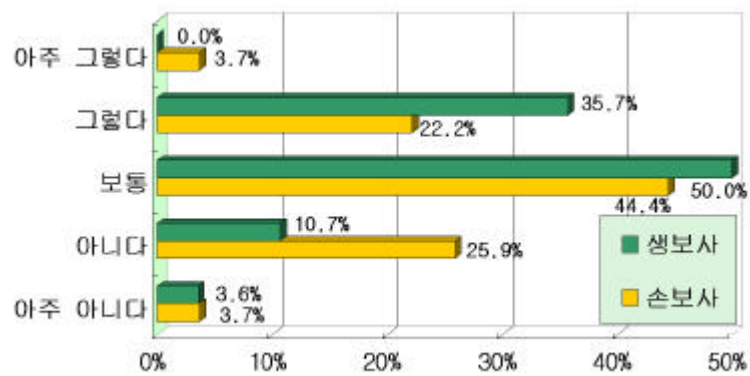
(3)

,
“ ”
“ 35.7% , “ ” 14.3%
“ ”
“ ” 25.9% , “ ”

29.6% .

가 .

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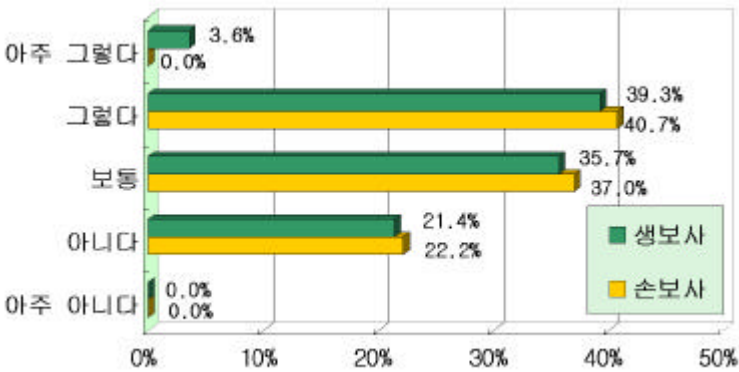
가

, “ ” 42.9% , “ ” 21.4% . “ ” 40.7% , “ ” 22.2% . ,

가 . ,

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(2)

가 가

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가 “ ”

42.9% , “ ” 10.7%

가 “

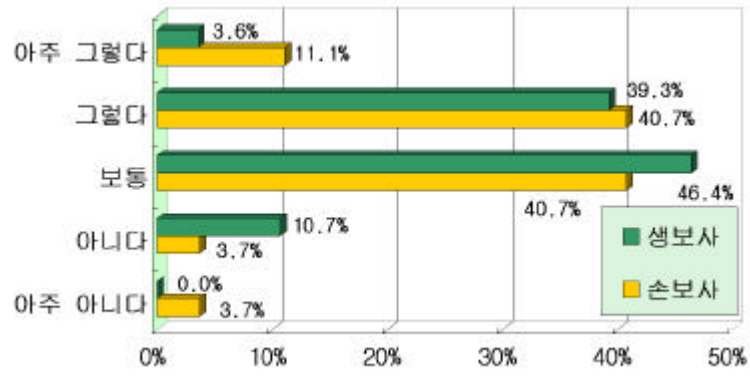
” 51.8% , “ ”

7.4% . ,

가 가

. 가

< -19>



(3) ,

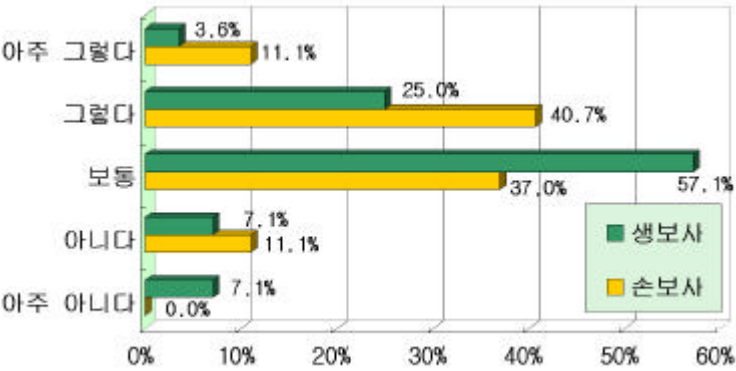
가 .
 ,

가 “ ” 28.6% , “ ” 14.2% .

가 “ ” 51.8% , “ ” 11.1% .

,
가 .
가

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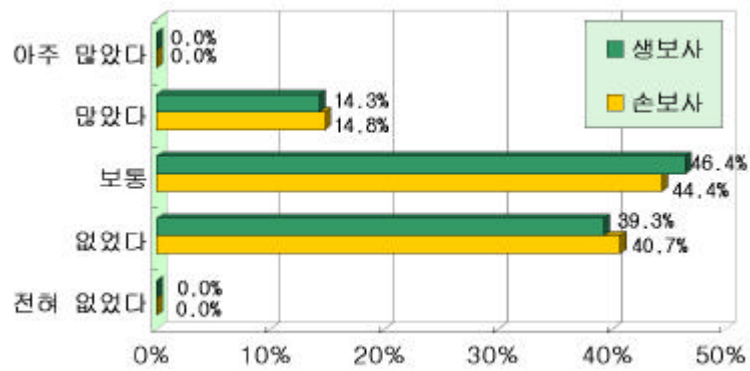
3)

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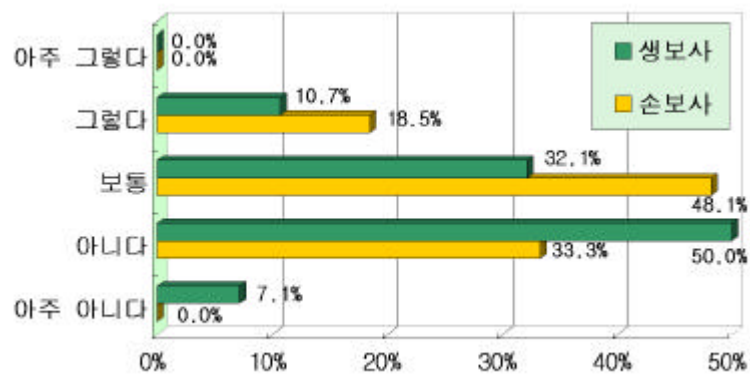
가 “ ” 14.3% , “ ” 39.3% .
가 “ ” 14.8% , “ ” 40.7% .

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(2)

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“ ”

“ ” 10.7% , “ ”

57.1% .

“ ” 18.5% , “ ”

“ ” 33.3% .

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, 가

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14.5%(14.5%+ 0.0%) .

23.6%(23.6%+ 0.0%) .

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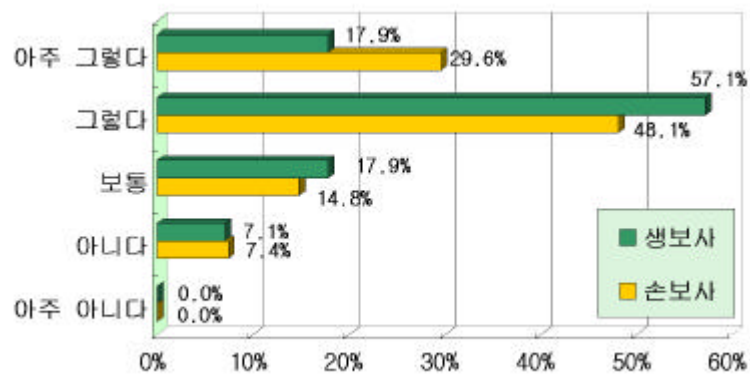
		0.0%	5.5%	0.0%	
		3.6%		3.6%	
		23.6%	34.5%	14.5%	

(3)

,
.
“ ” 70.0%
“ ” 7.1%
“ ”
77.7% , “ ” 7.4%
.

가

< -23 >



가

69.1%(69.1%+ 0.0%) .
9.1%(5.5%+ 3.6%) .

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		0.0%	1.8%	3.6%	
		1.8%	1.8%	3.6%	
		5.5%	12.7%	69.1%	

) DB

(1)

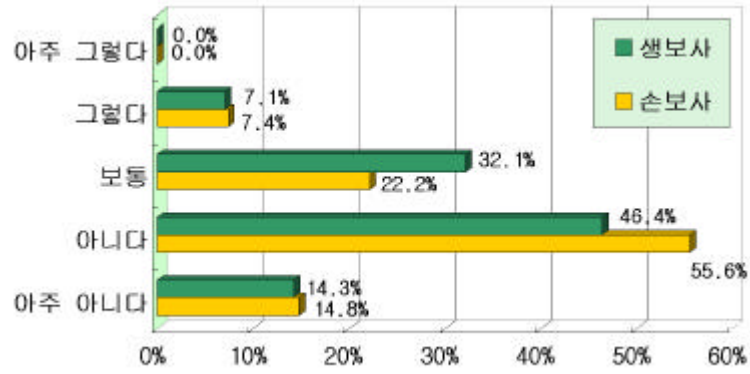
,

“ ” 7.1% , “ ”
60.9% .
“ ” 7.4% , “
” 70.4% .
 ,

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가 .

< -24>



가

9.1%(

5.5%+ 3.6%) .

58.2%(58.2%+ 0.0%) .

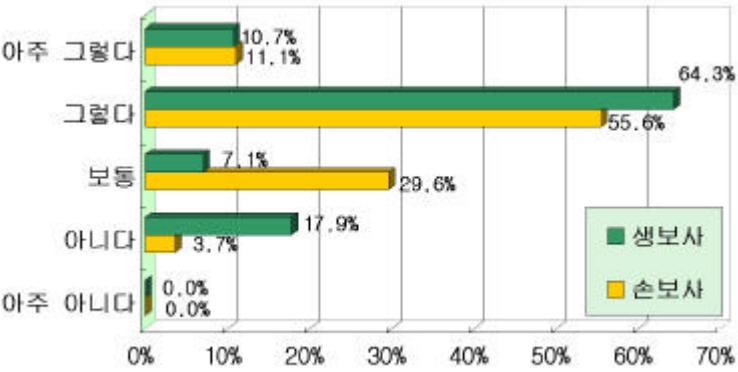
< -11>

		3.6%	1.8%	0.0%
		3.6%	1.8%	1.8%
		58.2%	23.6%	5.5%

(2)

84.0% , “ ” 17.9%
“ ” 66.7% , “ ”
3.7%

< -25>



가

69.1%(65.5%+ 3.6%)

7.3%(5.5%+ 1.8%)

< -12>

		3.6%		1.8%	
		1.8%	1.8%	3.6%	
		5.5%	16.4%	65.5%	

(3)

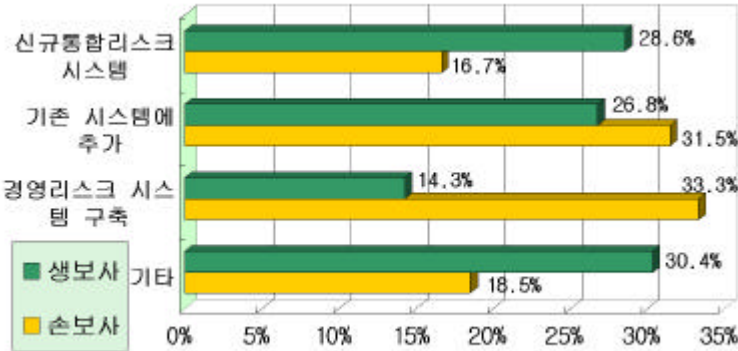
가

28.6% 가

가

26.8%, “ ”
14.3% . , “ ”
” 33.3%, “ ”
가 ” 31.5%, “ ”
” 16.7%
.

< -26>



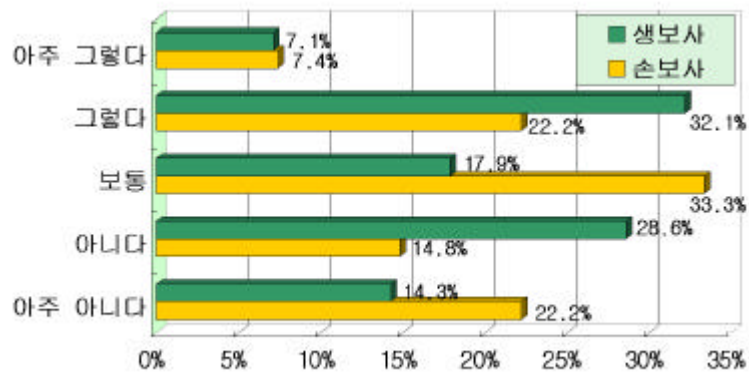
,
가 , 가,
가 .
30.4% ,
18.5% .
가 .

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(1)

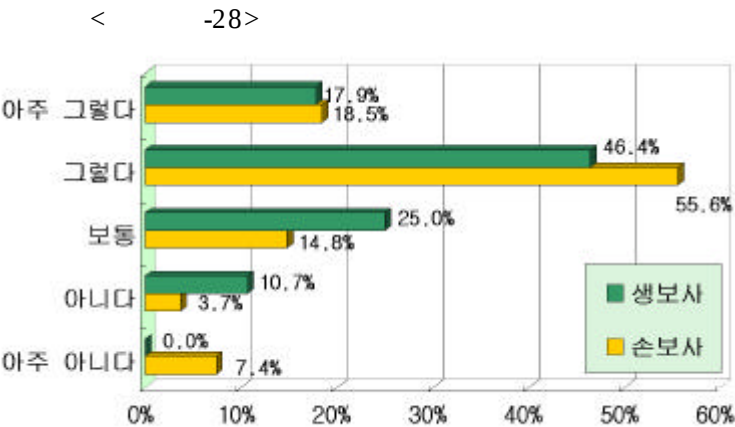
“ ” 39.2%
 , “ ” 42.9%
 “ ” 29.6% , “ ” 37.0%

< -27>



(2)

“ ” 64.3% , “ ”
10.7% .
“ ” 74.1% ,
“ ” 11.1% .

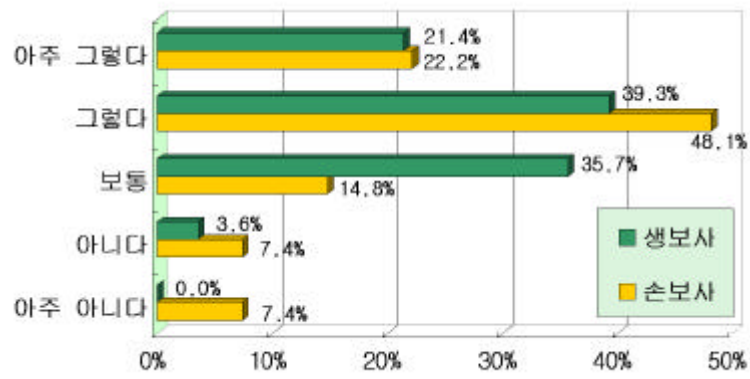


(3)

가

“ ” 60.7% ,
 “ ” 3.6% .
 “ ” 70.3% , “ ” 14.8% .

< -29>

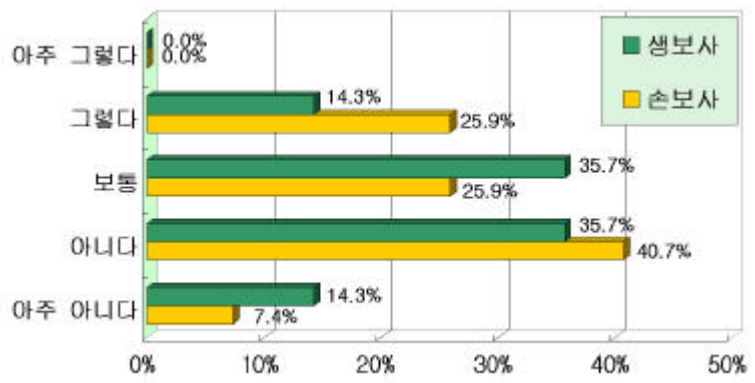


(4)

“ ”

“ 14.3% , “ ” 50.0%
“ ” 25.9% , “ ”
48.1% . , .

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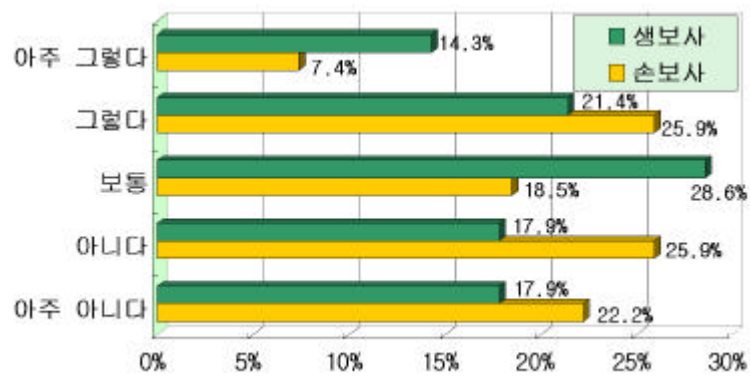


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가

,
.
“ ”
35.8% , “ ” 35.6% .
“ ”
33.3% , “ ”
48.1% .

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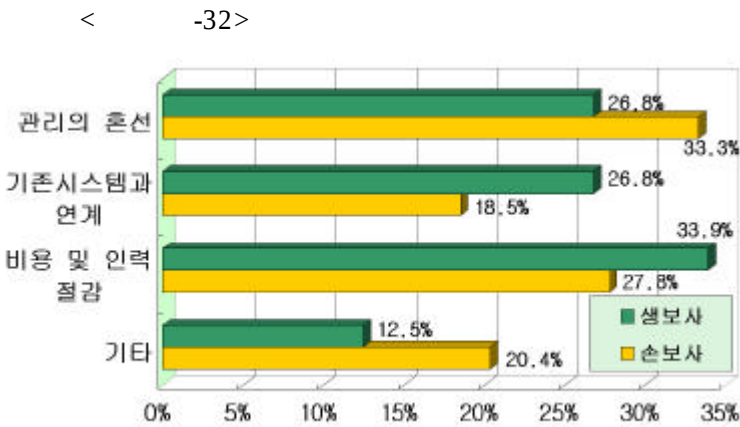


(2)

가

“가 33.9% 가 , “ ”
 26.8%, “ ” 26.8%, “ ” 12.5%
 “ ” 33.3% 가
 “가 27.8%, “ ” 20.4%,
 “ ” 18.5%

가 가



(3)

“

”

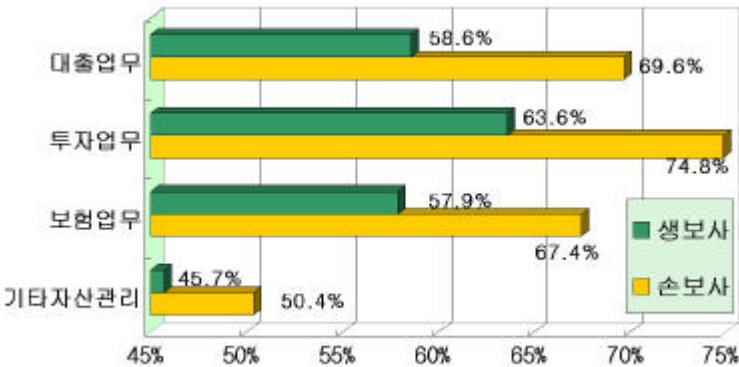
%

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가 74.8% 가 , 69.6%,
67.4%, 50.4%

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OP2 (Process)	, ,	-
OP3 (System)		- ,
OP4 (External)		- ,
		- 3 , ,

7가 가 ,

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, 57.9% 가

, 51.4%,

47.1%, 45.7%, 40.7%,

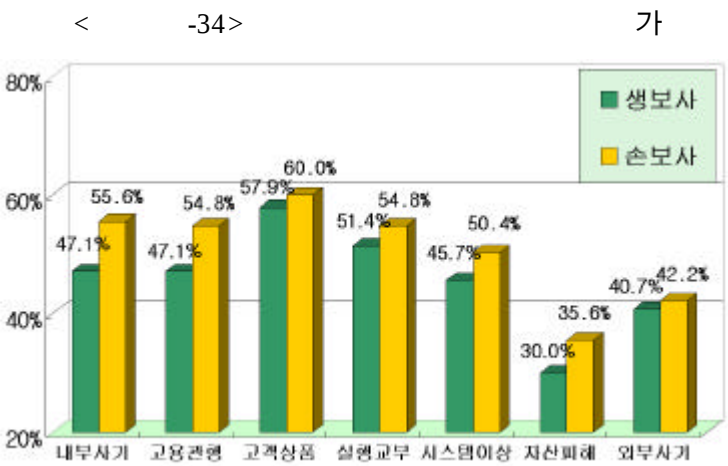
30.0% .

60.0% 가 ,

55.6%, 54.8%,

50.4%, 42.2%, 35.6%

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2. ()

22) 2001 30

BIS

22) BIS Risk Mgt. Group, “The Quantitative Impact Study for Operational Risk: Overview of Individual Loss Data and Lessons Learned”, January 2002, pp. 1-26.

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가 (30) 2/3

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101 200	4	1	0	3
201 500	3	0	2	1
501 1,000	5	4	0	1
1,001 2,000	3	0	1	2
2,001 3,000	3	0	0	3
3,001 4,000	3	1	1	1
	30	6	5	19

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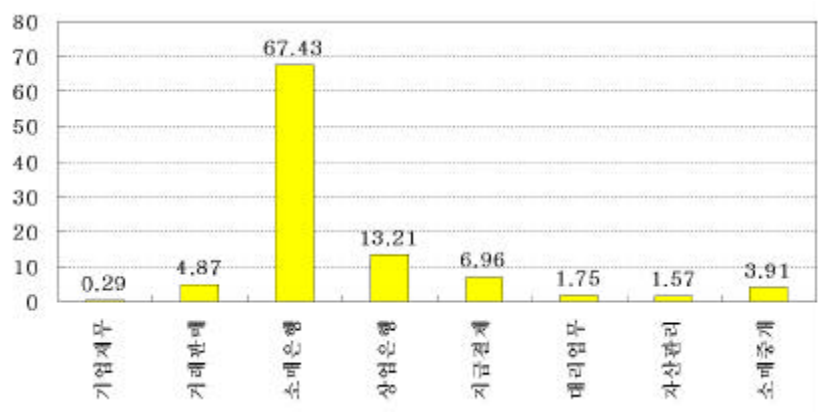
< -16>

	4 (0.0)	3 (0.01)	16 (0.06)	15 (0.05)	8 (0.03)	1 (0.00)	33 (0.12)	80 (0.29)
	16 (0.06)	6 (0.02)	37 (0.14)	112 (0.41)	10 (0.04)	39 (0.14)	1,114 (4.07)	1,334 (4.87)
	593 (2.17)	7,798 (28.49)	579 (2.12)	1,273 (4.65)	837 (3.06)	570 (2.08)	6,807 (24.87)	18,457 (67.43)
	93 (0.34)	1,180 (4.31)	55 (0.20)	66 (0.24)	285 (1.04)	474 (1.73)	1,463 (5.35)	3,616 (13.21)
	22 (0.08)	961 (3.51)	9 (0.03)	57 (0.21)	40 (0.15)	64 (0.23)	752 (2.75)	1,905 (6.96)
	6 (0.02)	7 (0.03)	12 (0.04)	69 (0.25)	17 (0.06)	11 (0.04)	356 (1.30)	478 (1.75)
	4 (0.01)	4 (0.01)	21 (0.08)	35 (0.13)	-	6 (0.02)	360 (1.32)	430 (1.57)
	7 (0.03)	2 (0.01)	12 (0.04)	122 (0.45)	28 (0.10)	291 (1.06)	609 (2.22)	1,071 (3.91)
	745 (2.72)	9,961 (36.39)	741 (2.71)	1,749 (6.39)	1,225 (4.48)	1,456 (5.32)	11,494 (41.99)	27,371 (100.0)

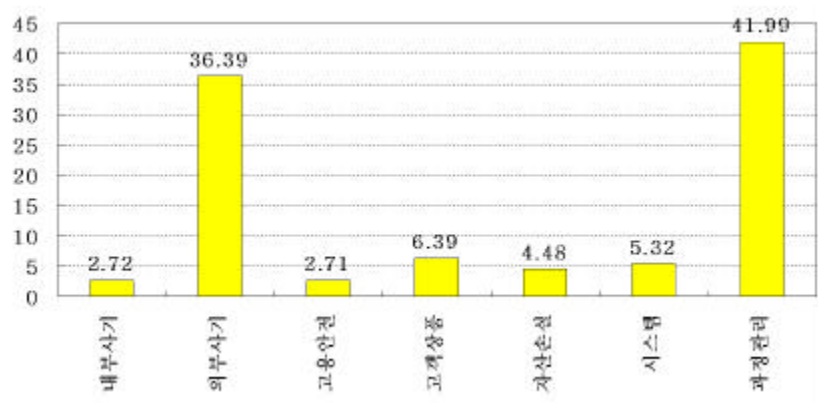
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	3,293	25,231	6,114	131,012	18	-	28,432	194,100
	(0.13)	(0.97)	(0.23)	(5.01)	(0.00)		(1.09)	(7.43)
	68,819	826	7,845	89,054	138	6,237	326,563	499,481
	(2.63)	(0.03)	(0.30)	(3.41)	(0.01)	(0.24)	(12.50)	(19.11)
	115,578	210,026	54,600	387,447	61,176	2,110	198,820	1,029,757
	(4.42)	(8.04)	(2.09)	(14.83)	(2.34)	(0.08)	(7.61)	(39.41)
	78,869	287,855	3,662	76,217	14,033	1,424	136,659	598,717
	(3.02)	(11.02)	(0.14)	(2.92)	(0.54)	(0.05)	(5.23)	(22.91)
	750	5,447	719	1,144	2,061	2,705	112,468	125,295
	(0.03)	(0.21)	(0.03)	(0.04)	(0.08)	(0.10)	(4.30)	(4.79)
	2,265	281	374	7,635	860	1,718	43,310	56,443
	(0.09)	(0.01)	(0.01)	(0.29)	(0.03)	(0.07)	(1.66)	(2.16)
	8,566	603	1,075	8,978	-	664	34,841	54,728
	(0.33)	(0.02)	(0.04)	(0.34)		(0.03)	(1.33)	(2.09)
	445	596	1,845	17,485	575	6,471	27,127	54,545
	(0.02)	(0.02)	(0.07)	(0.67)	(0.02)	(0.25)	(1.04)	(2.09)
	278,586	530,866	76,235	718,971	78,860	21,329	908,219	2,613,066
	(10.66)	(20.32)	(2.92)	(27.51)	(3.02)	(0.82)	(34.76)	(100.0)

* () %

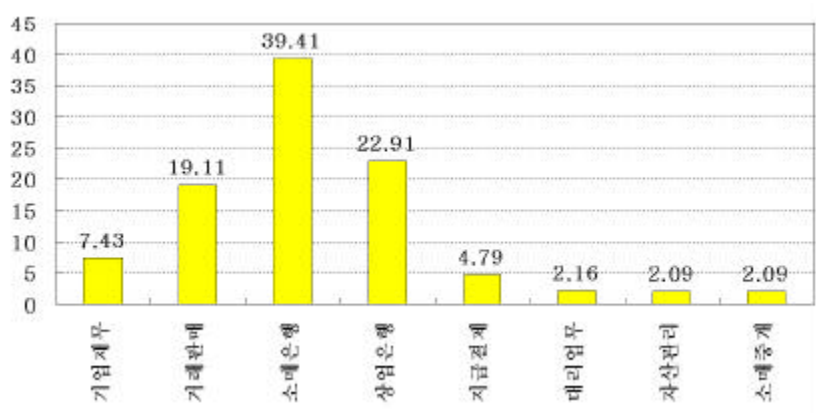
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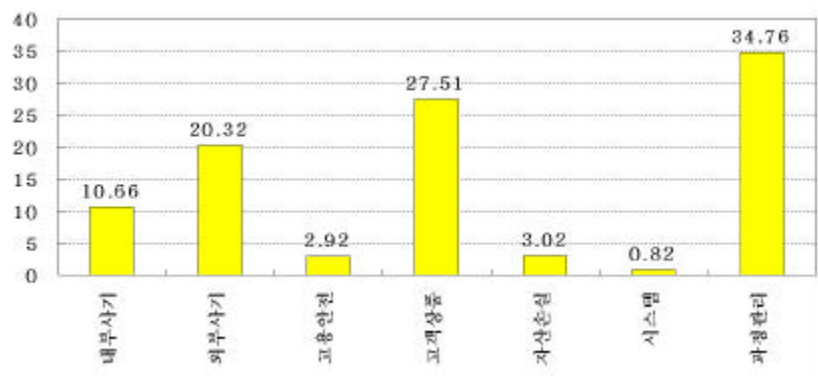
가 4.6% ,
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0 10	16,039	59%	-	31.2	1%	-
10 50	8,156	30%	72%	174.1	7%	7%
51 100	1,428	5%	13%	100.6	4%	4%
100 500	1,250	4%	11%	263.3	10%	10%
500 1,000	213	1%	2%	148.3	6%	6%
1,000 10,000	245	1%	2%	715.2	27%	28%
10,000	39	0.1%	0.3%	1,180.4	45%	45%

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	4 (0.04)	3 (0.03)	15 (0.13)	15 (0.13)	1 (0.01)	-	33 (0.29)	71 (0.63)
	16 (0.14)	6 (0.05)	36 (0.32)	107 (0.94)	3 (0.03)	34 (0.30)	708 (6.24)	910 (8.02)
	419 (3.69)	3,693 (32.55)	267 (2.35)	641 (5.65)	350 (3.09)	19 (0.17)	1,758 (15.50)	7,147 (63.00)
	68 (0.60)	519 (4.58)	23 (0.20)	44 (0.39)	63 (0.56)	13 (0.11)	288 (2.54)	1,018 (8.97)
	12 (0.11)	60 (0.53)	8 (0.07)	21 (0.19)	28 (0.25)	48 (0.42)	593 (5.23)	770 (6.79)
	6 (0.05)	2 (0.02)	12 (0.11)	31 (0.27)	10 (0.09)	8 (0.07)	347 (3.06)	416 (3.67)
	4 (0.04)	4 (0.04)	10 (0.09)	32 (0.28)	-	2 (0.02)	233 (2.05)	285 (2.51)
	4 (0.04)	2 (0.02)	11 (0.10)	94 (0.83)	9 (0.08)	187 (1.65)	420 (3.70)	727 (6.41)
	533 (4.70)	4,289 (37.81)	382 (3.37)	985 (8.68)	464 (4.09)	311 (2.74)	4,380 (38.61)	11,344 (100.0)

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	3,293 (0.13)	25,231 (0.98)	6,109 (0.24)	131,012 (5.07)	16 (0.00)	-	28,432 (1.10)	194,093 (7.52)
	68,819 (2.67)	826 (0.03)	7,837 (0.30)	89,038 (3.45)	100 (0.00)	6,221 (0.24)	325,593 (12.61)	498,435 (19.30)
	114,937 (4.45)	198,575 (7.69)	53,836 (2.09)	385,722 (14.94)	61,174 (2.33)	1,796 (0.07)	191,617 (7.42)	1,006,658 (38.99)
	78,765 (3.05)	287,275 (11.13)	3,569 (0.14)	76,159 (2.95)	13,534 (0.52)	1,359 (0.05)	135,346 (5.24)	596,008 (23.08)
	732 (0.03)	4,767 (0.18)	718 (0.03)	1,058 (0.04)	2,045 (0.08)	2,638 (0.10)	111,993 (4.34)	123,951 (4.80)
	2,265 (0.09)	267 (0.01)	374 (0.01)	7,517 (0.29)	859 (0.03)	1,707 (0.07)	43,244 (1.67)	56,233 (2.18)
	8,566 (0.33)	603 (0.02)	1,037 (0.04)	8,968 (0.35)	-	644 (0.02)	34,302 (1.33)	54,120 (2.10)
	426 (0.02)	596 (0.02)	1,845 (0.07)	17,387 (0.67)	561 (0.02)	5,646 (0.22)	26,029 (1.01)	52,490 (2.03)
	277,803 (10.76)	518,140 (20.07)	75,325 (2.92)	716,861 (27.76)	77,288 (2.99)	20,013 (0.78)	896,557 (34.72)	2,581,987 (100.0)

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	12.2%	2.4%	9.9%
0 10	9.3%	2.1%	7.2%
10 50	14.7%	2.5%	12.2%
50 100	16.7%	2.7%	14.1%
100 500	20.2%	3.3%	17.0%
500 1,000	22.3%	2.8%	19.4%
1,000	36.1%	6.3%	29.9%

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	6.5%	0.8%	5.8%	374
	13.5%	2.4%	11.1%	56
	17.3%	4.6%	12.7%	166
	3.8%	0.2%	3.7%	66
	6.4%	4.7%	1.7%	120
	2.8%	1.2%	1.6%	127
	1.6%	0.5%	1.1%	51
	28.8%	1.4%	27.4%	375
	10.3%	1.3%	9.0%	53
	34.3%	33.7%	0.5%	103
	6.3%	0.1%	6.2%	412
	22.5%	20.1%	2.4%	65
	4.5%	0.0%	4.5%	15
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1999	77.4%	82.2%	74.2%
2000	83.8%	78.9%	84.8%
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0 10	89.8%	85.8%	91.0%
10 50	80.2%	83.0%	79.5%
50 100	64.3%	79.0%	61.5%
100 500	67.5%	64.6%	67.8%
500 1,000	62.4%	67.5%	61.7%
1,000	63.3%	55.8%	64.8%

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-3. (Process)

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-4. (System)

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-1.

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<1-2> ()

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<1-3> () .

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-2.

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-3.

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-4.

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-5.

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-1.

가 (5)

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BL4			

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* BL : Business Line, 가 5 , 1 가 5 가

-2.

가 (5)

()	()		가
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	, ,	- ,	
OP2 (Process)	, ,	-	
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* OP1 : (People) , OP2 : (Process) ,
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