Risk Management

Rajib Ranjan Borah

Table of Contents

- Risk Management Process
- Case studies of major risk incidents globally
- Algorithmic Trading Related Risks
- Risk Management for Indian Exchanges
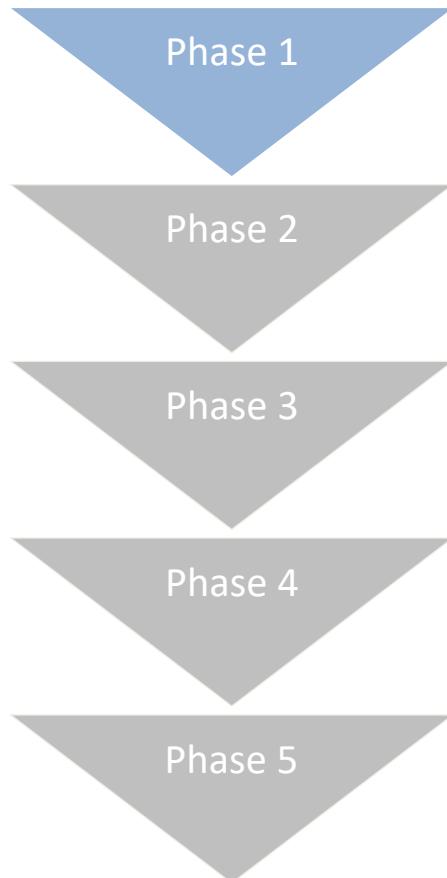
- Risk Management Process
  - Setting risk management structure & policies
  - Identifying sources of risk
  - Evaluating different risk components
  - Establishing risk appetite & setting risk limits
  - Designing systems with strict adherence to risk controls
- Case studies of major risk incidents globally
- Algorithmic Trading Related Risks
- Risk Management for Indian Exchanges

Risk Management Process
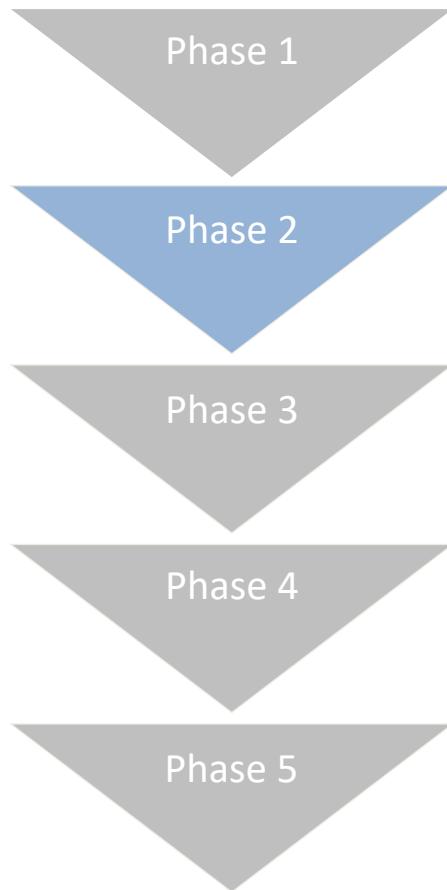
Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- **Phase 1:** Setting risk management structure & policies

  - Dedicated risk department

  - Completely cut off from trading department

  - Full autonomy & powers to risk department

  - Approval process for each new product and operation introduced

Risk Management Process
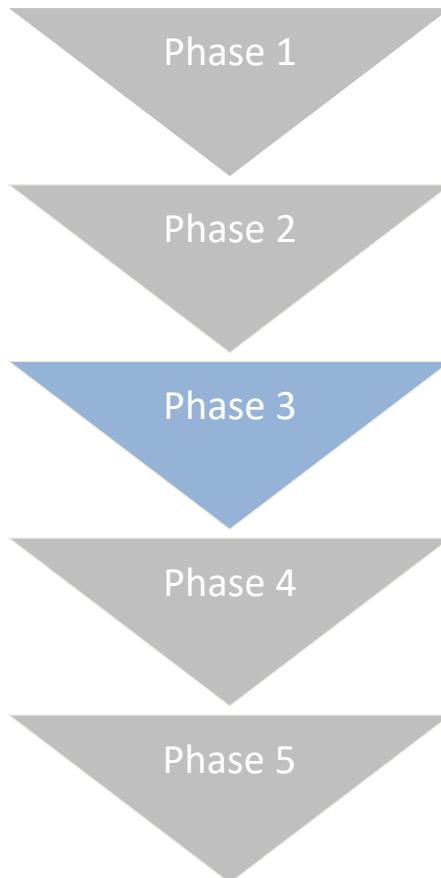
Phase 1
Phase 2
Phase 3
Phase 4
Phase 5

- **Phase 2:** Identifying sources of risk

  - Market Risks

  - Credit / Counter-party Risks

  - Financial Risks

  - Operational Risks (Systems, Mechanical, Criminal)

  - Regulatory Risks

  - Liquidity Risks (Exogenous & endogenous)

  - Natural disasters, political, terrorism, etc.
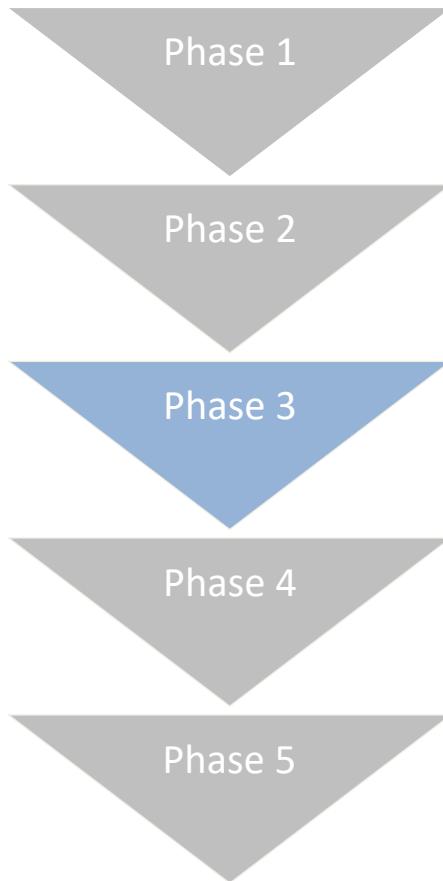
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Phase 2

Phase 3
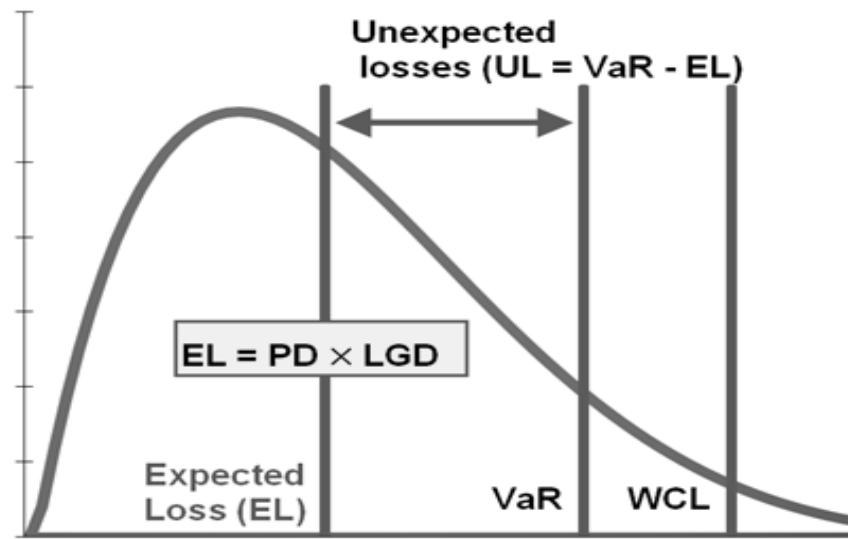
Phase 4

Phase 5

- **Phase 3:** Evaluating risk components
  - Market Risks :
    - Sensitivity Analysis
      - Total Greeks, Dividend, Currency exposures
      - What-if scenario analyses
    - VaR analysis
   - Stress tests
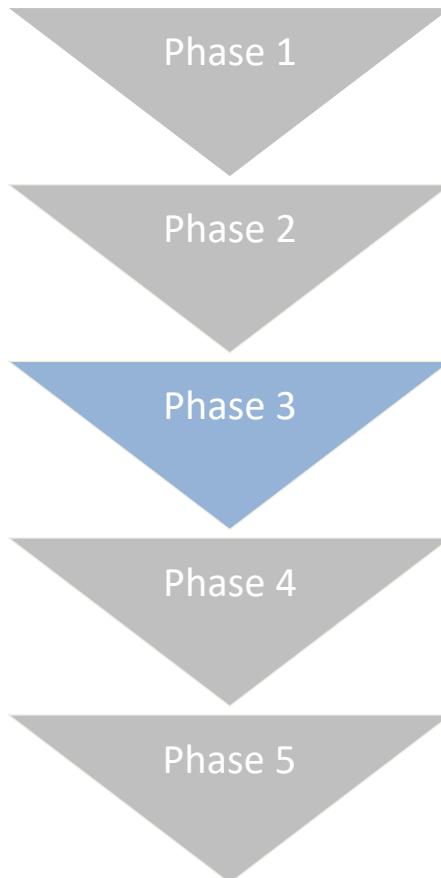
Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- **Phase 3:** Evaluating risk components
  - Credit / Counter-party Risks
    - Basel II IRB method
  (Internal Rating Based Method)

Unexpected losses (UL = VaR - EL)

$EL = PD \times LGD$

Expected Loss (EL)   VaR   WCL

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Risk Management Process

Phase 1

Phase 2

Phase 3
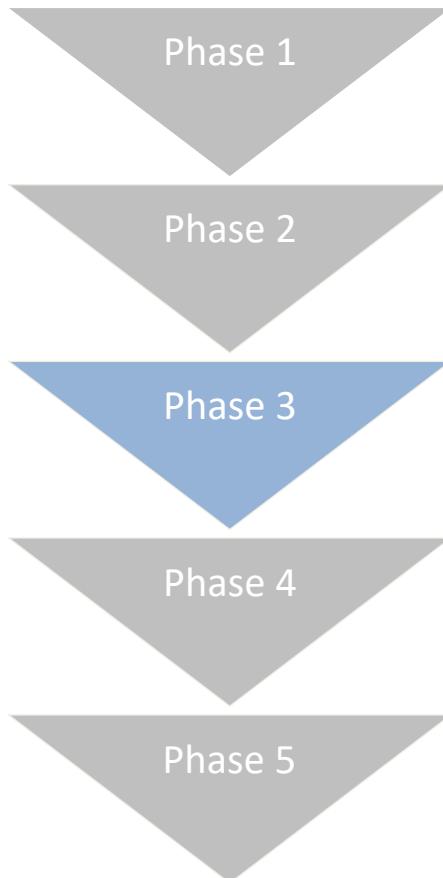
Phase 4

Phase 5

- **Phase 3:** Evaluating risk components
  - Financial Risk

Probability of downgrade * interest rate hike * Size of portfolio
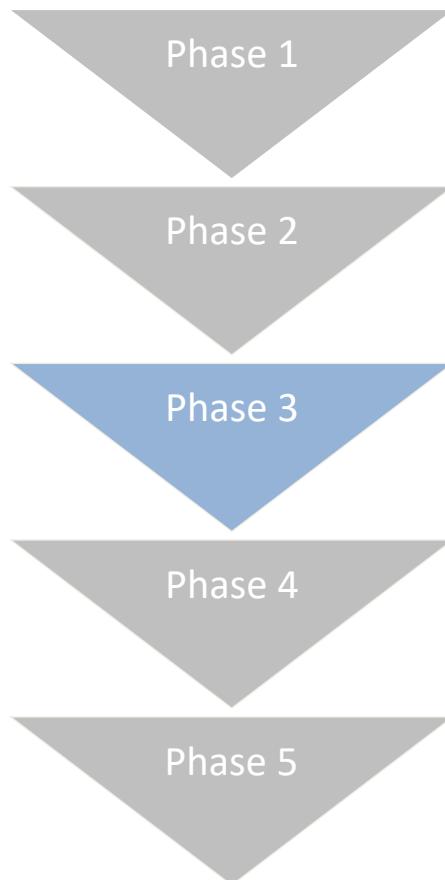
Phase 1	**Phase 3:** Evaluating risk components
Phase 2	• Regulatory Risk
Phase 3	Probabilities of new Regulations- Is estimated from News Analysis & Historical Data
Phase 4	Examples…
Phase 5	• Short Selling Ban
	• Margin Increase
	• Taxes Introduced
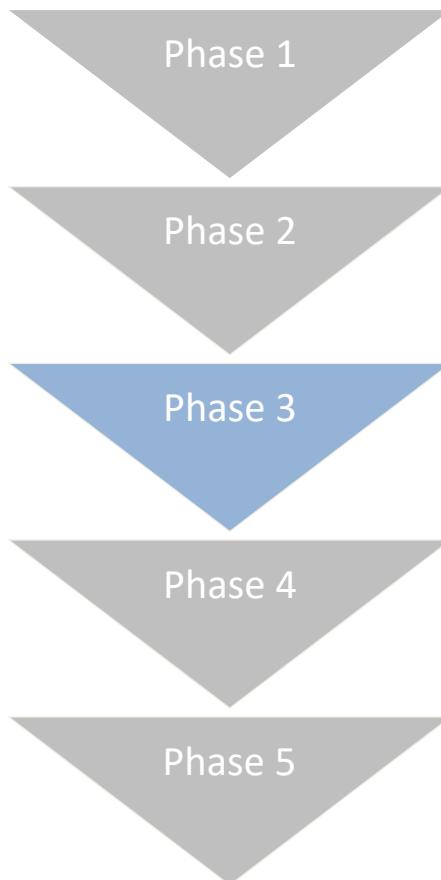
Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- **Phase 3:** Evaluating risk components
  - Operational Risks (Systems, Mechanical, Criminal)
    - Robustness of a System
    - System Load handling capacity
    - Maximum order flow before system detects failure
    - Maximum leeway in error while setting parameters

Phase 1

Phase 2

Phase 3
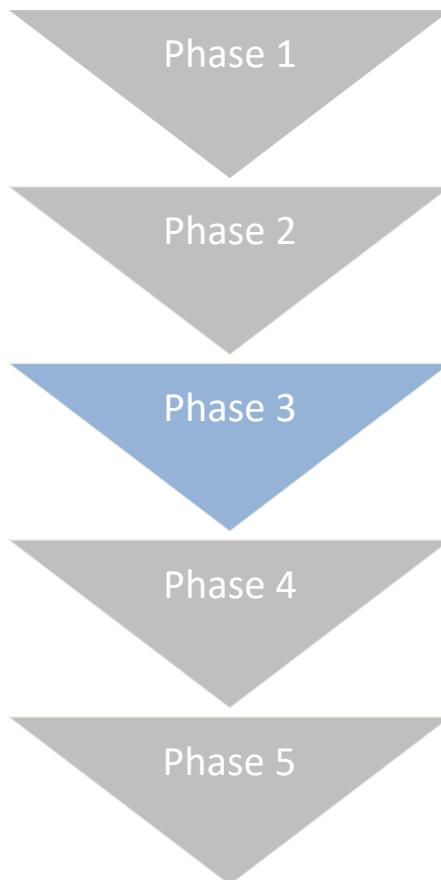
Phase 4

Phase 5

- **Phase 3:** Evaluating risk components
  - Liquidity Risks
    - Liquidity adjusted VaR

L-VaR = VaR + Liquidity Adjusted

Risk Management Process
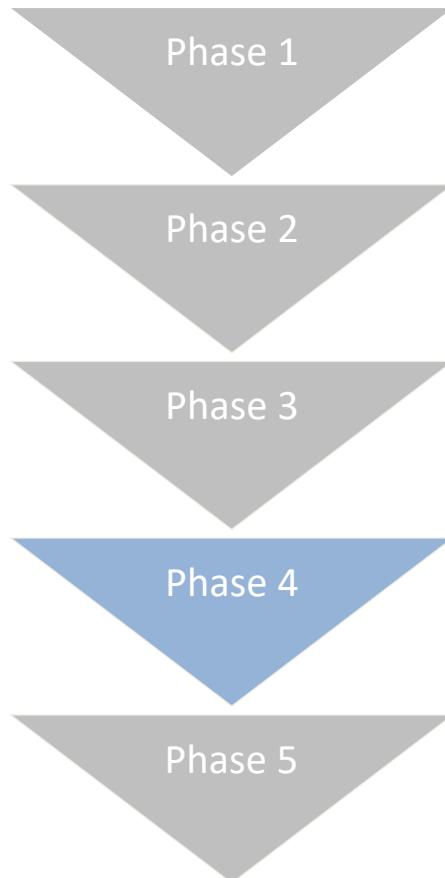
Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- **Phase 3:** Evaluating risk components
  - Natural Disaster, Political Risk, Terrorism:
    - Risk v/s Uncertainty
    - News Analysis
    - Anticipation is the key

Risk Management Process
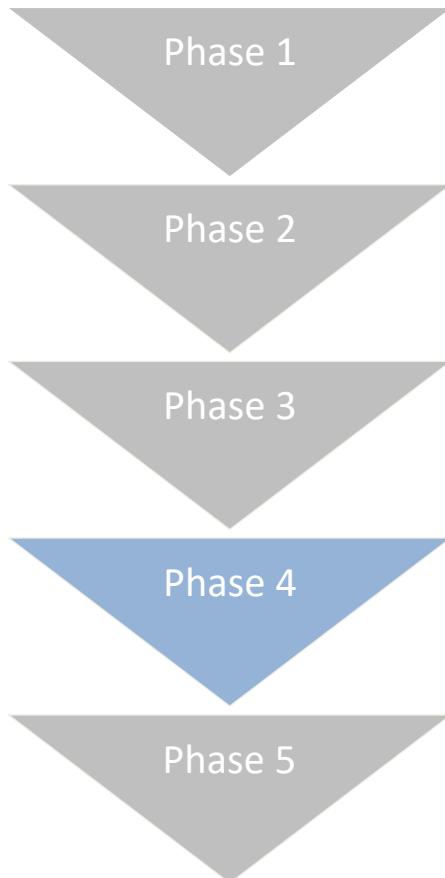
Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- **Phase 4:** Setting risk limits
  - Market Risks :
    - Total cash exposure
    - Exposure to geography
    - Exposure to sector
    - Exposure to asset class
    - Exposure to assignment / delivery risks (settlement risks)
    - Settlement Type (future vs cash)
    - Exposure to interest rates
    - Exposure to exchange rates

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Risk Management Process
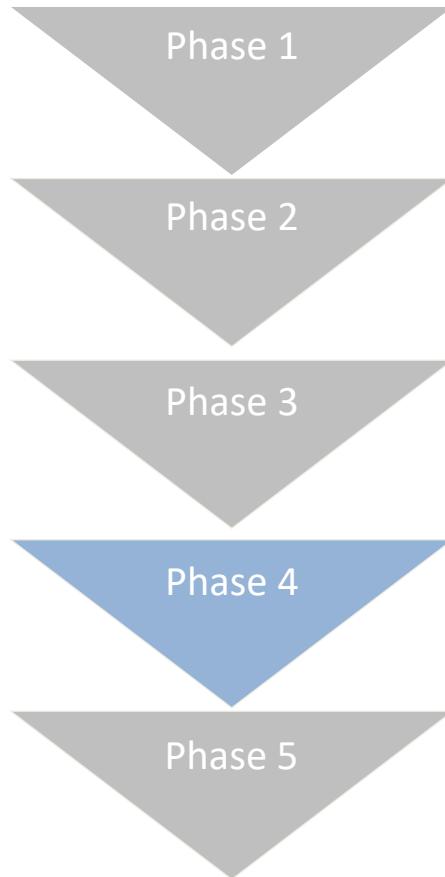
Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- **Phase 4:** Setting risk limits
  - Credit / Counter-party Risks
    - Maximum exposure to any counter-party
    - Maximum exposure per credit rating level
  - Financing Risks
    - Maximum amount borrowed per counter-party
    - Repayment period for loans
    - Rho exposure
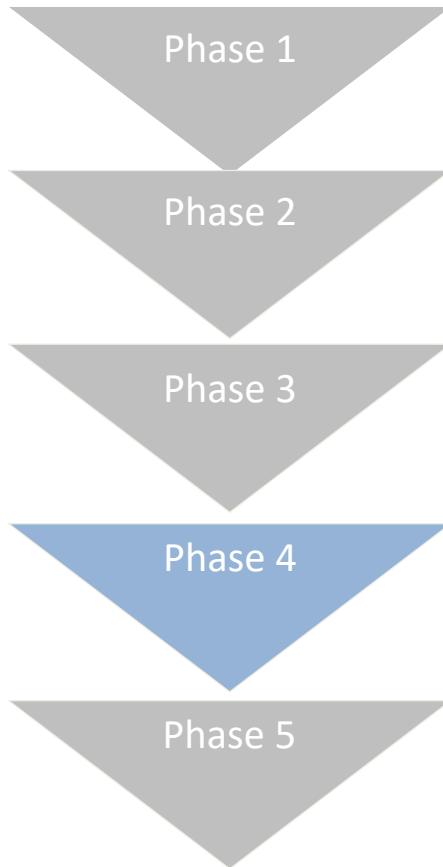
Risk Management Process

Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- **Phase 4:** Setting risk limits
  - Operational Risks (Systems, Mechanical)
    - Max exposure per strategy
    - Max orders per second
    - Max orders in a day
    - Max exposure per application
    - PnL fluctuation per application
    - Price Range check
    - Max order size
    - Max Value Traded
    - Net Value of portfolio

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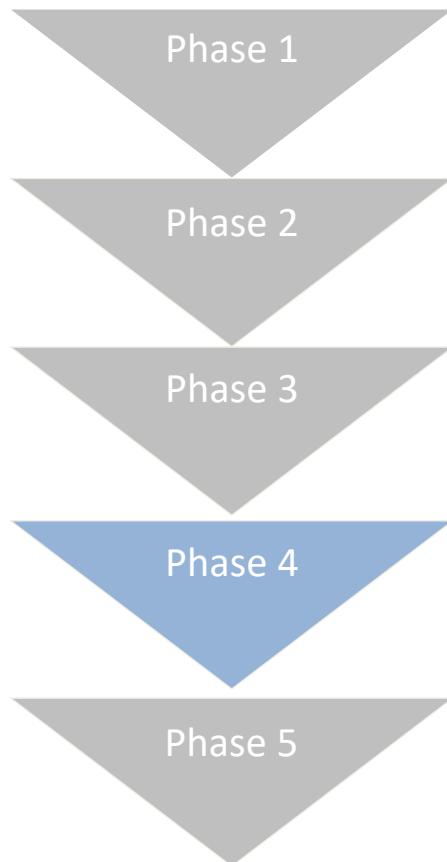
Phase 1

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Phase 3

Phase 4

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- **Phase 4:** Setting risk limits
  - Operational Risks (Criminal/Fraud/ Theft, etc)
    - Access Control
    - Transparency of operations
    - Rotation of team members
    - Audit (internal & external)
    - Centralized PnL reconciliation
    - Independent verification of price to pricing models
    - Online Infiltration & Virus Protection

Risk Management Process
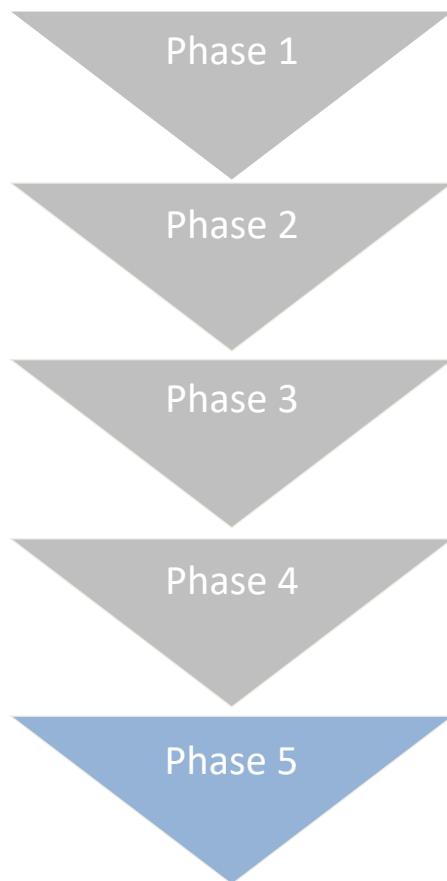
Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

- **Phase 4:** Setting risk limits
  - Liquidity Risks
    - Maximum exposure per instruments of each liquidity category
    - Total exposure per liquidity category
  - Natural disasters
    - Score-card approach
    - Similar to one used By Insurance/ Actuaries

Phase 1

Phase 2

Phase 3

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Phase 5

- **Phase 5:** Designing systems with strict adherence to risk controls
  - Centralized system which summarizes net position & exposure
    - Asset classes, Interest rates, Exchange rates, Volatility, Dividends, Counter parties
  - What if Analysis
  - Centralized control of all trading operation
  - Pre trade controls

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- Credit Suisse, Nov 2007
  - Incident:
    - Hundreds of thousands of cancel orders sent to the exchange
    - Orders clogged NYSE and affected trading of over 900 stocks
  - Reasons:
    - Software developer implemented code which could change parameters on clicking on spin button

      (without any need for confirmation)
    - With each click, orders were cancelled and resent
  - Fine/ Losses:
    - $150,000 fine

- Infinium Capital, Feb 2010
  - Incident:
    - 4612 trades on crude oil futures in 24 seconds
  - Reasons:
    - Strategy was designed to trade energy ETFs on the basis of crude prices
    - Trader configured crude oil futures on the basis of energy ETFs
    - Moreover, RMS was designed on the basis of ETF prices, not crude prices
  - Fine/ Losses:
    - $850,000 fine by CME

Major algorithmic trading incidents globally - III

- Deutsche Bank, June 2010
  - Incident:
    - Sent orders for 1.24 million Nikkei 225 Futures & 4.82 million Nikkei 225 mini-futures in first few minutes
    - More than 10 times normal volume
    - Market dropped 1% on orders
  - Reasons:
    - Pair trade strategy used value of mini-Nikkei to quote Nikkei. At start of day, there was no liquidity in mini-Nikkei
    - Error recognized immediately, 99.7% orders cancelled
  - Fine/ Losses:
    - Forced to close Algorithmic trading desk in Tokyo

- Knight Capital, Aug 2012
  - Incident:
    - Traded 154 stocks at bizarre prices (4 million trades for 397 million shares in 45 minutes): alternately bought at higher prices and sold at lower prices
  - Reasons:
    - Accidentally installed test software which incorporated an old piece of code designed 9 years ago
    - In one out of 8 production servers, new code was not installed by a technician
    - No process for second technician to review
  - Fine/ Losses:
    - Trading loss of $460 million in 45 minutes. Fine of $12 million
    - Knight Capital had to be rescued by Getco

- Goldman Sachs, Aug 2013
  - Incident:
    - Traded stock options at very erroneous prices at the exchange
  - Reasons:
    - Indication of interests were sent as actual orders to the exchange
  - Fine/ Losses:
    - Trading loss of $100 million

- Tel Aviv Stock Exchange, Aug 2013
  - Incident:
    - Shares of Israel Corp. country's largest holding company fell sharply from 167,200 Israeli Shekels to 210 Shekels.
  - Reasons:
    - Trader wrongly entered Israeli Corp as scrip name instead of some other firm
 - Fine/ Losses:
    - All trades cancelled

- Everbright Securities, Aug 2013
  - Incident:
    - Rogue algorithm kept buying – index moved up 6% intraday
    - Did not inform regulators, shorted the artificial bubble – banned from prop trading forever for insider trading
  - Reasons:
    - Faulty algorithm
  - Fine/ Losses:
    - Banned from prop trading forever for insider trading
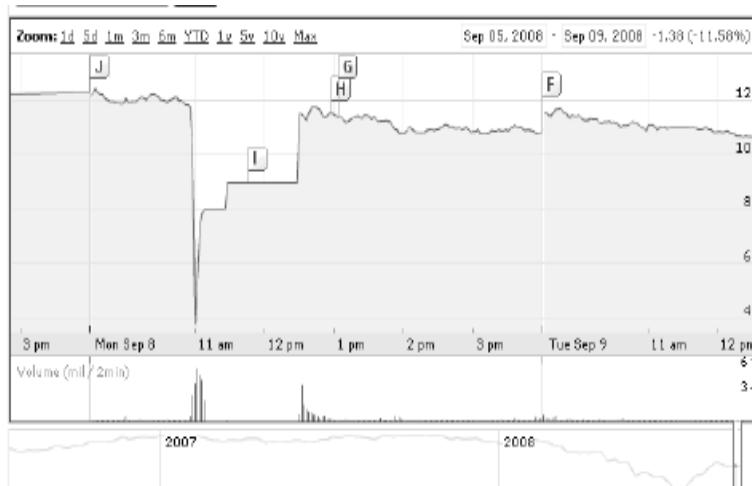
- HanMag Securities, Dec 2013
  - Incident:
    - HanMag exercised wrong call and put options
    - 36,100 trades in a few minutes
  - Reasons:
    - Error in automated profit taking trade program (interchanged puts with calls)
  - Fine/ Losses:
    - Some firms returned money back to HanMag (Optiver returned $600k trading profits)
    - Eventual loss of 57 billion Korean Won

Major algorithmic trading incidents - IX

- United Airlines flash crash
  - Incident:
    - On Sep. 7, 2008 United Airlines had a downward price spike
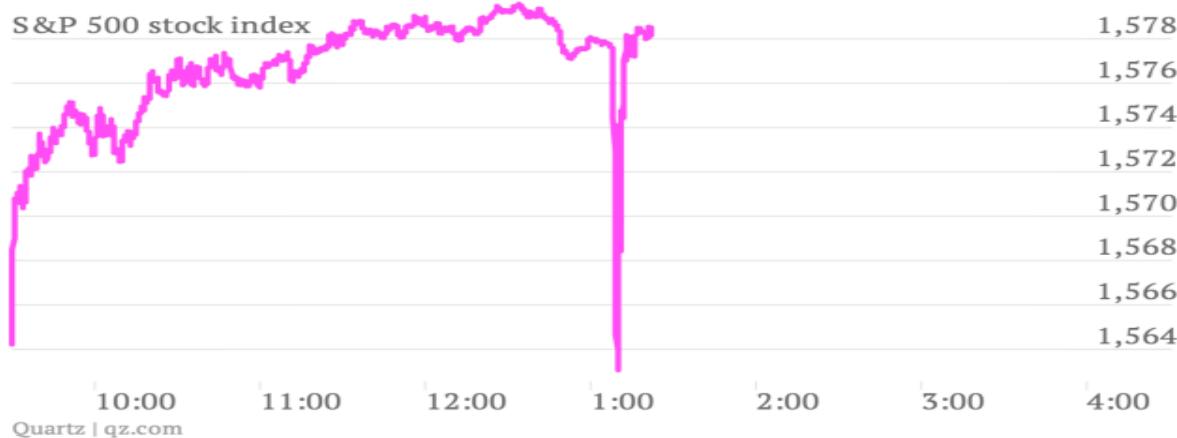
  - Reasons:
    - Google's news bots picked up an old 2002 story about United Airlines possibly filing for bankruptcy
    - News Analytics based automated traders reacted to it

- Dow Jones Flash Crash
  - Incident:
    - On Apr 23, 2013 Markets dropped 0.8% momentarily

S&P 500 stock index — Quartz | qz.com

  - Reasons:
    - Twitter account of news publisher hacked – false news of White house explosion
    - News Analytics based automated traders reacted to it

- Down Tick immediately on Osama Bin Laden's death
  - Incident:
    - Market's dropped on the news of Osama Bin Laden's capture and death
  - Reasons:
    - News Analytics trained to treat "Osama Bin Laden" and "death" as negative keywords
    - News Analytics based automated traders reacted to it

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Risks related to Algorithmic Trading

- Orders flow without human control
  - Higher reliance on technology implies increased sys-ops risk
  - In case of a wrong input, algorithm will execute at a wrong level
  - If price feed goes down, algorithm will send orders based on stale data
    - price feed could go down because of physical connectivity, exchange disconnection, software crash, etc
- Before a human can realize (and then respond), tremendous damage would have been done already
- Trades happen at such a fast pace, that positions could reach a dangerous level in no time
  - Real-time monitor of positions, exposures, regulation checks

Risks related to Algorithmic Trading

- Risks specific to automated trading can be classified into the following categories:
  - Access
  - Consistency
  - Quality
  - Algorithm
  - Technology
  - Scalability
- These risks have to be handled pre-order:
  - Within the application
  - Before generating an order in the Order Management System
- Moreover, it is pertinent that the trader understands the internal working of the black-box.

Risks related to Algorithmic Trading

	RISK	Methodology
Access	Connectivity to an exchange goes down	Heart-beats
	Exchange disconnects you	Heart-beats
	Network issue	Hardware, Operating System
Consistency	Market Data is stale	Time-stamp
	Analytics are running in real-time (huge processing time)	Time-stamp
	OM adaptor is responding in real time	Time-stamp
Quality	Market data is garbled	Common RMS rule
	Loss of liquidity during high-volatility	Common RMS rule

Risks related to Algorithmic Trading

RISK		Methodology
Algorithmic	Margin breached	Common RMS rule
	Exposure limit set by exchange	Common RMS rule
	Risk limits exceeded	Check for acknowledgements before sending order
	Incorrect strategy setting leading to continual mistrades	PnL fluctuation check
	-do-	Order throttle rate
	-do-	Fat finger settings check
	-do-	Max Value Traded
	Incorrect order generation	Price range check
	Order throttle	Exchange reject limit

Risks related to Algorithmic Trading

RISK		Methodology
Technology	Hard disk gets full	Independent check
	Virus /Trojan	Firewall, Anti-virus
	System Crash	Operating System
	Application crash	Heart-beat to check application
	Protocol Mismatch	Third-party software compatibility check

Risks related to Algorithmic Trading

RISK		Methodology
Scalability	Number of applications & portfolios that can be handled	
	Number of exchanges that can be connected	
	Number of symbols that can be handled	
	Order of complexity of computations	

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Case study: RMS in India as per regulations

RMS	Description
Manual Trading disabled	Manual orders are disabled for auto-trading systems
Trade Price Protection Limit	Order should be within x% of last price
Quantity Freeze Limit	For each instrument an order size freeze limit is set
Price Range Check	Order should not breach the circuit limit (daily price range) of an instrument
FII restricted list	FIIs cannot trade in a select set of stocks (RBI directed)
Market Wide Protection Limit	Cannot trade derivatives to increase Open Interest beyond a threshold
Shares available for selling	Overnight long position that is available per share for selling
Automated Trading enabled	Automated trading to be enabled for a select list of instruments only
Index change check	Cannot send buy orders if Index moves up beyond a point. Likewise for sell orders

Case study: RMS in India as per regulations

RMS	Description
Client Position Limit	Maximum position that a client can have in a particular stock
Margin Limit	If a threshold of the available margin is reached, then the application should not send orders to increase the position further
Position Value Check	Net Position value per instrument
Order Value	Max Order Value

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