

Maritime Disruptions Management

Research Student: Saut Gurning

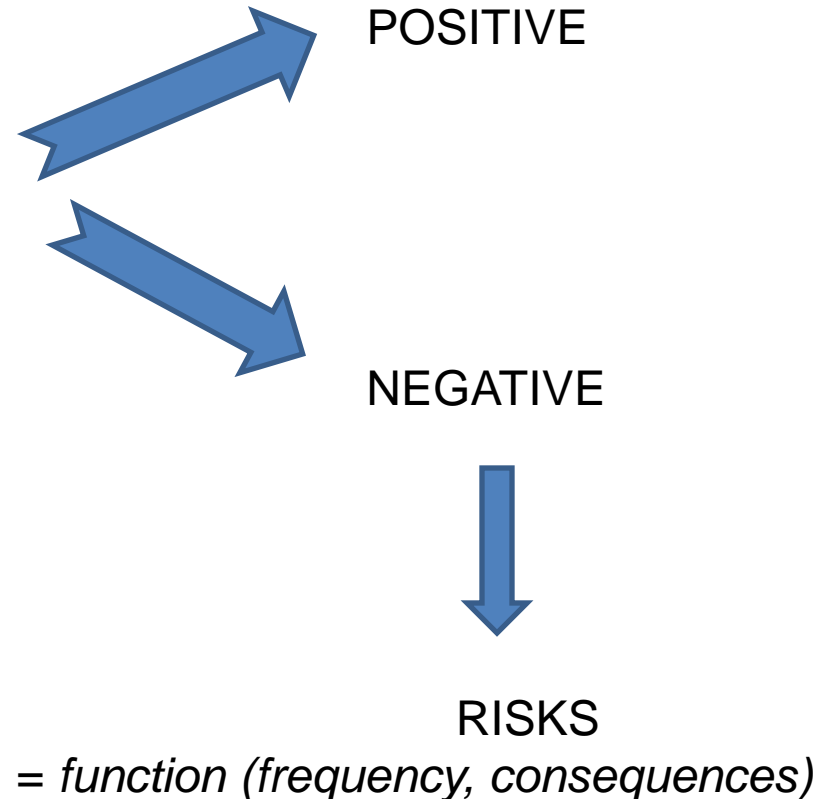
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Changes, the important issue !!!

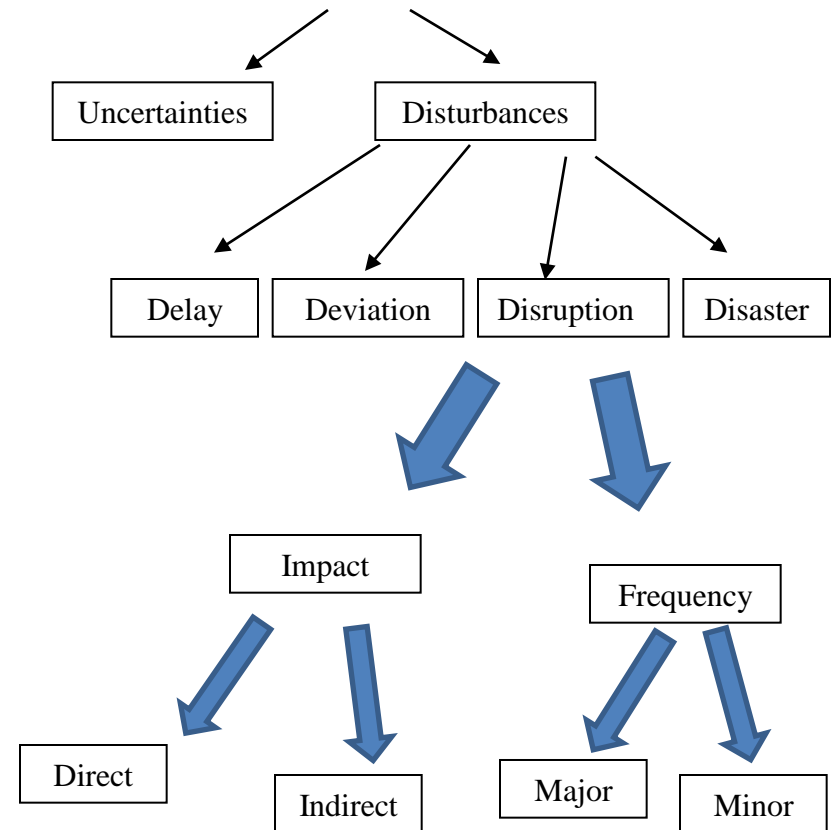
in :

- *System environment*
- *Unpredictable events*
- *System parameters*
- *Availability of resources*
- *New restrictions*
- *System Performance*
- *New considerations*



Related to risks as Disruption Risks	
Clausen <i>et al.</i> (2001a, p. 41)	“A state during the execution of the current operation, where the deviation from plan is sufficiently large that the plan has to be changed substantially”.
Yu and Gi (2004)	“Various unanticipated events caused by internal and external factors which significantly deviate original plans of a system and consequently affect its performance severely”
Events in Supply Chain as Supply Chain Disruption	
Craighead <i>et al.</i> (2007, p.132)	“Unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain and, as a consequence, expose firms within the supply chain to operational and financial risks”.
Disruptions in Maritime	
Bearing-Point & Hewlett-Packard (2005, p.2)	<i>“The maritime industry is directly impacted by a variety of disruptions to the flow of legitimate trade and travel. These range from minor weather disruptions to hurricanes and typhoons, from workforce shortages to work stoppages and from security breaches to potential Terrorist attacks”.</i>

Supply-Chain Risks



Disturbances

Stage One (delay) or the first stage through which a risk passes is referred to as the delay stage; here the focus is on the *recurrent changes* displayed by the performance of a supply-chain and the cancelation of previous planned (Wright 2008; Zsidisin & Smith 2005).

Disturbances

Stage Two is *the deviation* stage when one or more performance parameters of a supply-chain diverge from their estimated or mean value, without significant transformation to original supply-chain structure (Gaonkar & Viswanadham 2007)

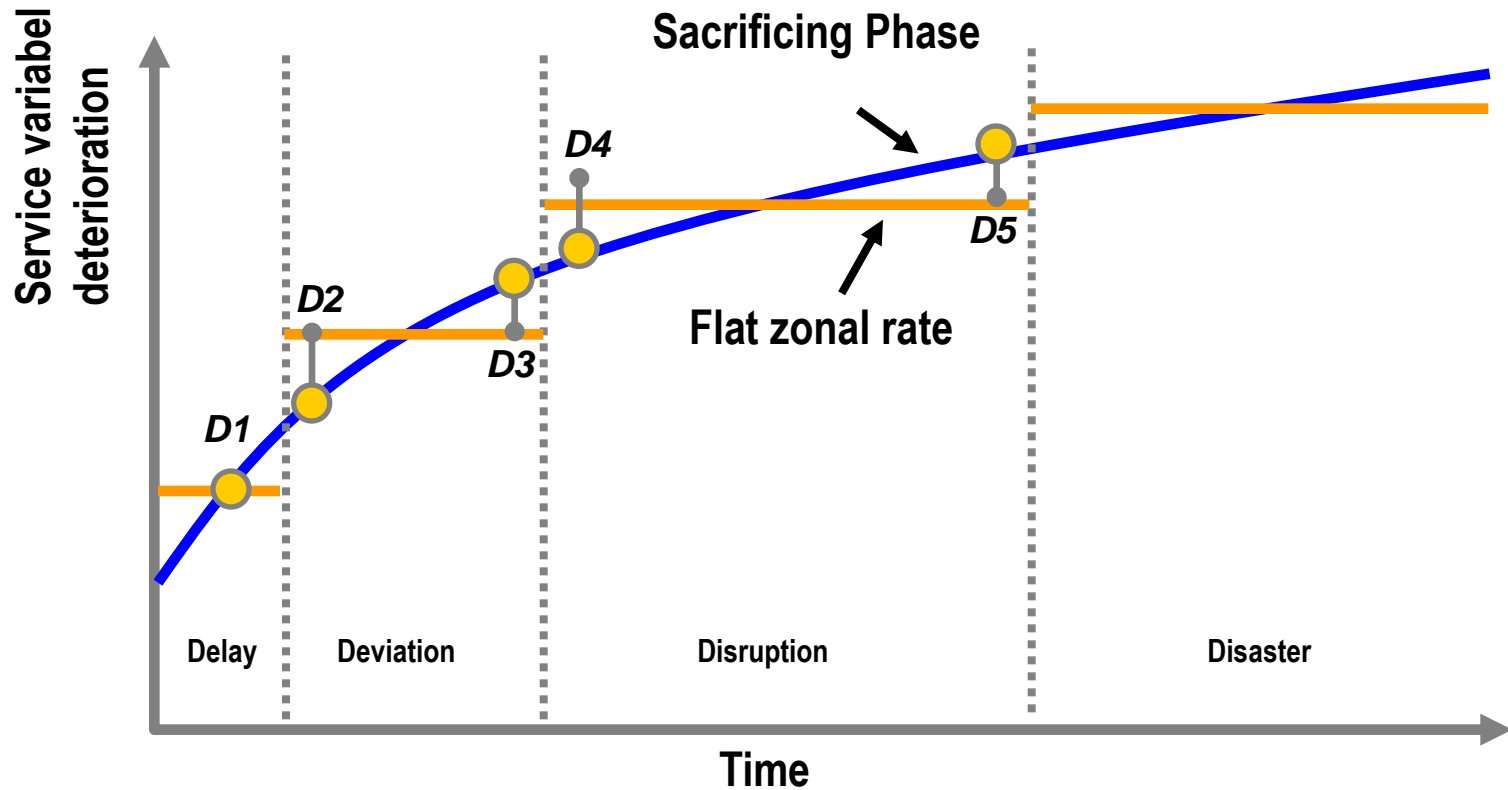
Disturbances

Stage Three is *the disruption stage* which occurs when existing services are unavailable due to direct and indirect factors interrupting the services' provisions (Gaonkar & Viswanadham 2007; Handfield et al. 2008; Yu & Qi 2004).

Disturbances

The last stage is *the disaster stage* which results in a service platform being damaged and as a consequence, supply-chain entities are unable to provide services (Chang 2000; Gaonkar & Viswanadham 2007).

Hypothesis of Disruption Stages



Maritime Disruptions and its impacts

(Explorative Study and Literatures)

TYPE OF MARITIME DISRUPTION RISKS

DIRECT

Security and safety

- Ship accidents
- Ship pollution
- Political events
- Terrorist attack

Service related factors

- Operational and equipment
- Competition
- Fuel and bunkering
- Electrical shortage
- Congestion

- Infrastructure related factors

- Communication facility
- Lack of development
- Inland transport connections

INDIRECT

Market

- Shortage of Demand
- Shortage of ships
- Financial Crisis
- Trade imbalance

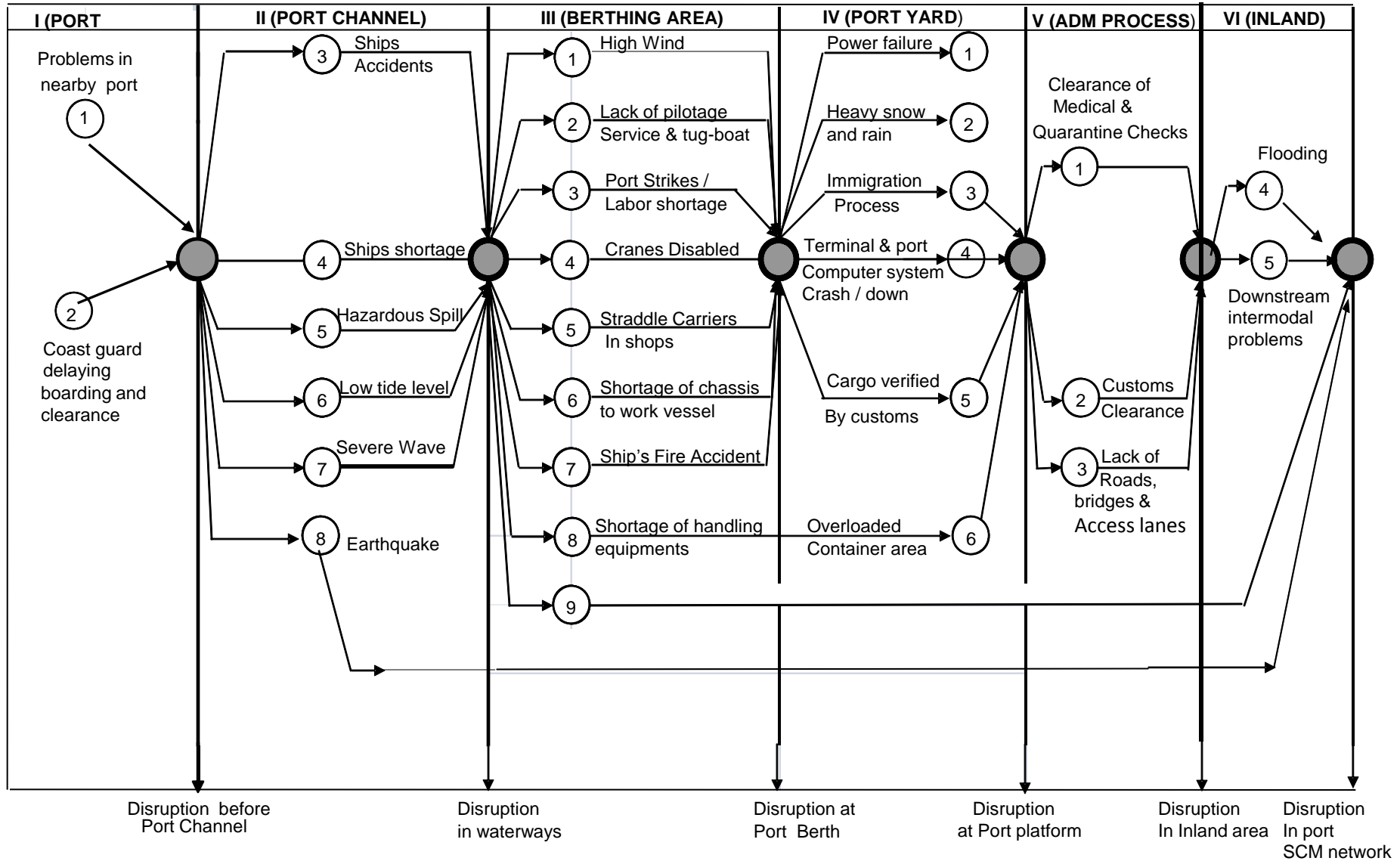
Organisation and relationship

- Employment / Port Workers
- Legal and policy
- Resource
- Customs process
- Ships inspection

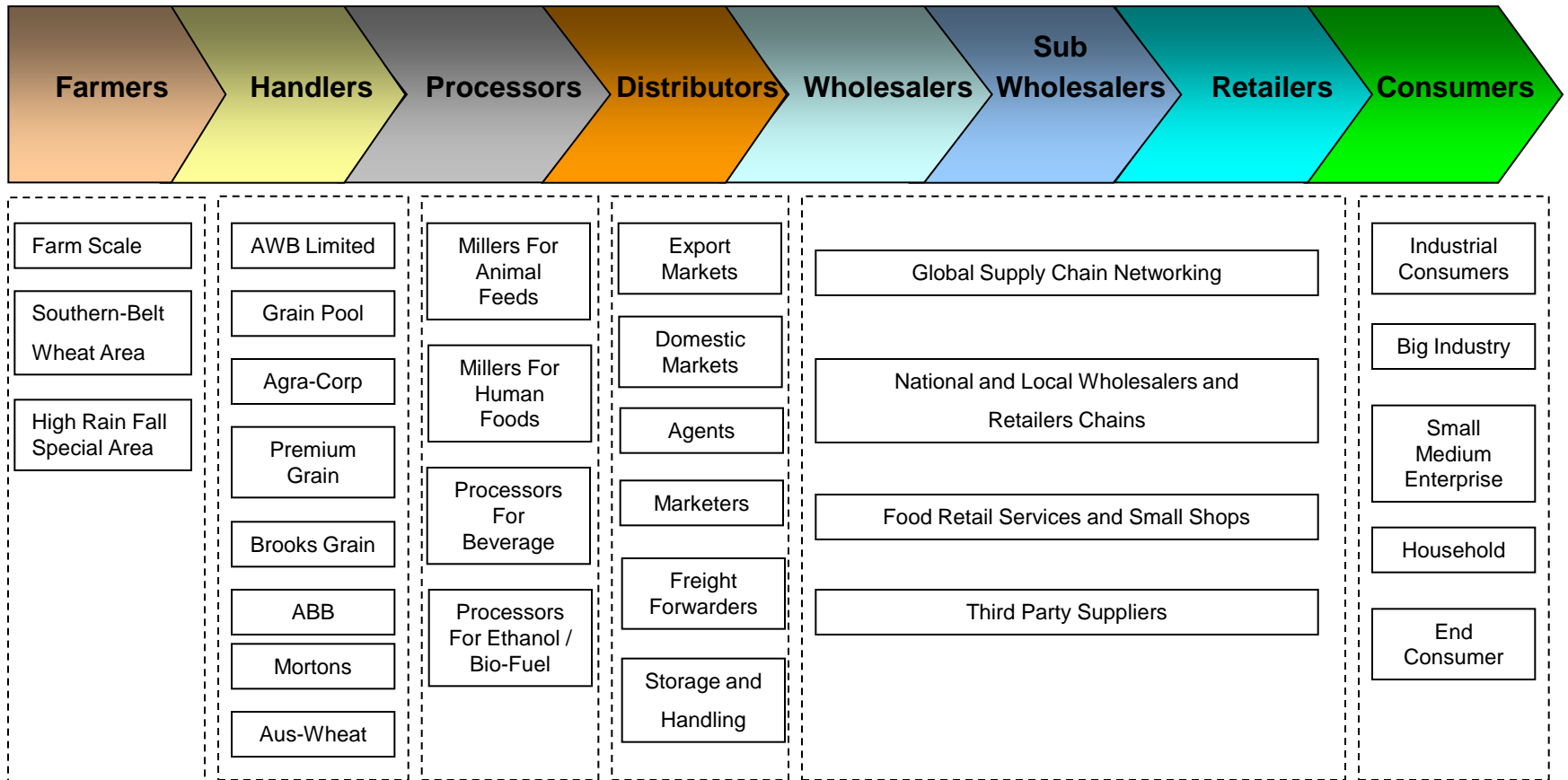
Environmental

- Severe weather
- Earthquakes
- Flood

Diagram of Possible Direct Maritime Disruptive Events

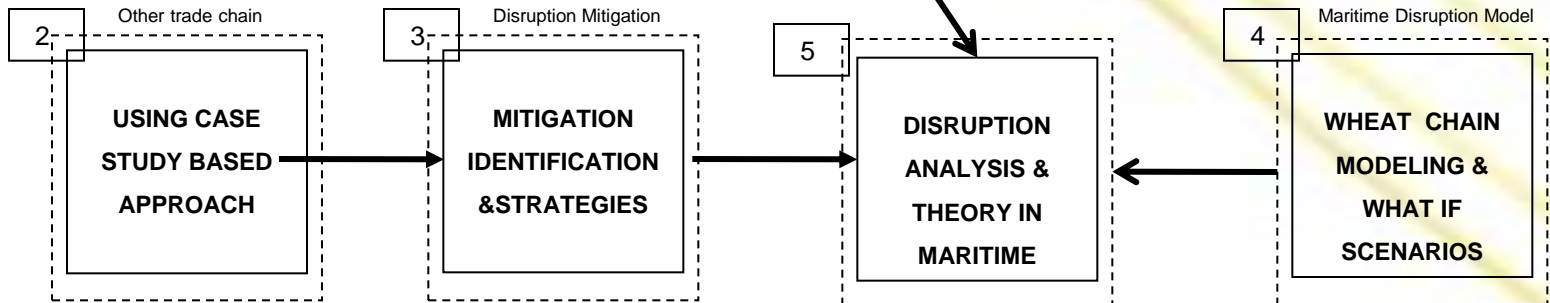
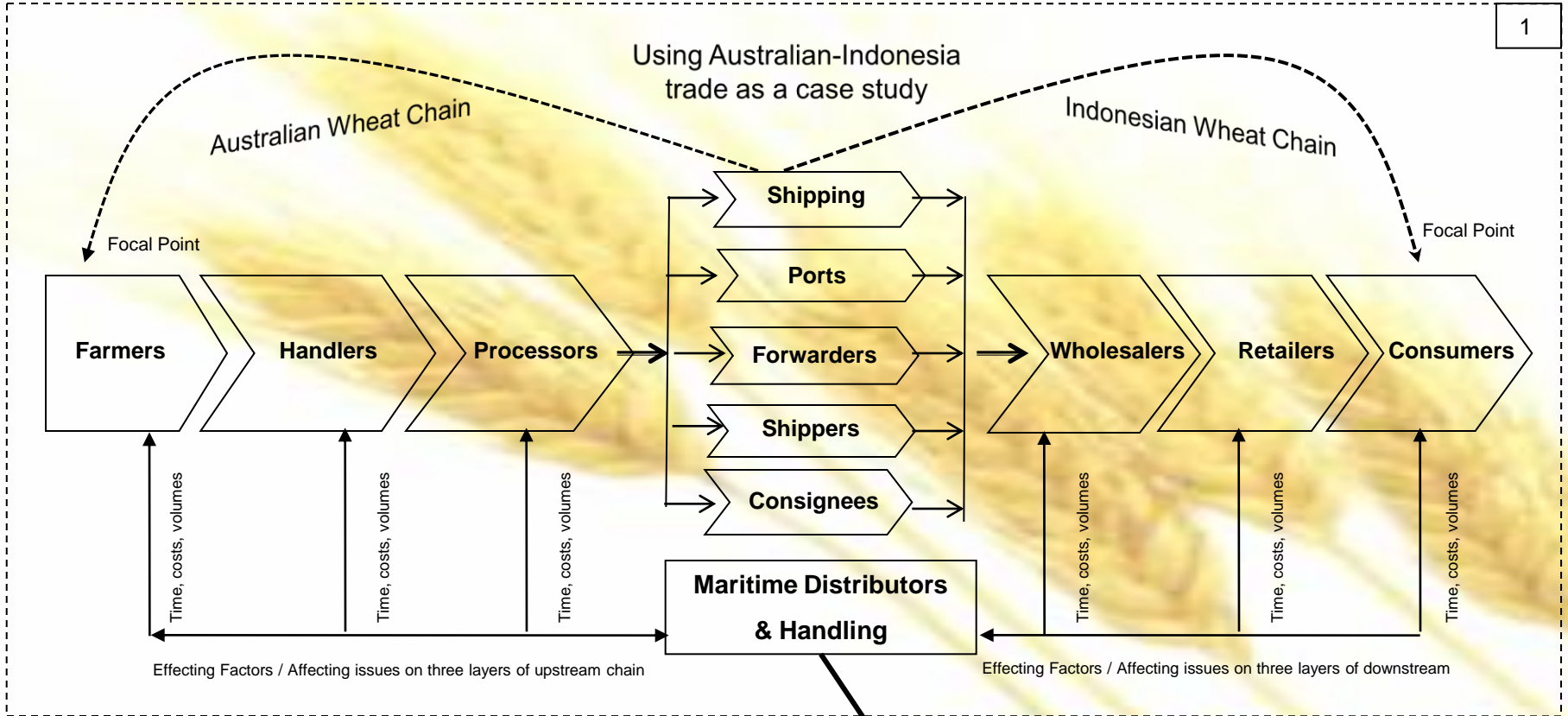


WHEAT SUPPLY CHAIN IN AUSTRALIA AND INDONESIA

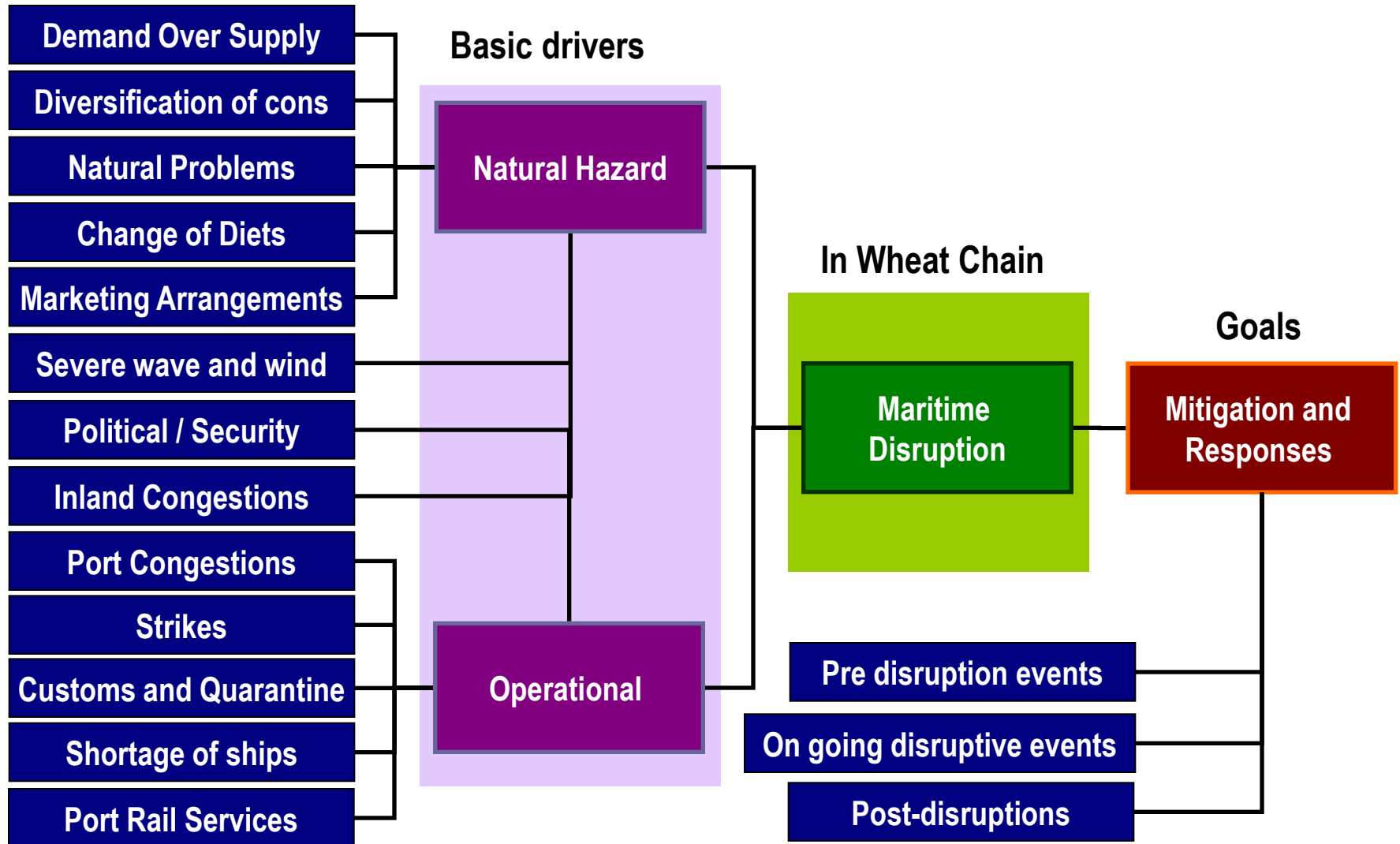


THE ILLUSTRATION OF RESEARCH SCENARIO

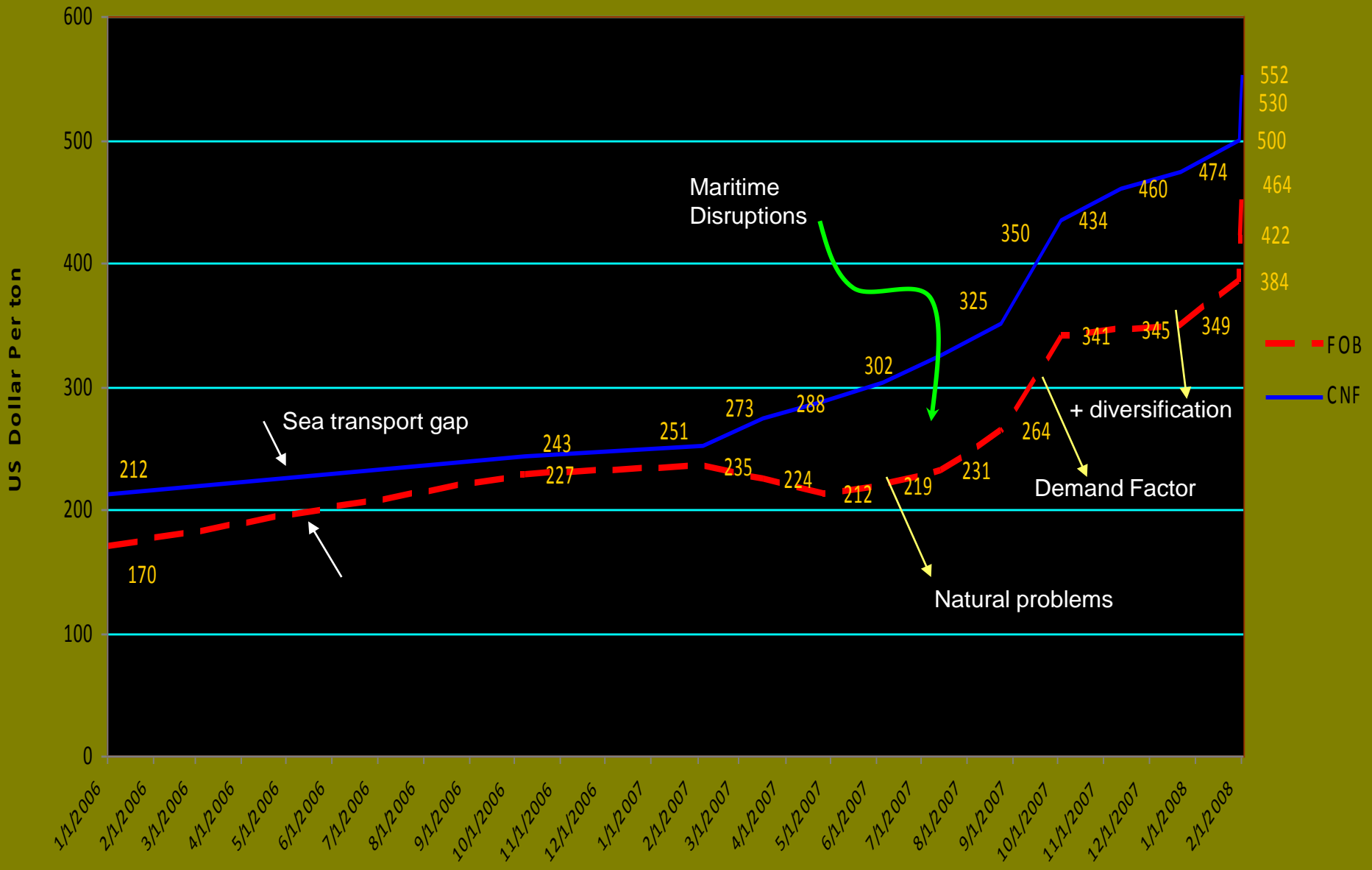
Global and common wheat chain as research perspective and objective



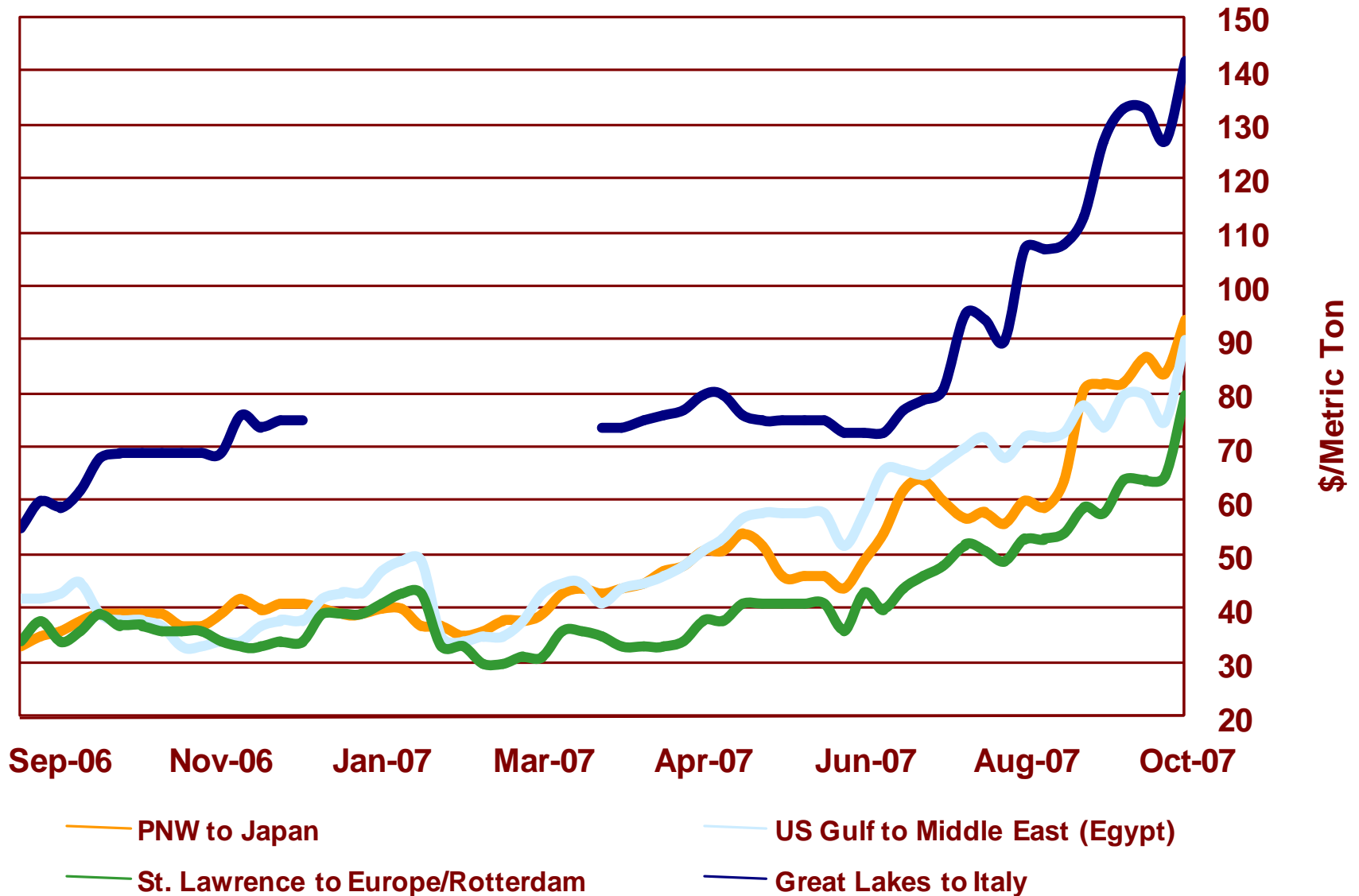
Logical Process of Maritime Disruptions on Wheat-Trade



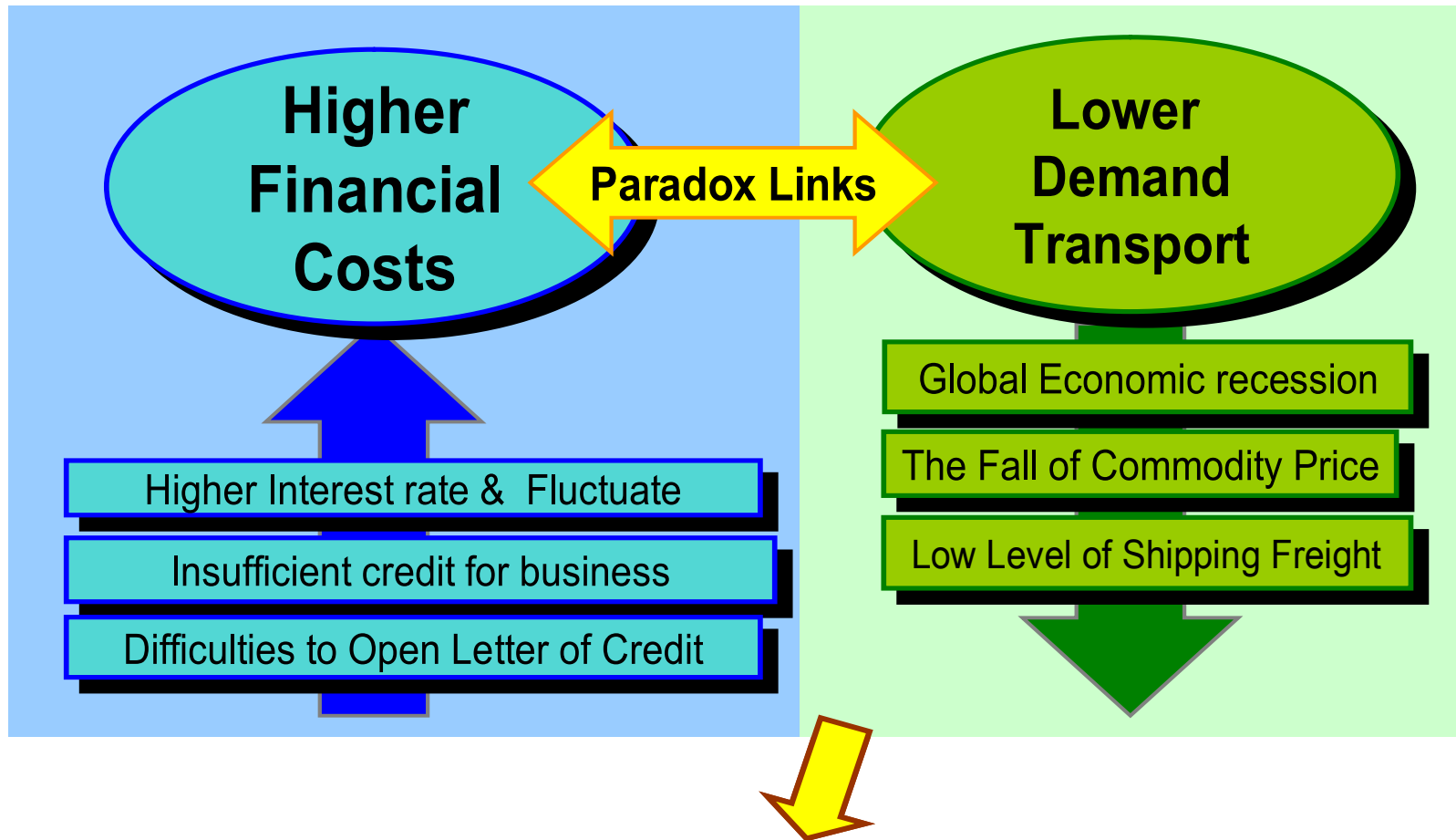
Trend of FOB and C&F Price of Wheat from Australia to Indonesia



Ocean Freight Rates for Grains (USDA 2008)



Global Financial Crisis and Maritime Disruptions



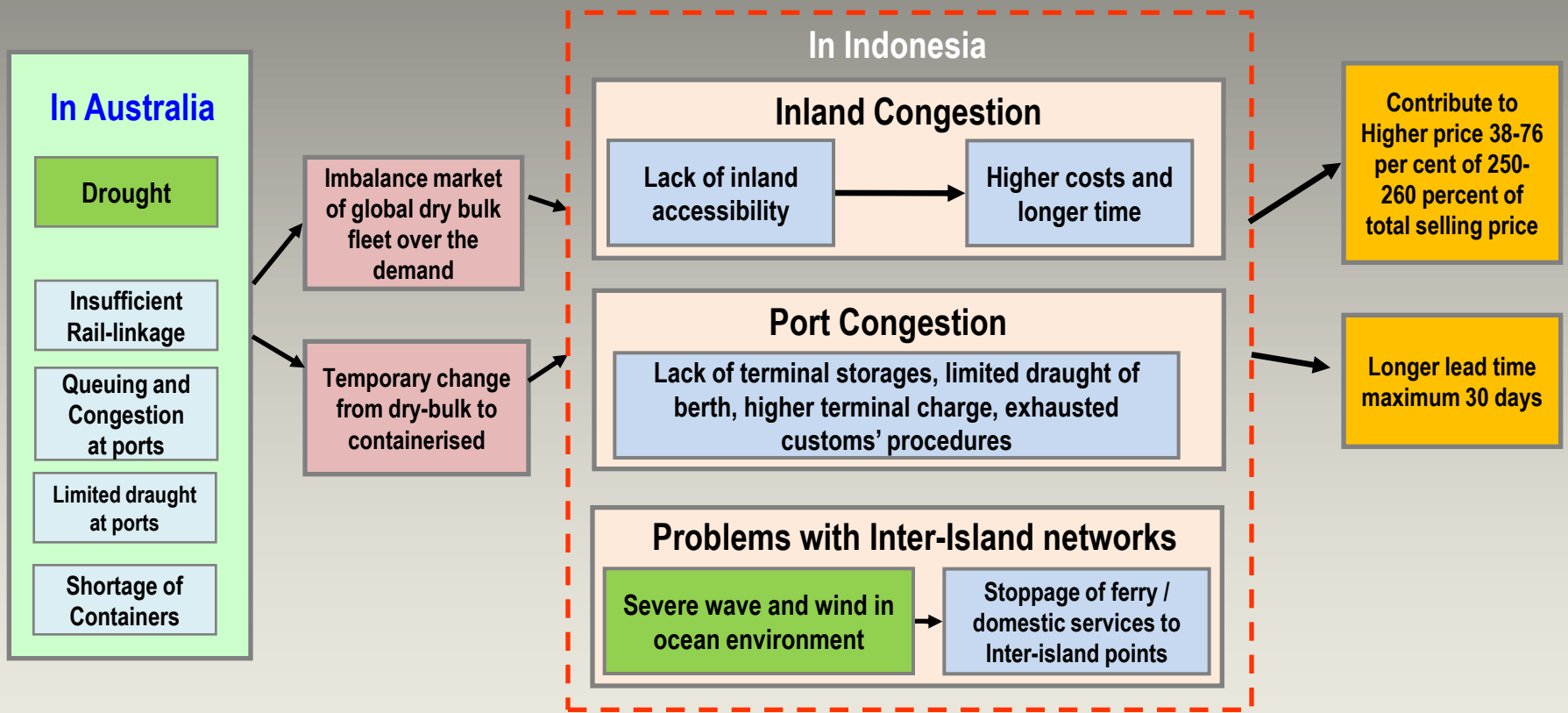
**MARITIME
DISRUPTIONS**

**INTERRUPTION
OF PORT
SERVICES**

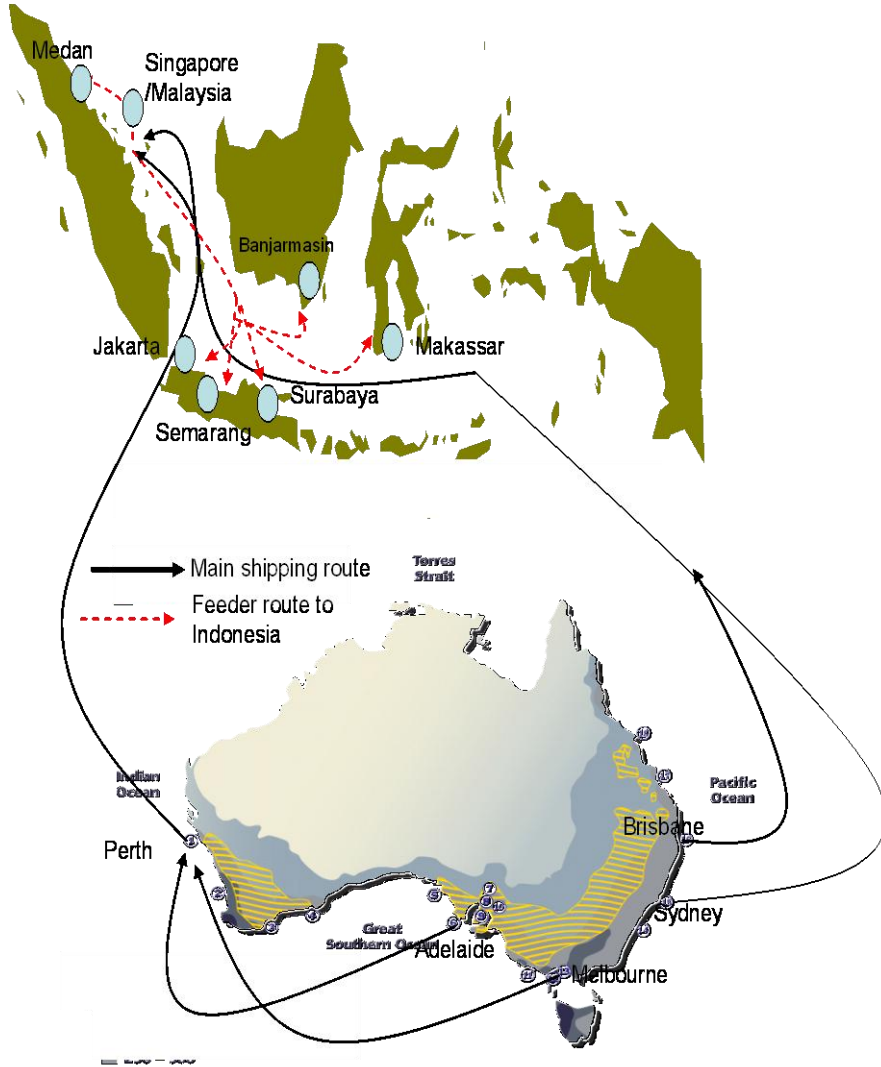
**LOWER PORT
TRAFFIC**

**IDLE OF
SHIPPING
FLEET**

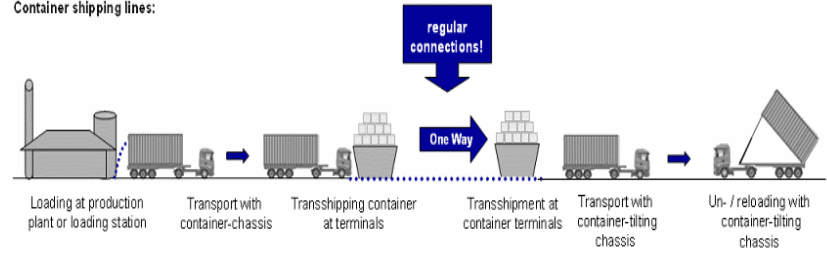
Initial finding of maritime disruption in the period 2006-2008



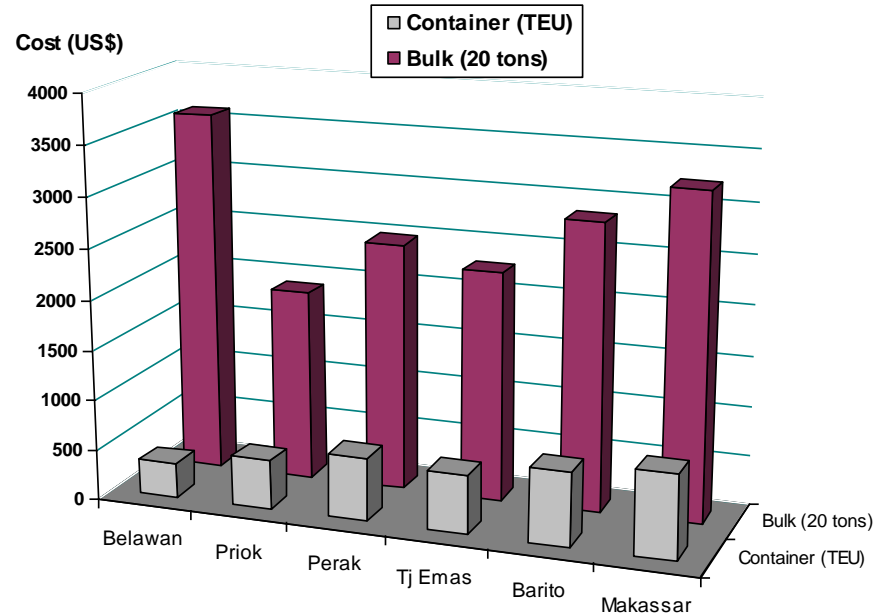
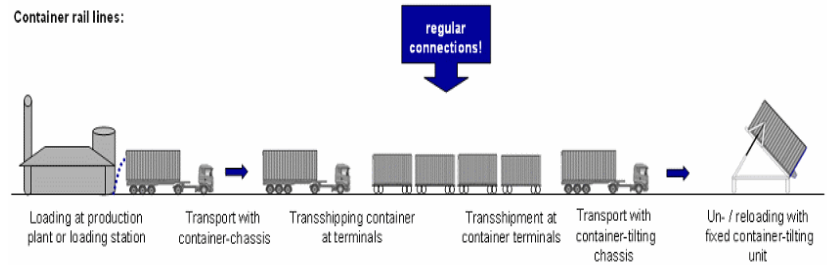
RESPONSE ON MARITIME DISRUPTIONS



Container shipping lines:



Container rail lines:



KNOWLEDGE EVOLVEMENT ON DISRUPTIONS MANAGEMENT

1. Inventory and Sourcing Mitigation
2. Contingency Rerouting

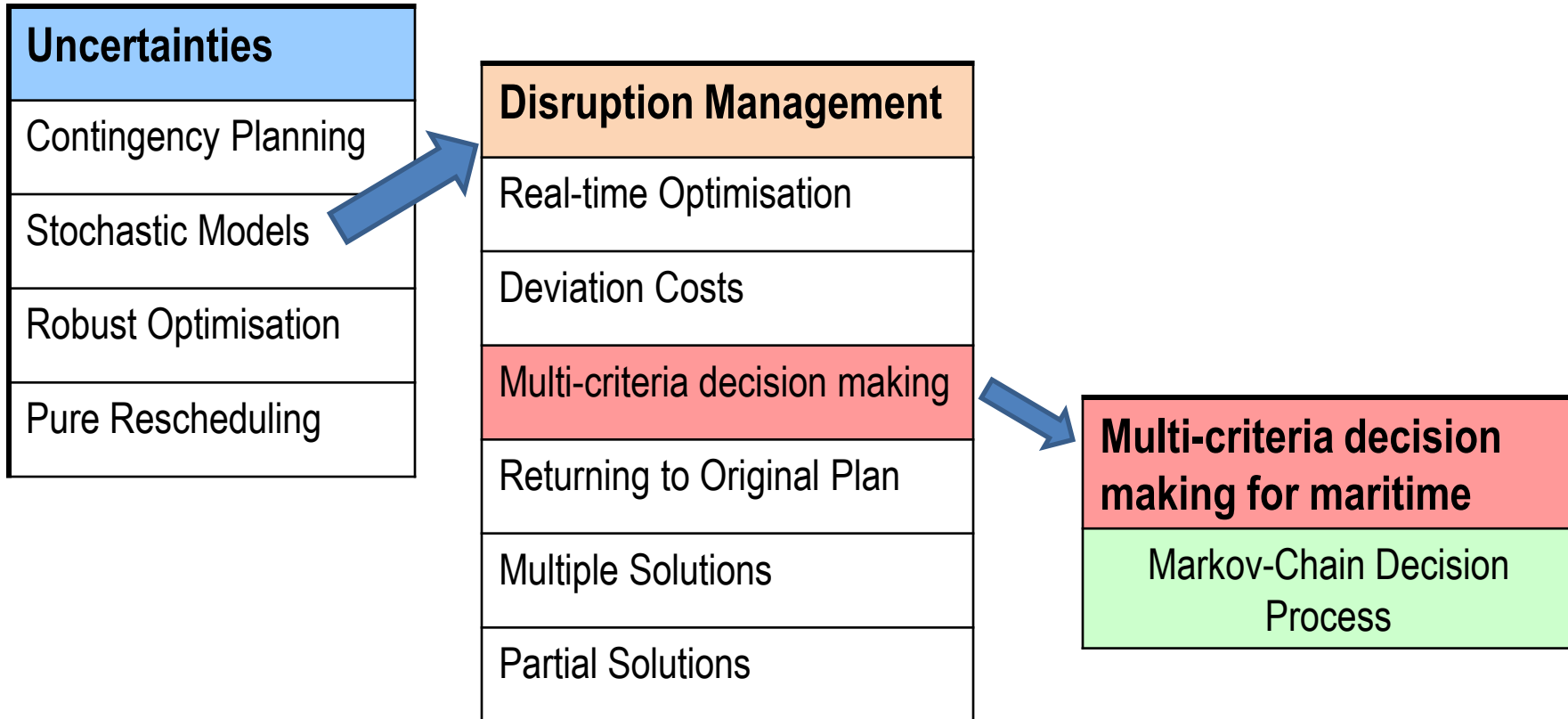
3. Business Continuity Planning
4. Recovery Planning

Year	Disruption Management topics	Application in maritime operation	Researchers	Objectives	Methods	Disruption management strategies			
						ISM	CR	BCM	RP
2001	Security on supply chain risk assessment	Terrorist attack at port	Sheffi	Propose postponement delays and imported inputs Input limitation	Risk Pooling Analysis	√	-	√	-
2003	Business Continuity planning	Multimodal application of maritime services	Depak	Developed business continuity scenario of a firm facing disruptions	Continuity cycle	-	-	√	
2004	Formal risk assessment	Inbound supply after maritime services	Zsidiisin, Carter, & Cavinato	Propose formal risk assessment procedures and techniques	Agency theory	√	√	-	-
2005	Disruption visibility	Port stoppages	Blackhurst <i>et al.</i>	Propose actions related to disruption discovery, recovery and redesign	Focus group interview Telephone interview,	√	√	-	√
2005	Analytical framework of disruption response	Port closure	Kleindorfer and Saad	Measure the implications of Risk Management program data for disruption management system	Standard logistic regression model	√	-	√	-
2006	Resilient supply chain	Stoppage of maritime operation because of severe weather	Tang	Robust strategy of mitigation process disruption	Lesson learned from cases of Nokia, Dell, Li and Fung.	√	√	-	-
2006	The quantification of mitigation and contingency strategies	Blockages of one particular shipping routes	Tomlin	Proposed flexible scenarios of optimal disruption-management strategies	Optimal ordering Policy under Markov chain	√	√	-	-
2007	Disruption severity	Port Strike	Craighead <i>et al.</i>	Develop warning and recovery planning	Complexity analysis	√	√	-	√
2008	Risk Monitoring system Supply Chain risk assessment event	Supply chain port entry Port Strike event	Handfield <i>et al.</i> McCormac	Mapping the high critical nodes Develop procedures to estimate the probability supplier attributes and environment risk Index	Incident report system Risk Probability Index and multi-use matrix	- √	√ √	- -	- -

Modelling of maritime risks and its application to supply-chain

Year	Researchers	Country	Stages in maritime flow	Risk Stages				Simulation Needs			Simulation Method	Objectives Assessed	System Model			
				DEL	DEV	DISP	DST	Mitigation	Response	Recovery			I	CP	CN	D
1995	Parlar, Wang & Gerchak	Canada	Manufacturers, retailers and Wholesalers	-	x	x	-	-	x	-	Time-homogeneous Markov chain pattern	Period inventory Level	-	x	-	x
2002	Jason et al.	USA	Shipping Channel	-	-	x	x	x	-	x	Probabilistic risk analysis	Probability of oil spill accidents	-	x	-	x
2004	Conrad	USA	Port Operations and Queing problems	-	x	x	-	x	x	-	Long-term economic viability and risk assessment method	Port security action plan and long term economic impact	x	-	x	-
2005	Pachakis and Kiremidjian	USA	Port operation	-	-	x	x	-	x	x	Seismic Hazard and Risk assessment analysis	Downtime analysis and revenue loss impact	-	x	-	x
	Brian, Erera, and White	USA	Port Operations	-	-	x	x	x	x	-	Markov Decision Model with value iteration algorithm	The impact of temporary port closure	-	x	-	x
	Merrick, Van Dorp, & Dinesh	USA	Short-sea shipping	-	-	x	x	x	-	-	Bayesian simulation technique	Model framework for maritime uncertainties	-	x	-	x
2006	Pinto and Wayne	USA	Port Operations	-	-	x	x	x	x	-	Risk-based assessment and risk-based return-on investment	Total loss in throughput of incident until port operations restored	-	x	-	x
	Tomlin	Canada	Manufacturers, retailers and Wholesalers	-	x	x	-	-	x	-	Four-state continuous time of Markov Chain	Average costs Functions	-	x	x	-
2007	Gaonkar and Viswanadham	Singapore	Port Operations and Manufacturers	-	x	x	-	x	-	-	Simple integer quadratic Markowitz model	Risk propagation in supply chain	x	-	-	x
2008	Garcia	USA	Port Operation and Inland Transport	-	x	x	-	-	x	x		Rerouting Impact	x	-	x	-
2008	Guerrero, Muray, and Flood	USA	Port and Vessel traffic area	-	x	x	-	x	x	-	Large scale integer programming	Restoration/ recovery process	x	-	-	x

Fundamental Approach of Supply-Chain Risks



Markov Decision Processes (MDPs)

- MDPs is a decision-theoretic planning and learning problems.
- An MDP is a model $M = \langle \mathcal{S}, \mathcal{A}, T, R \rangle$ consisting
 - a set of environment states \mathcal{S} ,
 - a set of actions \mathcal{A} ,
 - a transition function $T: \mathcal{S} \times \mathcal{A} \times \mathcal{S} \rightarrow [0,1]$
$$T(s,a,s') = \Pr (s' \mid s,a),$$
 - a reward function $R: \mathcal{S} \times \mathcal{A} \rightarrow \mathcal{R}$.
- A policy is a function $\pi: \mathcal{S} \rightarrow \mathcal{A}$.
- Expected cumulative reward -- value function $V^\pi: \mathcal{S} \rightarrow \mathcal{R}$.

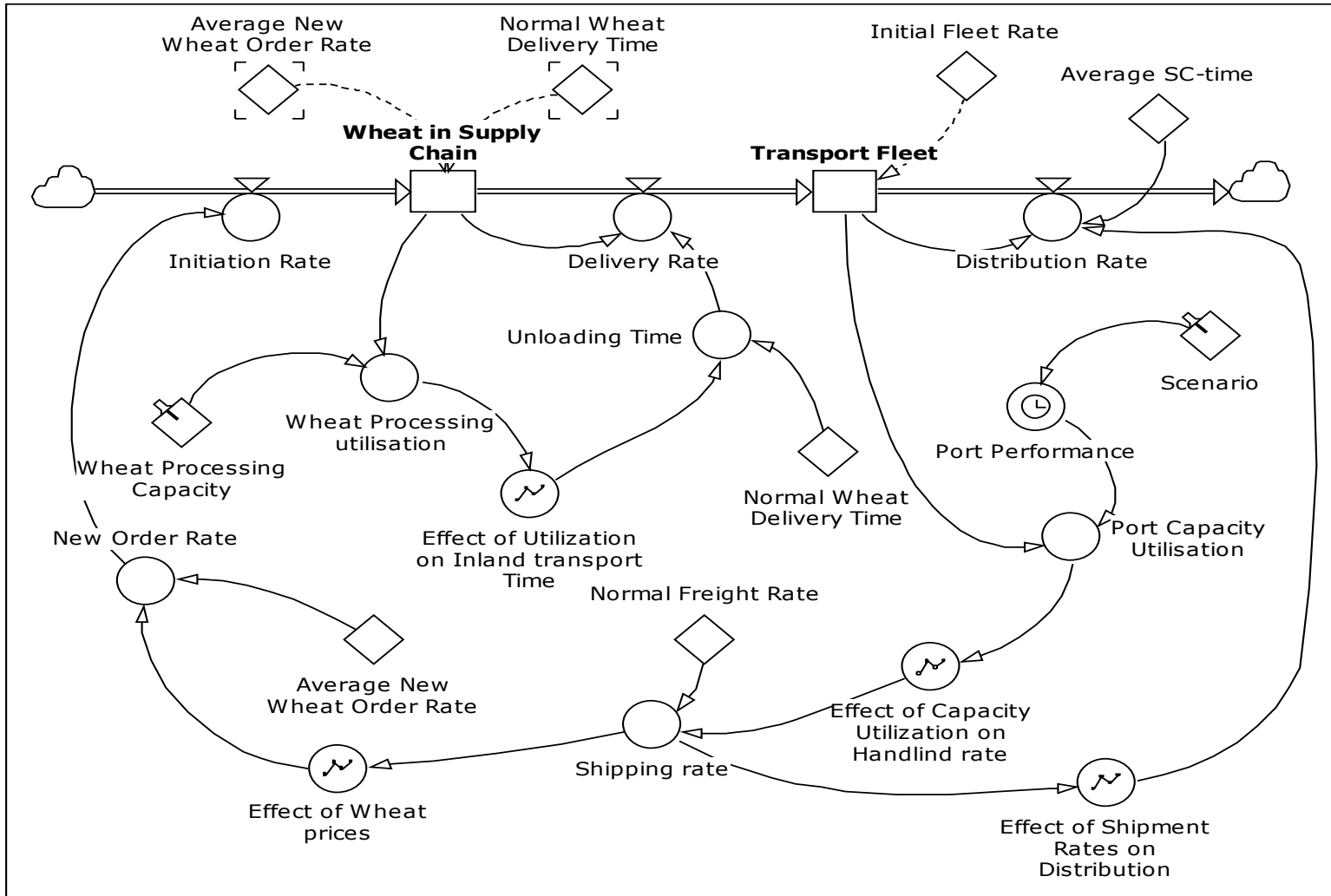
The Bellman Eq.: $V^\pi(s) = R(s, \pi(s)) + \gamma \sum_{s'} T(s, \pi(s), s') V^\pi(s')$

Surveys (mail & in depth telephone interviews)

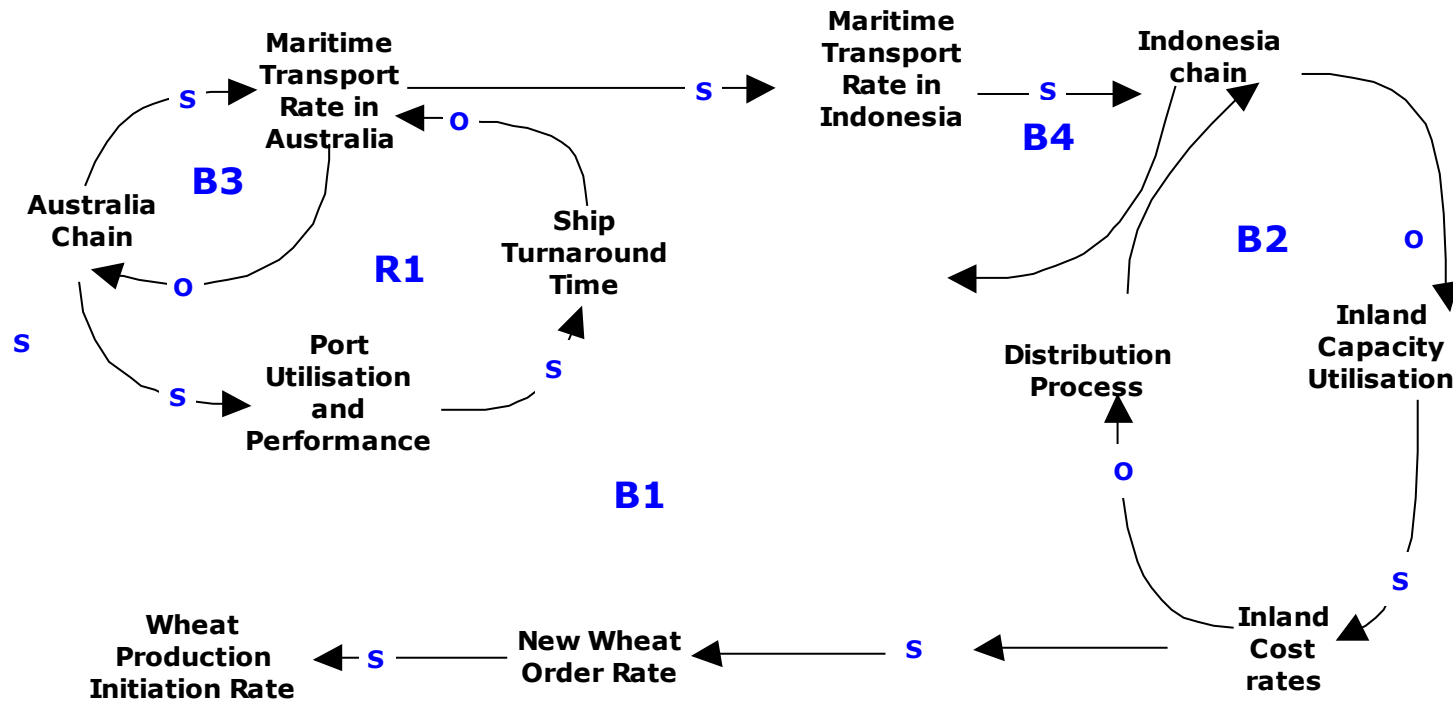
Items of Research Goals	Methods & Targets								The Scenario of Survey Questions									
	in Australia				in Indonesia													
	Far	Col	Mil	MarOp	MarOp	Proc	Dis	Ret										
Q.1. Are shippers and consignees aware of the disruption that may occur in the maritime leg of the wheat supply-chain? A. Disruption Process (including delay, deviation) B. Consequences (costs and lead-time) C. Frequency (occurency) D. Maritime contribution (shipping, port and FF) E. Dominant and maritime recurrent events	Mail Survey				Telp interview				Expected targets			Output expectd from various question types						
	Dichotomous			Checklist		Range		Open Ended		Likert		Total						
	x	x	x	x	√	√	√	√	Recognition & types			1	1	-	-	-	2	
	x	x	x	x	√	√	√	√	Average level of value			-	1	1	1	1	1	4
	x	x	x	x	√	√	√	√	Probabilistic value			-	-	1	-	-	-	1
	x	x	x	x	√	√	√	√	Categories of events			-	-	-	-	2	2	2
	x	x	x	x	√	√	√	√	Important events			-	-	-	-	1	1	1
Far	Col	Mil	MarOp	MarOp	Proc	Dis	Ret	<i>Awareness of disruption</i>			Sub Total Questions for Q1			10				
Q.2. Are shippers and consignees in wheat supply-chain implementing supply chain risk assessment or mitigation strategies to minimise disruption events in maritime of both countries F. Commodity transferred G. Risk assessment strategy H. Acceptable Consequences J. Mitigation process K. Contingency plan L. Respon actions M. Information sharing	Mail Survey				Telp interview				Expected targets			Output expectd from various question types						
	Dichotomous			Checklist		Rank		Open Ended		Likert		Total						
	x	x	x	x	√	√	√	√	Types of wheat products			-	2	-	-	1	3	
	x	x	x	x	√	√	√	√	Classification and its focuses			-	2	-	-	1	3	
	x	x	x	x	√	√	√	√	Identify the accepted level			1	1	-	1	-	-	3
	x	x	x	x	√	√	√	√	If exists or not & its stages			1	1	-	1	-	-	3
	x	x	x	x	√	√	√	√	The detailed goals of minimising			-	-	-	-	1	1	1
x	x	x	x	√	√	√	√	Prevention based and others			-	-	-	1	1	2		
x	x	x	x	√	√	√	√	Interactions level with others			1	1	-	1	-	-	3	
Far	Col	Mil	MarOp	MarOp	Proc	Dis	Ret	<i>Recognize & distinguish responses</i>			Sub Total Questions for Q2			18				
Q.3. Are current risk mitigation and detection processess in maritime operations effective in wheat supply-chain systems ? N. Approach to identify potential disruptions P. Propagation effect on SC performance R. Response analysis S. Recovery plan T. Redesign plan U. Effective mitigation process	Online Focus Group				Online Focus Group				Expected targets			Output expectd from various question types						
	Dichotomous			Checklist		Rank		Open Ended		Likert		Total						
	x	x	x	x	√	√	√	√	Various prevention methods			2	-	1	-	-	-	3
	x	x	x	x	√	√	√	√	Orientation to up/down stream			2	-	-	1	1	1	4
	x	x	x	x	√	√	√	√	Response objectives into time frames			1	1	-	1	-	-	3
	x	x	x	x	√	√	√	√	Important factors of recovering plan			1	-	1	-	1	1	3
	x	x	x	x	√	√	√	√	Significant variables of new planning			1	-	-	1	-	-	2
x	x	x	x	√	√	√	√	Detail stages and indicators			-	1	-	1	1	1	3	
Far	Col	Mil	MarOp	MarOp	Proc	Dis	Ret	<i>Operational & real time effectiveness</i>			Sub Total Questions for Q3			18				

Far: Farmers; Col: Collectors; Mil: Millers; MarOp: Maritime Operations ; Proc: Processors ; Dis: Distributors; Ret: Retailers

Using Studio 8 Academic of Powersim



Causal Loop Diagram



Parameters in Maritime Disruptions Model

- *Wheat Supply-Chain Performance Indicators* (time, costs, and unit volume) .
- *Maritime Operational Performance*
 - Throughput
 - Service Capacity
 - Service Platforms
- *Decision Support Indicators* in mitigation, response, recovery
- *Continuity Target and Plan*

Temporary Results of Maritime Disruption of Global Credit Crunch on Wheat Supply-Chain

