



Prevention of Oil spill by Tanker collision and Minimization of the Disaster damage by TRIZ

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HEBEI SPIRIT

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1. Introduction to NEMA and CDI



NEMA(National Emergency Management Agency)

- NEMA was established on June 1, 2004.
- As the first national disaster management authority in S. Korea, NEMA has been trying its best for the national safety.



CDI(Central Civil Defense and Disaster Management Institute)

- CDI was established on March 1, 2006.
- CDI has been a leader for constructing “Safer Korea” by offering systematic and comprehensive on-site training courses to foster civil defense and disaster prevention specialists with on-field expertise as the first national disaster management institute in S. Korea.

2. Cases of Oil spill by Tanker collision



Fig.1 Hebei Spirit Oil Spill
(Dec. 7th, 2007)

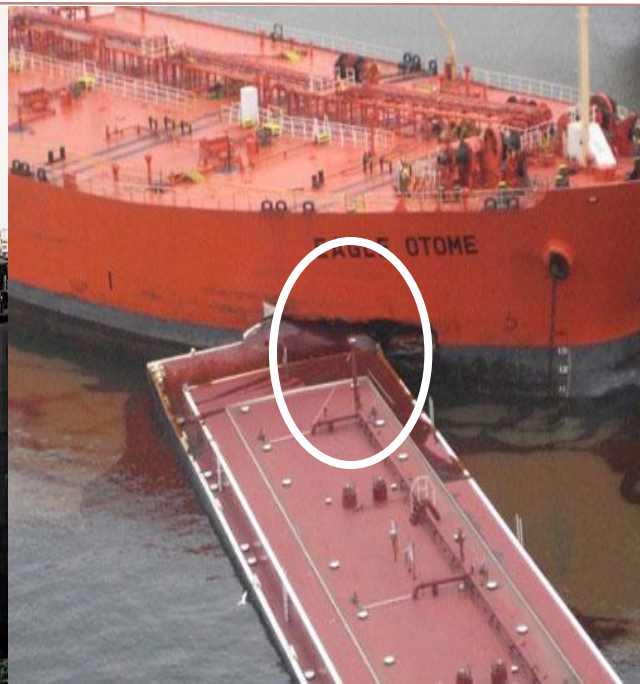


Fig. 2 Eagle Otome Oil Spill
(Jan. 23th, 2010)



Fig. 3 Gulf of Mexico Oil Spill
(April 20th, 2010)

3. Problems of Oil spill from Tanker collision

Tables of annual number and annual volume of oil spills

Table 1. Annual number of cases and annual volume of oil spills with relation to the cause of marine oil spill incidents in Korea for 10 years from 2003 to 2012

Year	Cause	Marine accident	Cause				Total
			Negligence	Intention	Damage	Others	
2003	No. of case	108	116	23	30	7	284
	Spillage(kL)	1,377	16	3	55	1	1,452
2004	No. of case	107	149	28	35	7	326
	Spillage(kL)	1,385	10	16	18	1	1,430
2005	No. of case	120	166	16	30	15	347
	Spillage(kL)	320	10	1	2	2	335
2006	No. of case	73	106	13	71	6	269
	Spillage(kL)	128	11	1	15	1	156
2007	No. of case	123	137	18	43	7	328
	Spillage(kL)	12,986	10	3	8	1	13,008
2008	No. of case	62	134	11	21	27	255
	Spillage(kL)	342	28	1	1	3	375
2009	No. of case	57	153	16	36	7	269
	Spillage(kL)	41	18	3	3	1	66
2010	No. of case	67	166	19	33	7	292
	Spillage(kL)	467	89	5	5	2	568
2011	No. of case	44	151	11	20	13	239
	Spillage(kL)	95	21	4	1	1	122
2012	No. of case	29	151	11	24	9	224
	Spillage(kL)	259	81	1	23	1	365
Total	No. of case	790	1,429	166	343	105	2,833
	Spillage(kL)	17,400	294	38	131	14	17,877
		27.9%	50.4%	5.9%	12.1%	3.7%	100.0%
		97.3%	1.7%	0.2%	0.7%	0.1%	100.0%

Source: Kim, K. S. (2013), Analysis of Marine Oil Pollution Incidents in Korea, Journal of the Korean Society of Marine Environment & Safety, Vol. 19, No. 5, pp. 470

Table 2. Annual numbers and quantities of oil spills of 7 tones and above worldwide for 20 years 1993~2012 (ITOPF, 2013)

Year	Annual number of oil spills			Annual oil spillage	
	(A)	(B)	(A+B)	Volume (kL)	Quantity (M/T)
	7t < spillage ≤ 700t	700t < spillage	7t < spillage		
	(8kL < spillage ≤ 800kL)	(800kL < spillage)	(8kL < spillage)		
1993	31	11	42	159,000	140,000
1994	26	9	35	147,643	130,000
1995	20	3	23	13,629	12,000
1996	20	3	23	90,857	80,000
1997	28	10	38	81,771	72,000
1998	25	5	30	14,764	13,000
1999	20	6	26	32,936	29,000
2000	21	4	25	15,900	14,000
2001	17	3	20	9,086	8,000
2002	12	3	15	76,093	67,000
2003	19	4	23	48,836	43,000
2004	17	5	22	18,171	16,000
2005	22	3	25	20,443	18,000
2006	13	5	18	26,121	23,000
2007	13	4	17	21,579	19,000
2008	8	1	9	3,407	3,000
2009	7	1	8	2,271	2,000
2010	4	4	8	13,629	12,000
2011	5	1	6	2,271	2,000
2012	7	0	7	1,136	1,000
Total	335	85	420	799,543	704,000

Source: Kim, K. S. (2013), Number and Volume of Marine Oil Spills in Korea and in the World, Journal of the Korean Society of Marine Environment & Safety, Vol. 19, No. 2, p.132

3. Problems of Oil spill by Tanker collision

Trends Graph of annual number and volume of oil spills

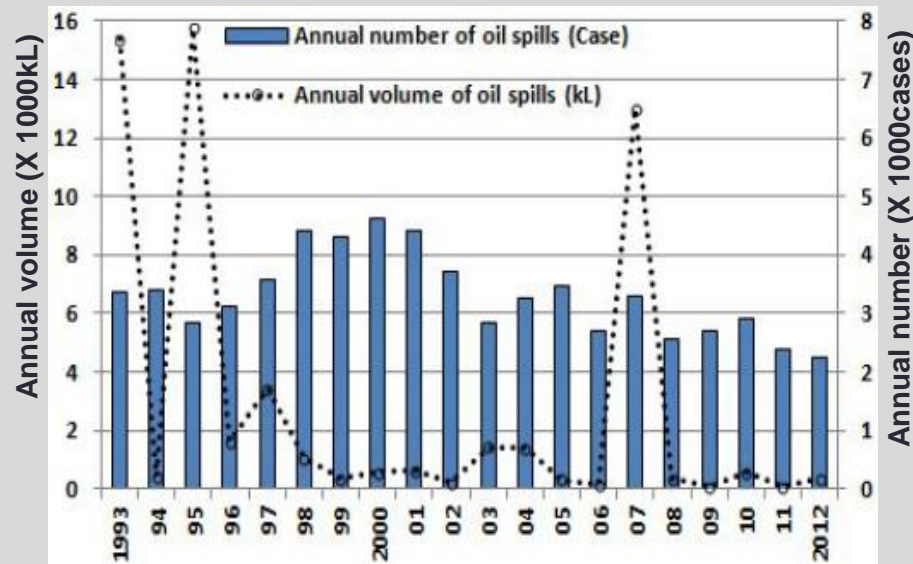


Fig. 4 Trends of annual number and annual volume of oil spills in Korea for 20 years 1993~2012.

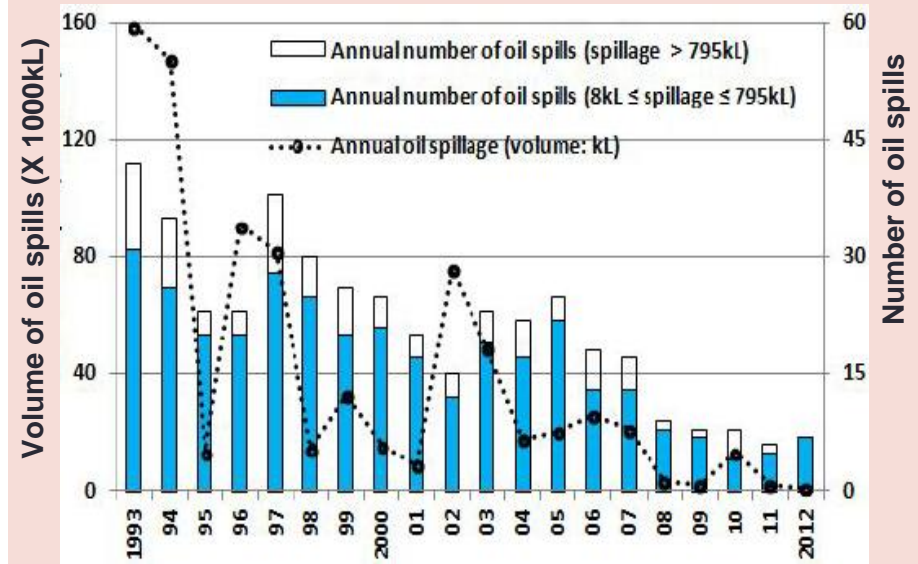


Fig. 5 Trends of annual number and volume of oil spills of 8kL and above worldwide for 20 years 1993~2012.

Source: Kim, K. S.(2013) Overview of Major Oil Spill at Sea and Details of Various Response Actions - 1. Number and Volume of Marine Oil Spills in Korea and in the World, Journal of the Korean Society of Marine Environment & Safety, Vol. 19, No. 2, pp. 131-132

3. Problems of Oil spill by Tanker collision

Impacts of Oil Spills

Destroys Marine Life

Destabilizes Marine Communities

Degrades Shore Amenities

Harms Economics Activities

Impacts Human Welfare



4. Importance of TRIZ for the First Response to Oil Spill

What is TRIZ?

- Teoriya Resheniya Izobretatelskikh Zadatch (in Russian)
- Theory of Inventive Problem Solving (in English)
- 재난안전관리 문제해결 기법 (PSM for DSM)

Why do we need to use TRIZ?

Problem A



Contradiction #1

Contradiction #2

Contradiction #3

Contradiction #4

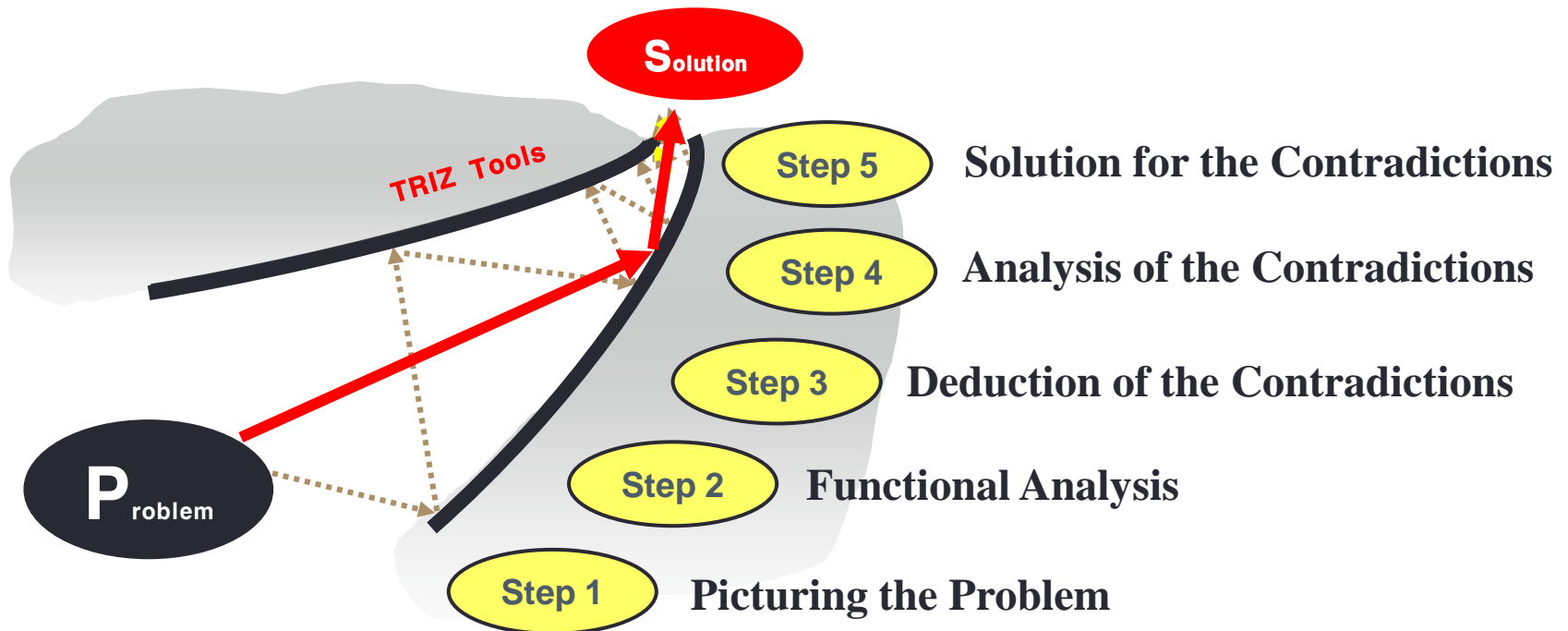
Contradiction #5

Contradiction #6

4. Importance of TRIZ for the First Response to Oil Spill

Steps for Problem Solving

- TRIZ is a practical verified problem solving tool that re-defines a problem for multiple steps to find the most desirable solution. TRIZ is widely used in various types of Korean industry for solving work-site problems.

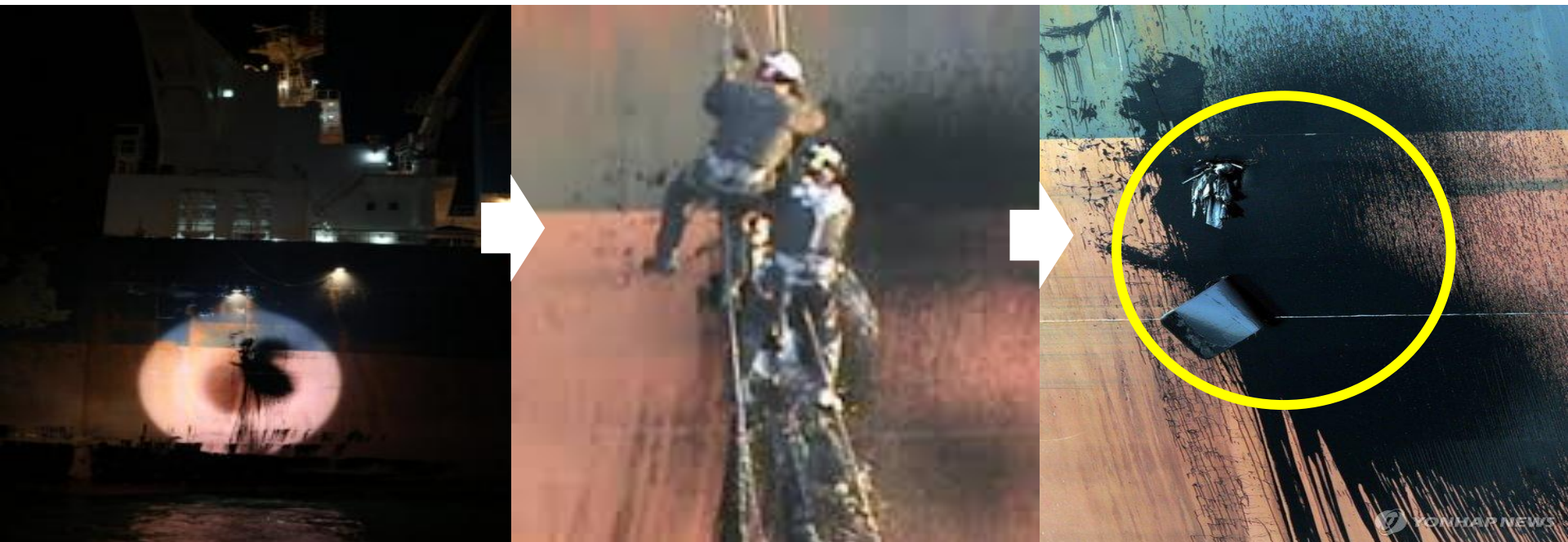


5. TRIZ based Analysis of Oil Spill Accidents

Defining the Problem Situation

▪ The Collision Damage of Oil Tanker

Near the south outer harbor in Busan, South Korea, there was an oil tanker collision on Feb. 16, 2014. Due to this collision, a 20cm width and 30cm length of hole has been created on the 8t Liberian cargo ship and caused bunker fuel oil C leakage.

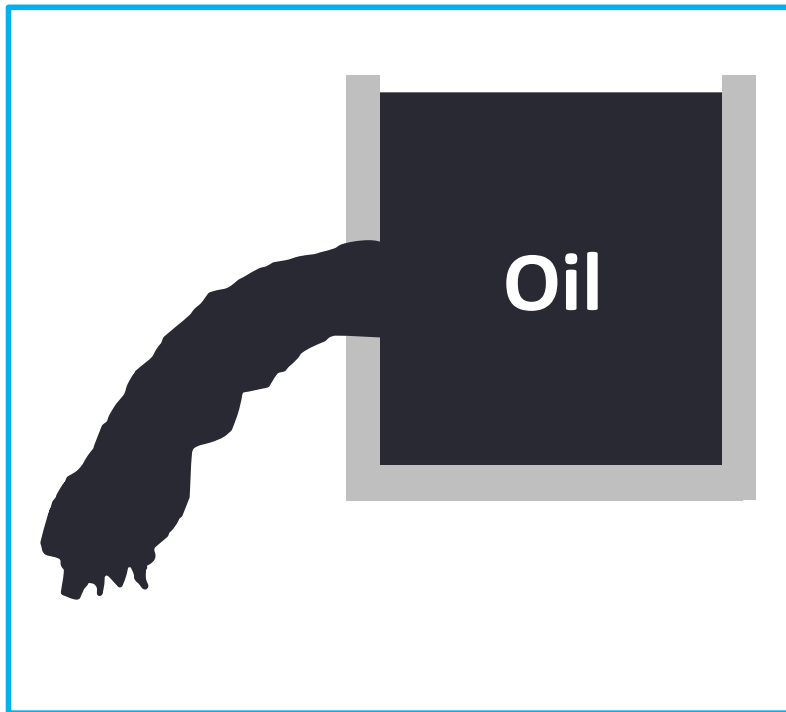


5. TRIZ based Analysis of Oil Spill Accidents

Step1

Picturing the Problem

- What is the problem? → Redefinition of the problem
- **The oil leakage from the damaged tanker cannot be blocked immediately after the collision.**

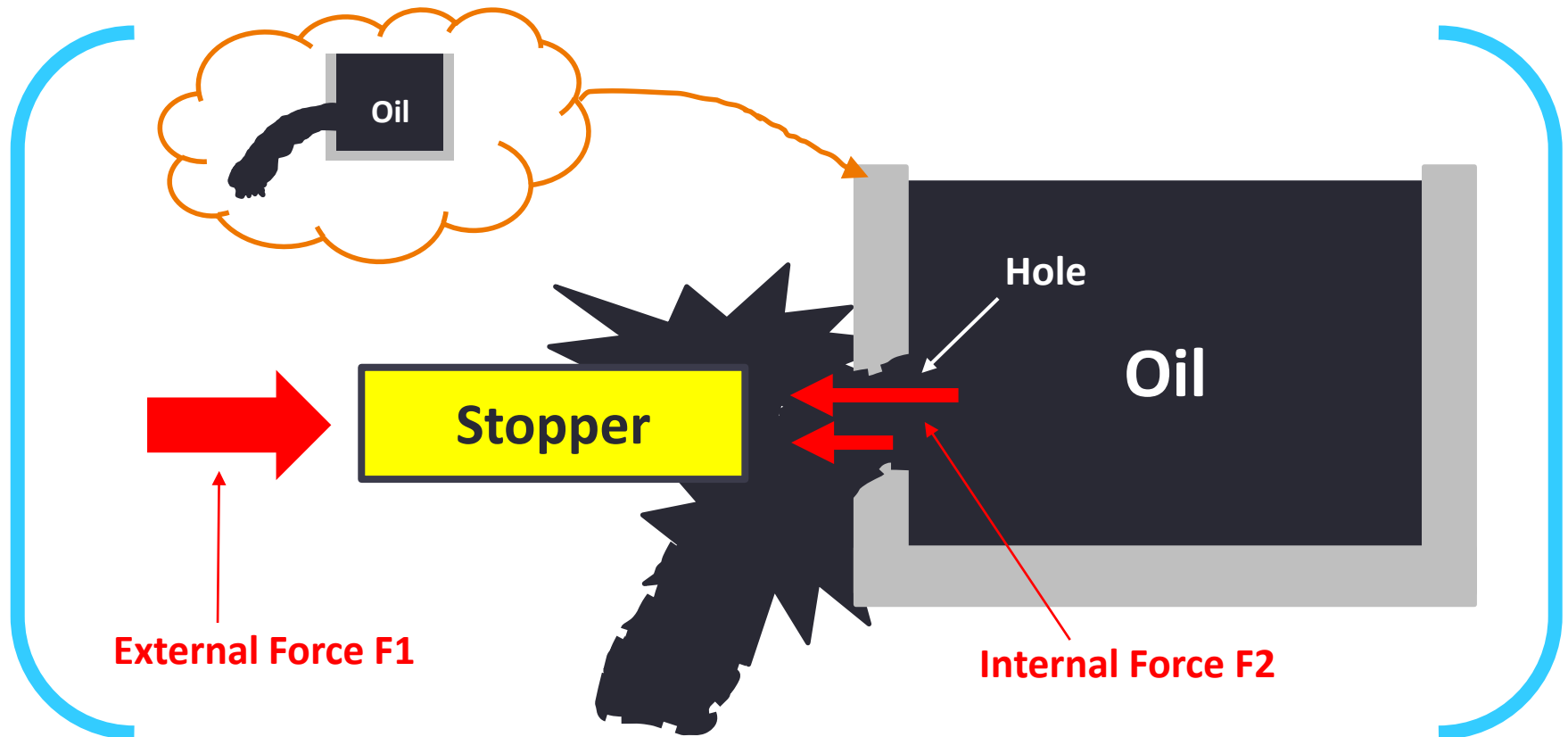


1. Problem that we cannot block the hole
2. Problem that the pressure of the oil leaking out from the hole is too high
3. Problem that it is very difficult to approach to the hole
4. **Problem that the oil leakage block stopper cannot be pushed into the hole easily**
5. Problem that the hole is too big
6. ??

5. TRIZ based Analysis of Oil Spill Accidents

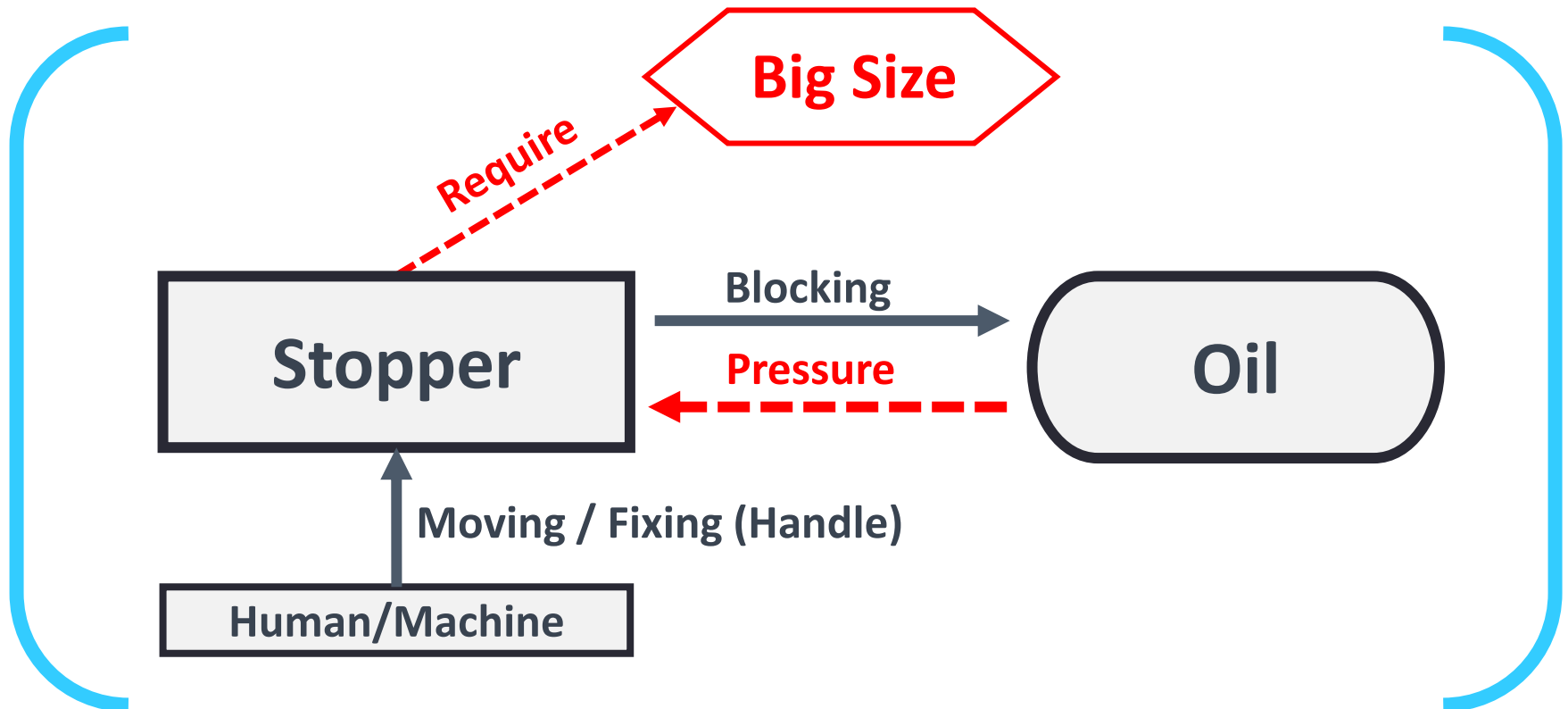
Step1 Picturing the Problem

- Detailed Picture of the Problem Area



5. TRIZ based Analysis of Oil Spill Accidents

Step2 Functional Analysis of the Problematic Area



5. TRIZ based Analysis of Oil Spill Accidents

Step3

Deduction of the Contradictions



● *Contradiction #1*

The diameter of the oil leakage stopper should be large, but also be small.

● *Contradiction #2*

The stopper should be big, but also be small.

● *Contradiction #3*

The external force should be larger, but also be smaller.

5. TRIZ based Analysis of Oil Spill Accidents

Step4 Analysis of the Contradictions



Contradiction #1: The diameter of the stopper should be large, but also be small.

Division Category	Solution for Contradiction
1. Time Division	There are periods when the diameter of the stopper is large or small.
2. Space Division	There are areas where the diameter of the stopper is large or small.

Contradiction #2: The stopper should be big, but also be small.

Division Category	Solution for Contradiction
1. Time Division	There are periods when the size of the stopper is big or small.
2. Space Division	There are areas where the size of the stopper is big or small.

5. TRIZ based Analysis of Oil Spill Accidents

Step4 Analysis of the Contradictions



Contradiction #3: The external force should be larger, but also be smaller.

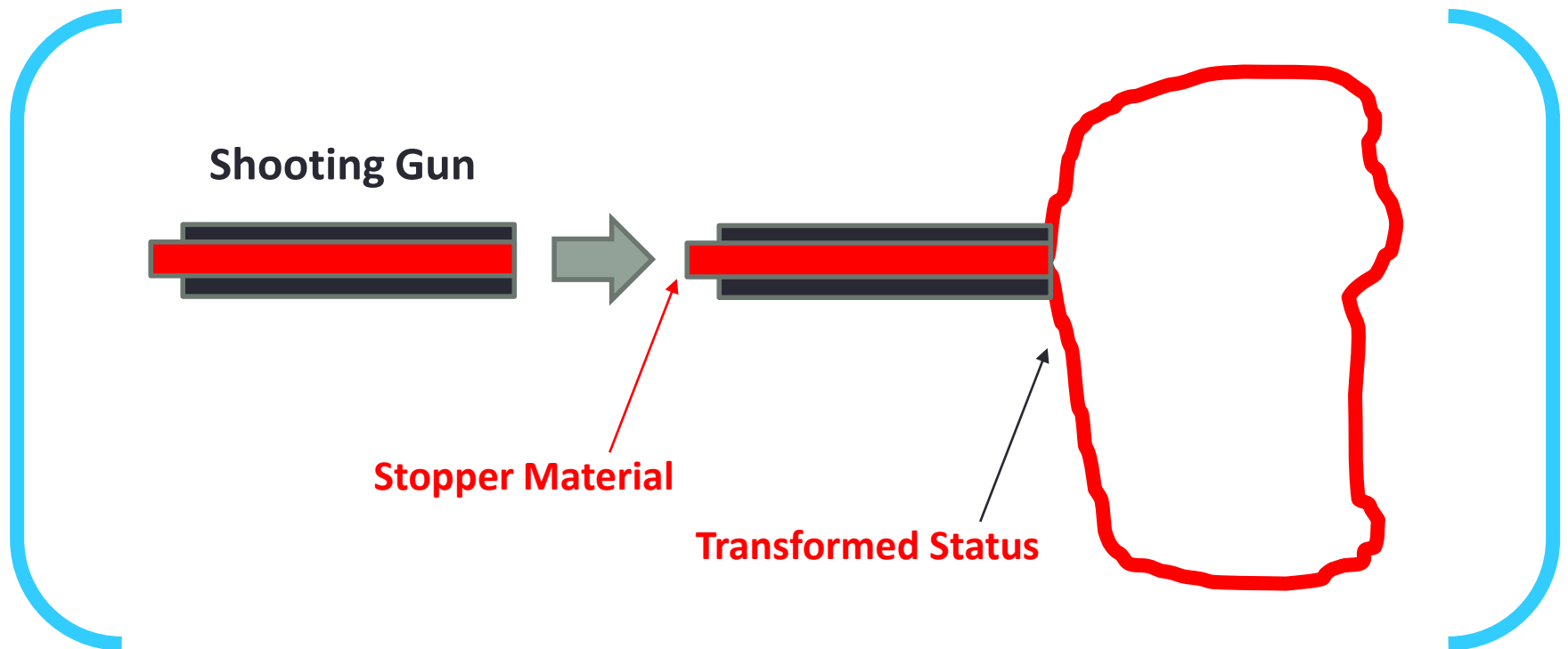
Division Category	Solution for Contradiction
1. Time Division	There are periods when the external force is larger or smaller.
2. Space Division	There are areas where the external force is larger or smaller.

5. TRIZ based Analysis of Oil Spill Accidents

Step5

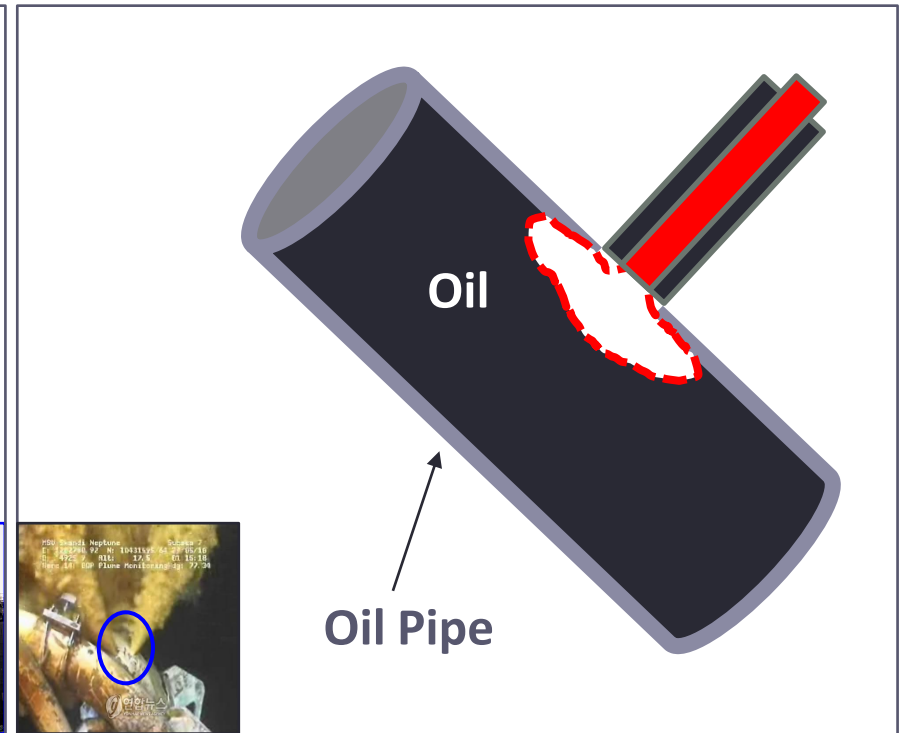
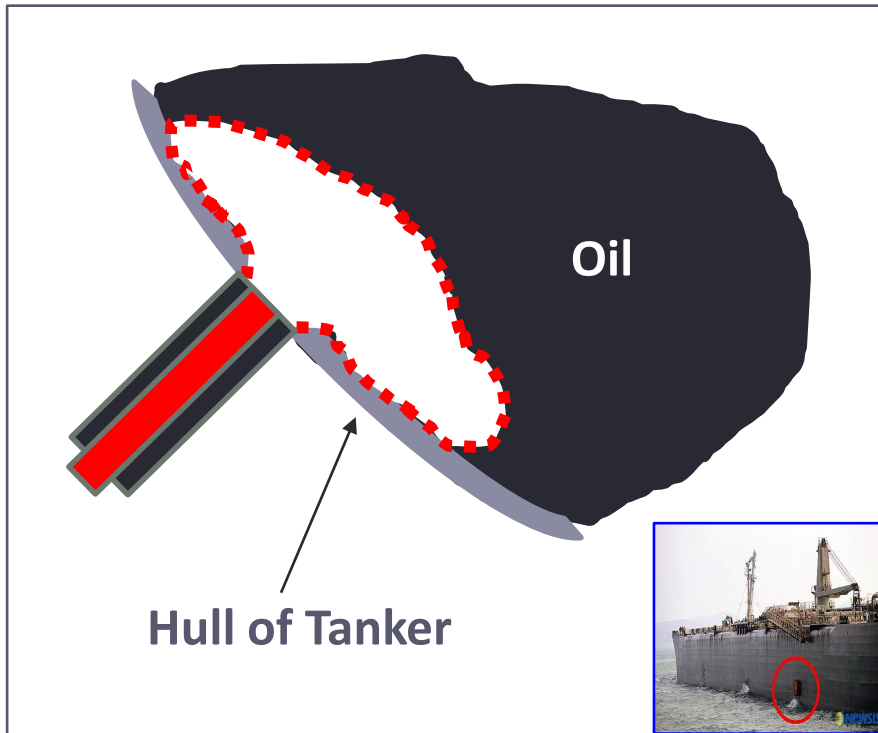
Solution for the Contradictions

- When the diameter of stopper is large, but also small.



6. Assessment of the TRIZ applied Solution

Application of the Solution



- Hebei Spirit Oil Spill(Dec. 7th, 2007),
- Eagle Otome Oil Spill(Jan. 23th, 2010), etc.

- Gulf of Mexico Oil Spill(April 20th, 2010), etc.

6. Assessment of the TRIZ applied Solution

The positive effects gained by the TRIZ applied problem solving method are the followings:

Suggestion of technical solutions for oil spill disaster damage minimization and tanker collision prevention

Reduction of disaster response and recovery costs regarding oil spill caused by oil tanker collision

The Prevention of possible environmental damage caused by oil tanker spill and offshore drilling

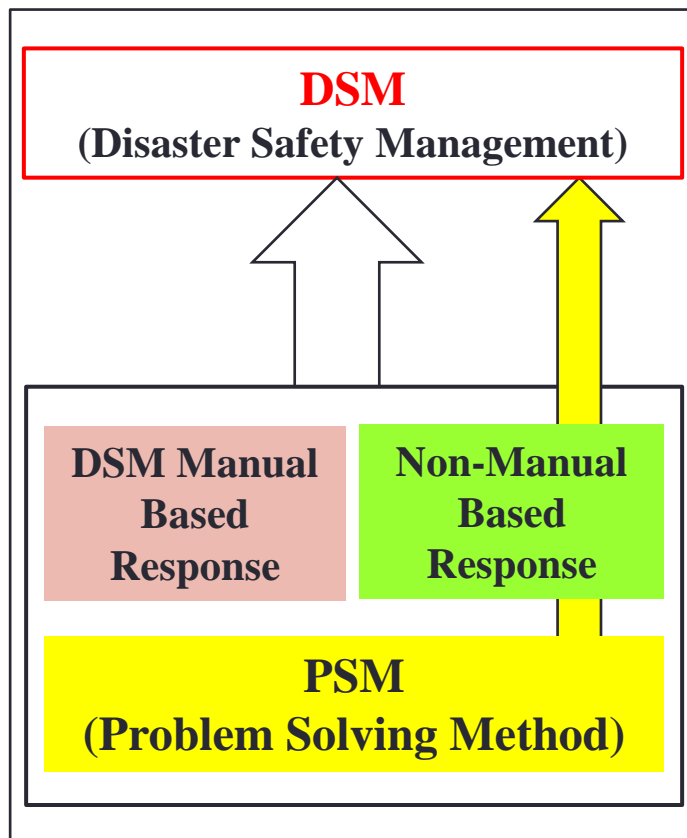
7. Education & Training by TRIZ based Curriculum

Design Stages of Curriculums



7. Education & Training by TRIZ based Curriculum

D0A7-F029 : Problem Solving Method for Disaster Safety Mgmt.



No	1 st Day	2 nd Day
1	<ul style="list-style-type: none"> Disaster Safety Management and Strategy 	<ul style="list-style-type: none"> Strategy and Tactic of Problem Solving Method for DSM
2	<ul style="list-style-type: none"> DSM Manual Based Response & Non-Manual Based Response 	<ul style="list-style-type: none"> Case Study 1 Problem Solving Method for DSM
3	<ul style="list-style-type: none"> Problem Solving Concept, Methodology, & TRIZ 	<ul style="list-style-type: none"> Case Study 2 Problem Solving Method for DSM
4	<ul style="list-style-type: none"> Problem Solving Method for Disaster Safety Management 	<ul style="list-style-type: none"> Evaluation & Discussion of Advanced PSM for DSM

7. Education & Training by TRIZ based Curriculum

Operation Plan of D0A7-F029

✓ *Curriculum Areas*

(Public and Private Sectors of DSM)

- Alternative Dispute Resolution
- Attorney
- Contracting / Acquisition
- Environmental/ Historic Preservation
- Coordinating Officer
- Human Resources
- Public / Individual Assistance
- Logistics
- Long-Term Community Recovery
- National Disaster Recovery Support
- Mitigation
- Planning
- Safety
- Security
- Employee Training, etc.

✓ *Delivery Location*

- CDI

✓ *Selection Criteria*

- Employees, either managerial or staff who must apply TRIZ based Disaster Safety Problem Solving skills in various Critical situations which require analysis
- Planning as well as solving workplace disputes at the lowest level and at the earliest opportunity

✓ *Course Length* 2 days

✓ *CEUs* 3.0

Q&A

Thank You!

for Your Attention

