



**From Technical to Business
Contradiction : An Example of
New Gantry Crane**

2010. 9. 9 (Th.)

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Container Terminal Business



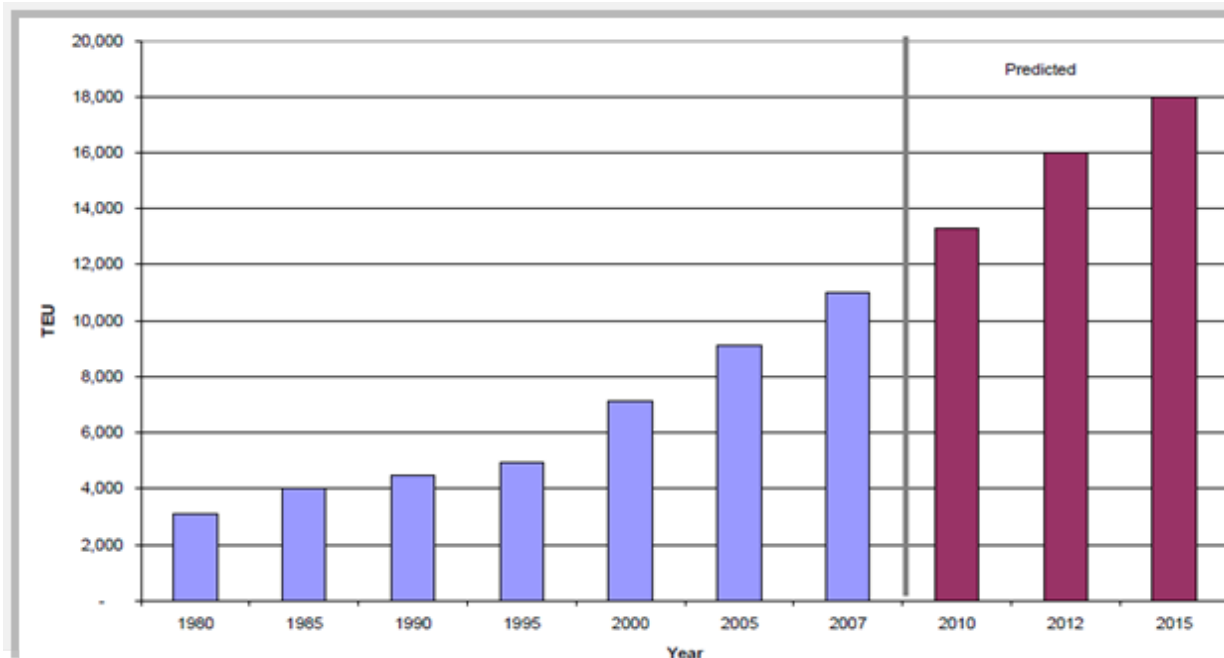
- Competition among terminals in terms of:
 - Service (Ship's turnaround time)
 - Productivity (TEUs per year)
 - * TEU : Twenty-foot equivalent unit (6.1m)
- Ever increasing size of ships
- Increasing time of loading
- Productivity
 - Design to encompass the big ships
 - Terminal running system
 - **Development of the high performance crane**



Increasing size of the container ships

Genera-tion	Capacity (TEU)	Length (m)	Width (m)	Number of decks	Years
1st	< 1700	180	25	<10	1960~1970
2nd	2305	225	29	10 ~ 11	1970~1980
3rd	3220	258	32	11~13	1980~1990
4th	4848	275	39	13~17	1990~2000
5th	8600	294	43	17~24	2000~2006
6th	> 10000	340	>43	> 24	2006~2012

* Panamax -> Post Panamax -> Super Post Panamax



Source :
REGIONAL SHIPPING AND
PORT DEVELOPMENT,
ESCAP, UN, 2007



Limitation of Current Crane

- <http://www.kbct.co.kr/en/content/work/work05.jsp>
- Optimization and acceleration of trolley system is limited by
 - Weight of the container
 - Sway
 - Mechanics and physics
 - Control
 - Pointing
 - Human labor



Development of the High Performance Crane

- Optimization -> % increase of the shipping rate
- Inherently limited by the system
- Radical innovation is needed
- Overcoming psychological inertia



Technical Issues

- Increasing speed of trolley is limited.
- Technical contradiction is derived.
 - To increase productivity -> Decrease in stability
 - To increase stability -> Decrease in productivity
- Physical Contradiction is derived.
 - Increasing speed -> Result in unstability
 - Decreasing speed -> Result in low productivity



Technical Contradiction

- Technical parameters
 - 39 : Productivity vs 33 : Convenience of use
- Solutions
 - 19 : Periodic action
 - 1 : Segmentation
 - 7 : Nesting
 - 28 : Mechanics substitution



Physical Contradiction

- Physical parameter
 - Speed
- Solutions : Separation in
 - Time : Periodic action
 - Space : Periodic action



Development of the Idea

- All TRIZ solutions suggest Periodic Action
- Overcoming the psychological inertia was very important.
- The solution concept is already used in Ski Lift.
- Naturally the first idea was to adopt horizontal rotating system.

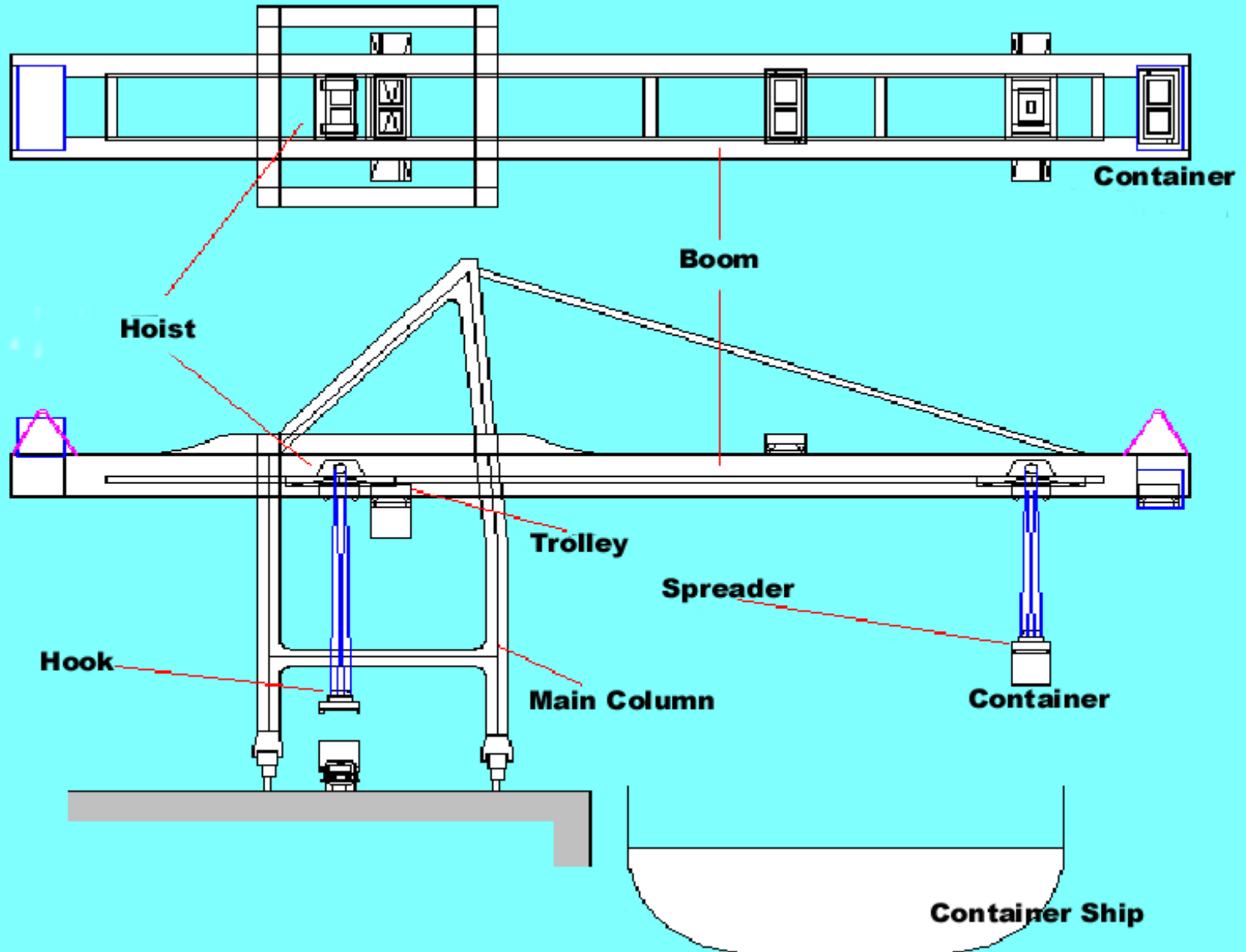


Evolution of the Idea

- Horizontally rotating system was not efficient, even though this idea appeared as the natural extension of existing system.
- Engineering analysis showed vertically rotating system was more efficient.



Technotainer





Performance

Performance: 100 van/hr

Rated Load : 40 ~ 50 ton

Spreader Size : 20 - 40 - 45 ft

Speed :

Hoist 80 m/min

(empty) 170 “

Trolley 180 “

Gantry 45 “

Boom Hoist 5 min

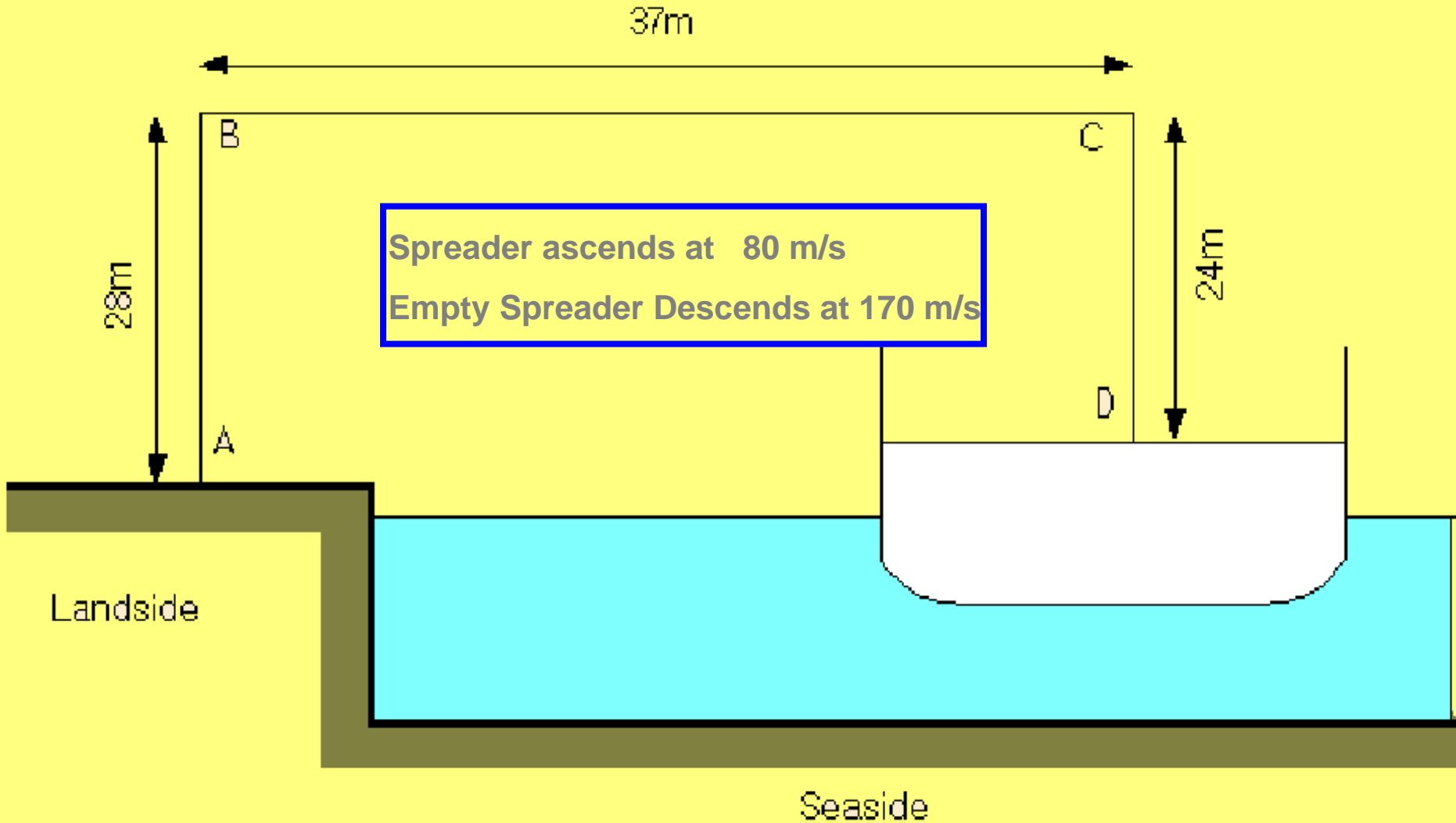


Features

- No-sway
- No-Pointing Time
- Semi-automatic Operation(2 Operators)
- 2 Hoist, 2 Hook, 5 Trolley, 5 Spreader & 2 Elevator
- Weight Measurement
- Communications System
- Maintenance Equipment
- Shore Power or Self-contained Diesel Power
- Man lift
- Emergency Braking System
- Storm Gantry Brakes

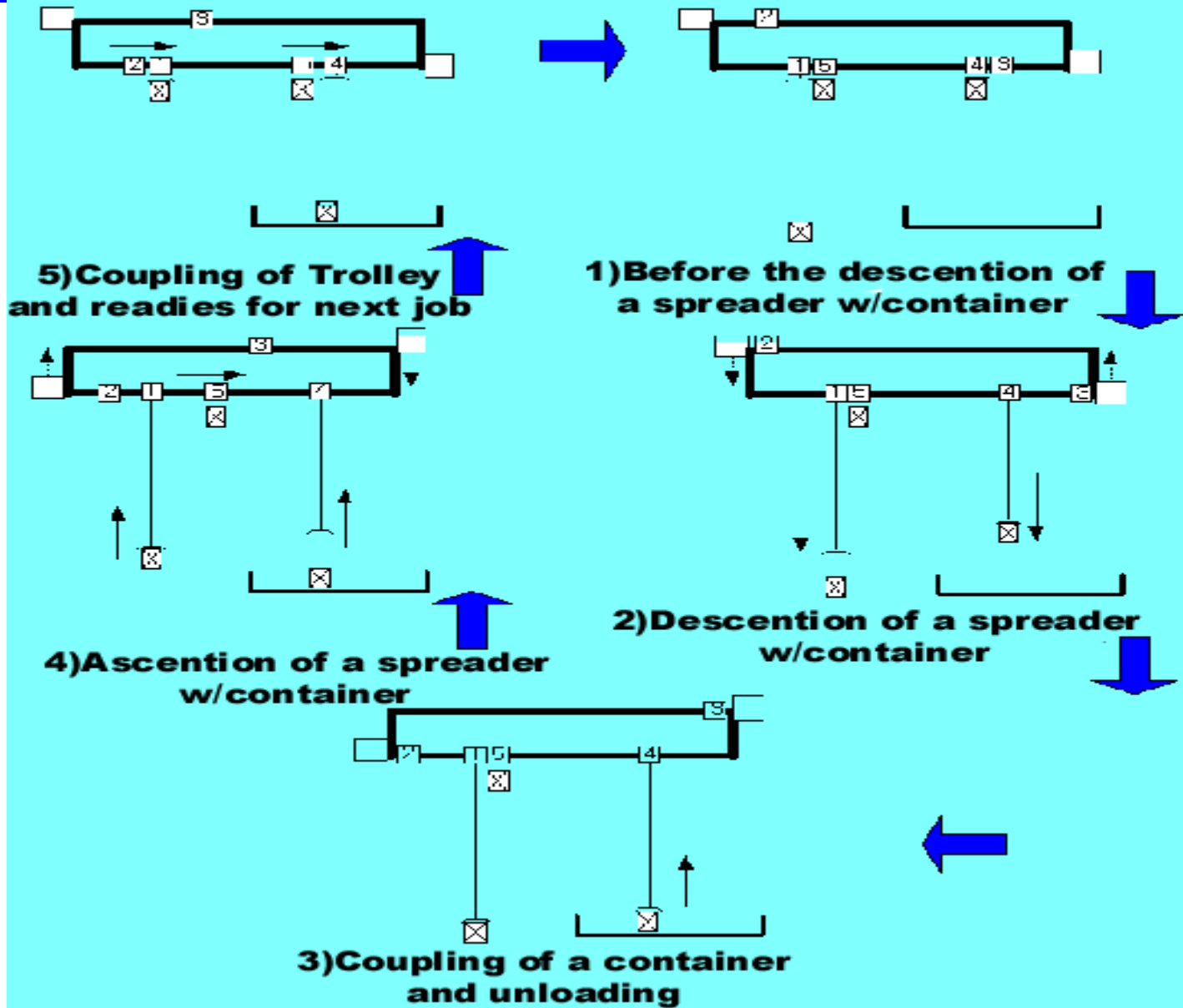


Model for Time Analysis (Pusan Port)





Technotainer Operation Cycle



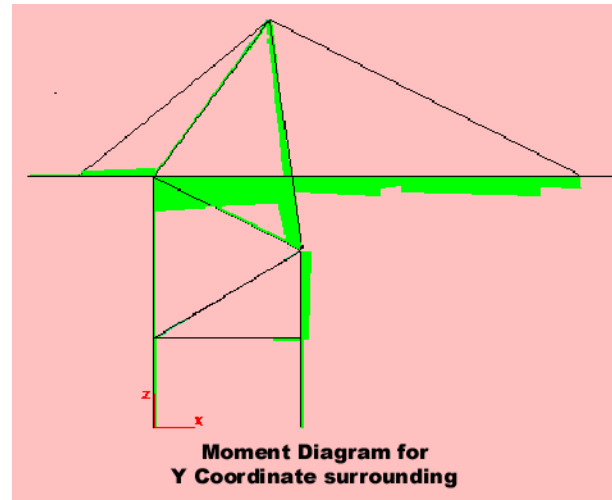
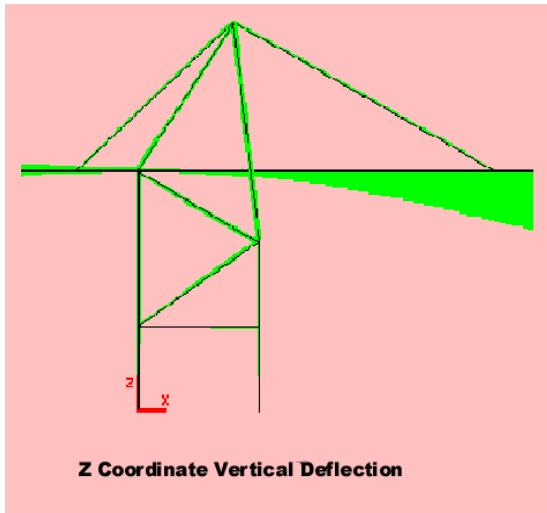


- ✓ The critical path of the crane is descending and ascending time at the land side.
- ✓ 1 Cycle Time = $2 + 11 + 20 + 3 = \underline{36 \text{ sec}}$
- ✓ Per Hour Performance = $60 \times 60 / 36 = \underline{100 \text{ van/hr}}$
- ✓ Performs 3 times faster than the ordinary crane

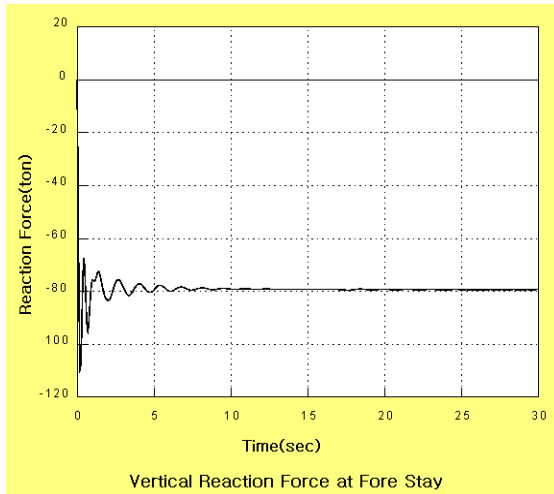


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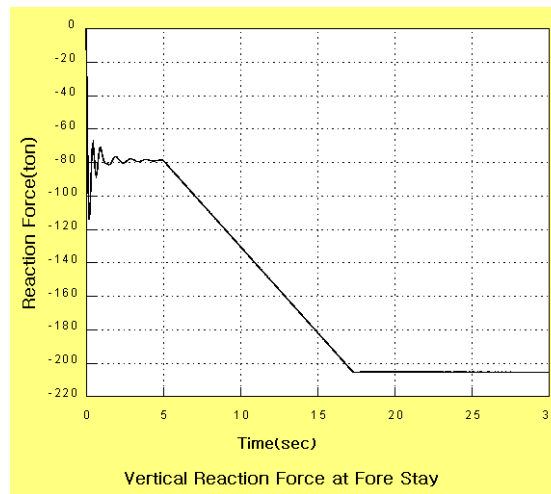
Engineering Analysis



- Structural Analysis
- Durability Analysis
- ABAQUS is used



In position with container



In motion with container

- Dynamic Analysis
- DADS is used



Technotainer

Features

- **Semi-automatic Operation**
(One operator each on ground and on deck)
- Reduction of moving weight and **energy efficient**
- **Maximize the performance** with 5 sets of trolley/spreader
- **Continuous operation** by using 4 tracks simultaneously.
- **Simplified track change** with elevators

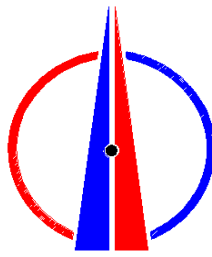


Technotainer Advantages

- Elimination of Sway problem
- Elimination of Pointing Time
- Real-time performance is 4 times faster than ordinary crane.
- Reduced Boom height up to 6 – 8 meter
- Easy conversion to crane automation
- Easy integration with high speed container terminal system



Summary (Technical Part)



CreaTech

- **Relatively low price considering its high performance**
- **Saving time of loading & unloading**
- **Improving the efficiency of yard utilization**
- **Faster return on investment**
- **Enhancing the competitiveness of the port**
- **Low maintenance and labor costs**
- **Easy conversion to full automation**



Next : Business story

- This technology was patented.
- A venture company was set up.
- Newspaper cover up.
- Funding was successful.
- R&D and business went together.
- So far, Good and Technical part.
- Next is Bad and Business story.



Stake holders

- Container terminal authority
 - Shipping company
 - Port labor union
 - Investor
 - Government
 - Crane builder – Big heavyweight manufacturer
-
- Crane Designer as a small venture company



Business Contradiction

- Customer wants a proven system.
- Without order(fund), we can not show real product.
- Contradiction :

To get an order, we should have a 'real working system'.

To build a 'real working system', we should have an order.



Real Cause of the Problem

- The subject is huge and expensive.
- This fact override any reasoning and solutions.
- Nobody wants to take the risk.



Possible solutions

- Proving the system.
 - CAD model : Fancy CAD simulation was not still enough to persuade.
 - Lego : Lego was considered, but ...
 - 1/n scaled down model : 1/10 model is still expensive.
 - Modification of existing system : Shutting down and extra expenses.
 - Full system (with our fund) : We are not ready.
 - Insurance : Not successful yet.
- Principle 27 in 40 principles is adopted : “Cheap objects”



Real problem

- For this business problem, we couldn't model our problem.
- Main cause and parameter is 'Size'.
- Can not find Systematic Approach.
- Too many stakeholders make situation more complex.
- We've got good and enthusiastic responses, but no order in reality.



Strategic Suggestions

- Coalition with big manufacturer
 - Several ruptured talks with companies in Korea, China
- Selling the patents and company
 - Tried but not accomplished
 - Newly emerging technology



Current situation

- R&D on technology is on-going.
- As the 'Vertically rotating' concept is so good, combination with other emerging technology would bring more productivity.



Elevating Girder Crane
(ZPMC)



Twin twenty
(Konecrane)



Twin forty
(ZPMC)



Conclusion as a TRIZNIK

- It is painful that we couldn't find practical answers from 'Business TRIZ' problem.
- We wonder 'the problem of SIZE' is real problem and ubiquitous for any new ideas with same condition.
- We humbly wait for any advices from TRIZ concept and want to stimulate serious study on the methodology.
- Sorry that we present not full solutions but problems.



Thanks for your attention and advices.

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82-11-9961-5235

This research was financially supported by the Ministry of Knowledge Economy (MKE), Korea and Korea Industrial Technology Foundation (KOTEF) through the Human Resource Training Project for Strategic Technology.