

Mahesh Kulal



ABB Crane Systems

How to maximize
productivity per quay
crane cycle



**How to maximize productivity
per quay crane cycle**

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**How to minimize the number of
STS cranes**



How to maximize productivity per quay crane cycle

Increase number of TEU per move

Twin 40 - 4x20 - double hoist

and/or

Reduce average cycle time



How to maximize productivity per quay crane cycle

Increase installed power

and/or

**Automate the crane to utilize
the available power and
reach optimum performance**



Optimum STS crane performance - Definition

Each crane cycle must be performed as fast or faster than can be achieved by the best crane driver

Optimum STS crane performance

Automatic operation with:

- Short and safe load path
- Fast approach to target
- Elimination of fine positioning
- Automatic landing
- Easy operation
- Smooth operation
- Full utilization of installed powers

Supported by good driver training

What technology and functionality is needed?



Experience - ABB unmanned stacking cranes



Hamburg



Kaohsiung



Singapore



Singapore



Tokyo

Optimum STS crane performance

- **The ABB standardized RMG automation package is based on accurate and fast measurement of:**
 - load position
 - target position
 - obstacle positions
- **The same concept is now used for STS cranes**

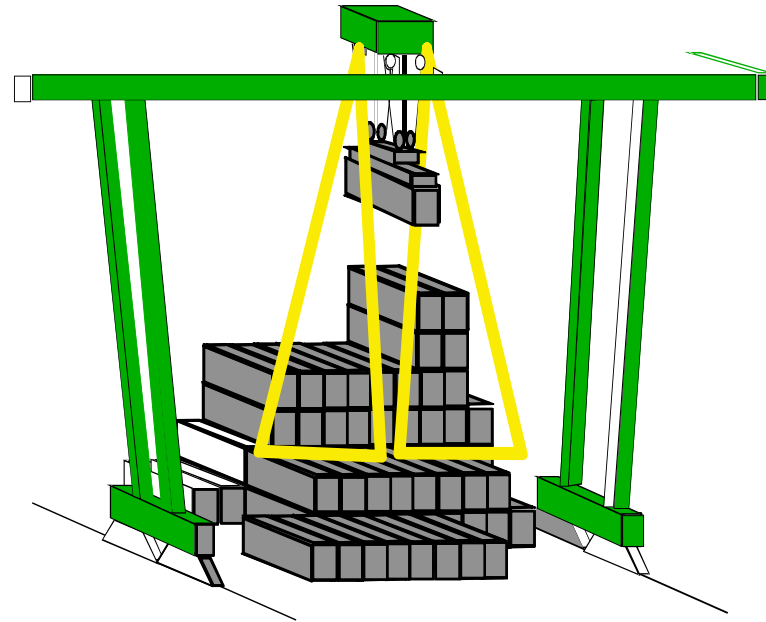
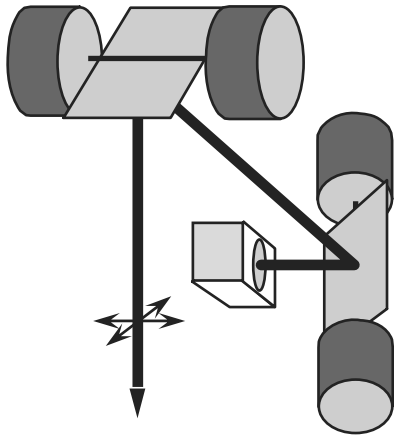
LPS - Load Position Sensor



- One transmitters + one receiver - easy installation
- Load position in trolley and gantry directions and skew angle
- Accuracy better than +/-1 mm at 50 m distance



TPS - Target Position Sensor



- Measure the distance to any object with centimeter accuracy
- Range >50 meters enables “safe” mounting on the trolley

TPS - Target Position Sensor

- **Functions**

- Edge detection
- Surveillance
- Accurate profiling
- Can handle all targets
- Can handle all weather conditions



- **Applications**

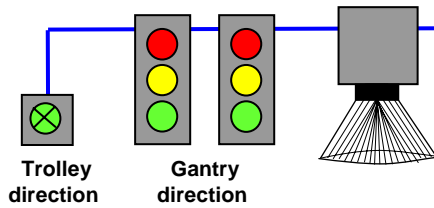
- Stack position measurement
- Anti collision (stack, vehicles)
- Ship profile scanning
- Vehicle position measurement (AGV, truck, chassis)



STS Crane Automation

Chassis Alignment System

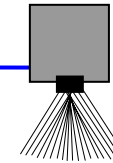
or
Eagle View



Crane Controller



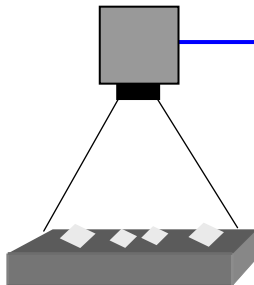
3D Ship Profiling



Skew Control



Electronic Load Control



STS Crane Automation

- **Short and safe load path**
 - 3D Ship profiling
 - Optimum Path control
- **Fast approach to target**
 - Electronic Load Control
 - Skew Control
- **Elimination of fine positioning**
 - Chassis alignment
 - Straddle carrier positioning
 - 3D ship profiling

Short and safe load path

Profile measurement

- Continuous measurement actual load profile
 - Simple set up of operation
 - Safe operation

Load path calculation

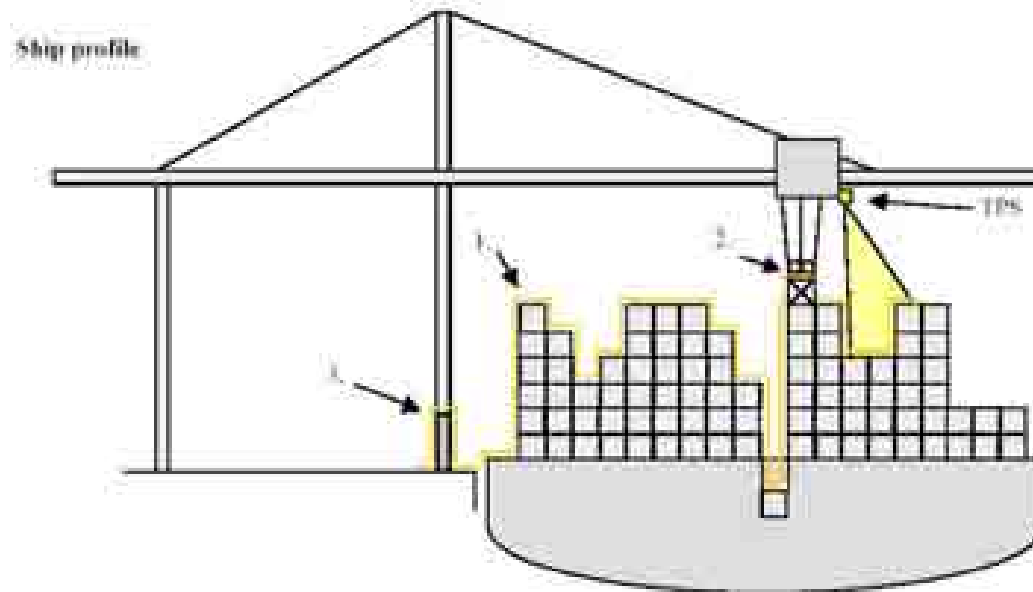
- Consistent margins to obstacles for all kind of cycles
 - shortest cycle time
 - no risk for collisions even in case of failures
- Based on optimum sway control/positioning performance



3D Ship Profiling with TPS sensor

Measurement of

- Height of each stack above/below deck for "Smart slow down"
- Ship profile for full width of 45 foot bay for input to path control
- Continuous anti collision supervision during operation



Optimum Path Control



Fast approach to target

Requirement

Target position should be known with relatively good accuracy early in the cycle and the accuracy should be improved coming close to the target



Fast approach to target

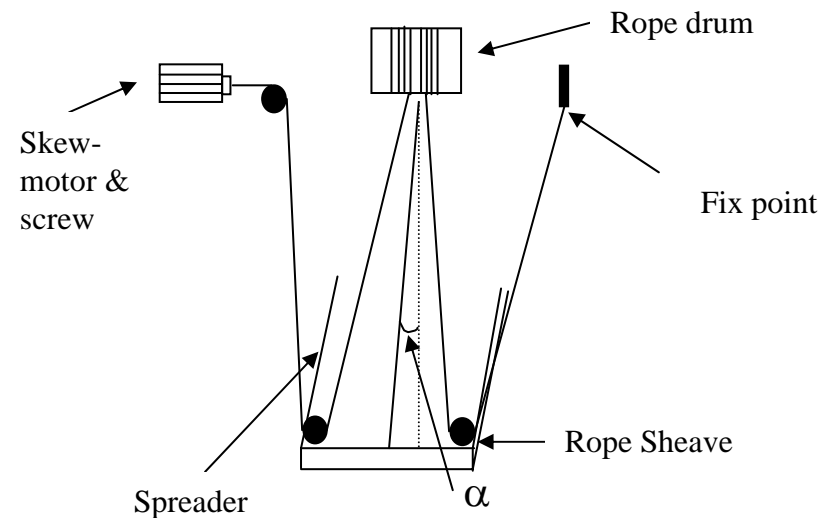
Functions

- Skew control handling any skew motion generated during lift off or by wind during motion.
- Sway and position control continuously optimizing approach based on actual load sway and speed.



Skew Control

- Minimizes skew sway
- Controlled reference change
- Independent of rope length, load, container size etc.



Skew Control



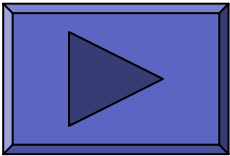
Skew reference can be set to 0 or any angle within the range of the skew motion



Skew Control



Link this one to the s



The skew sway period of a 40 ft container hanging close to the ground is about 20s!



Elimination of fine positioning

▪ Method

- Accurate measurement of target position in trolley, gantry and skew direction
- Position values are fed to load position control including skew control early enough to enable for the control to aim directly at the right target

▪ Target measurement & alignment

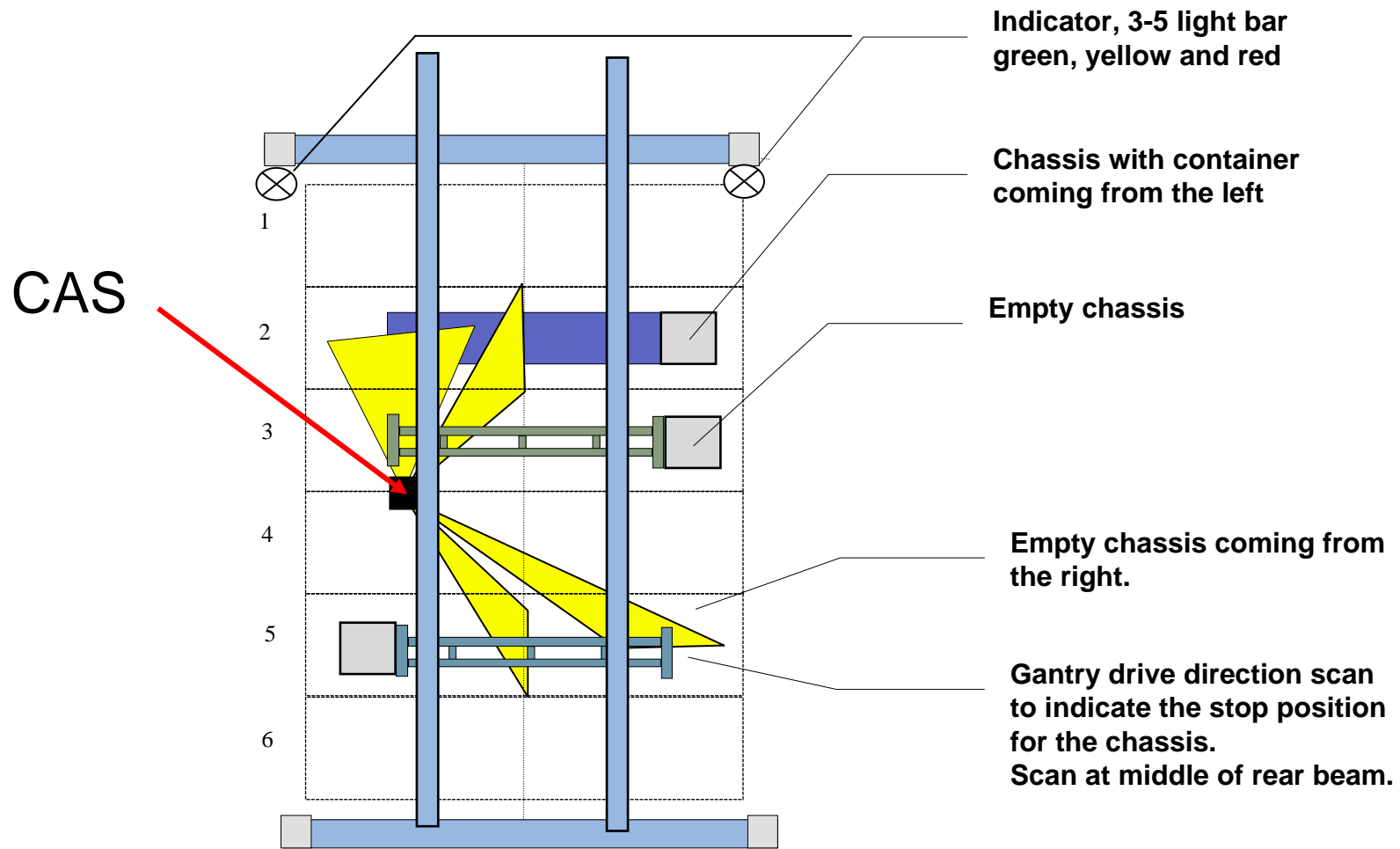
- Chassis alignment system
- Straddle carrier positioning (EagleView)
- 3D ship profiling

CAS - Chassis Alignment System

- Positions chassis in gantry direction
- Target correction in trolley and skew direction



CAS - Chassis Alignment System



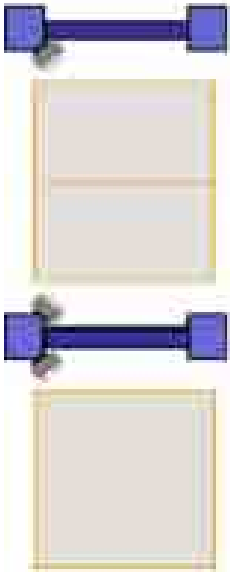
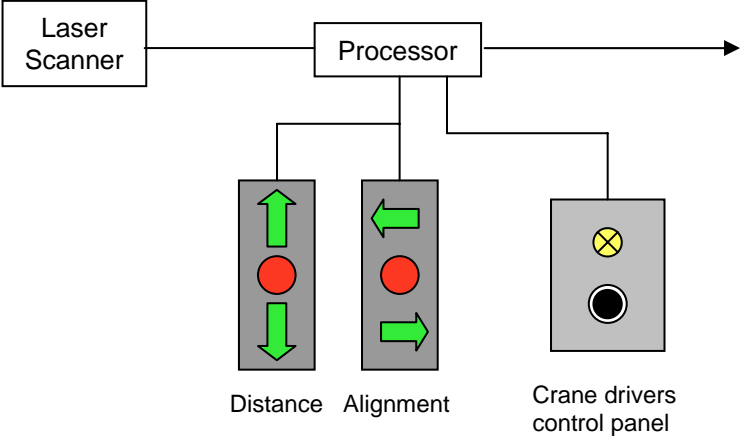
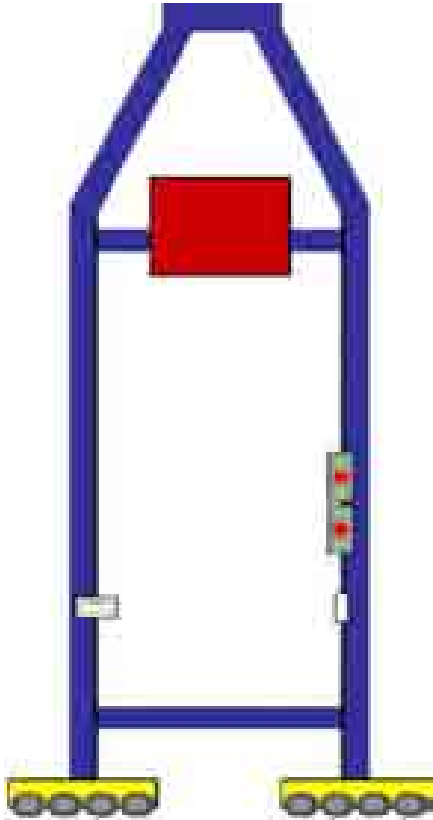
EagleView

Laser guided straddle carrier positioning for STS cranes

- Fast and accurate container positioning with SC
- Low maintenance costs of lane lines
- A collision warning system between SC and crane
- Safer environment for the SC drivers



EagleView - Guidance for straddle carriers



Automatic landing

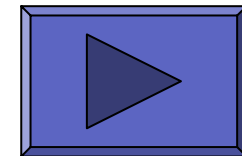
Functions

- Automatic landing in unmanned area
- Automatic landing in manned area with manual supervision.

Benefits

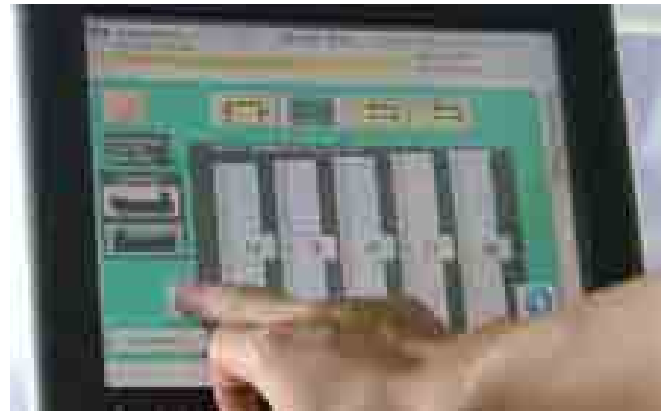
- No transfer between manual and automatic operation
- Maximum performance
- Smooth operation
- No damage

Link this one to the acas movie



Easy operation

Simple set up and job selection by touch screen



Interfacing with Terminal Operating System

- Job orders and confirmations are exchanged between TOS and the cranes
- Set up procedure can be almost eliminated



Smooth operation - low maintenance

Requirements

- Reduce damage on containers
- Reduce maintenance of spreaders and crane equipment in order to reduce crane down time and maintenance cost

Functions

- Automatic landing
 - soft landing with defined speed for last centimeters
 - accurate positioning, no need to lean against objects
- Anti collision supervision



Full utilization of installed power

Methods

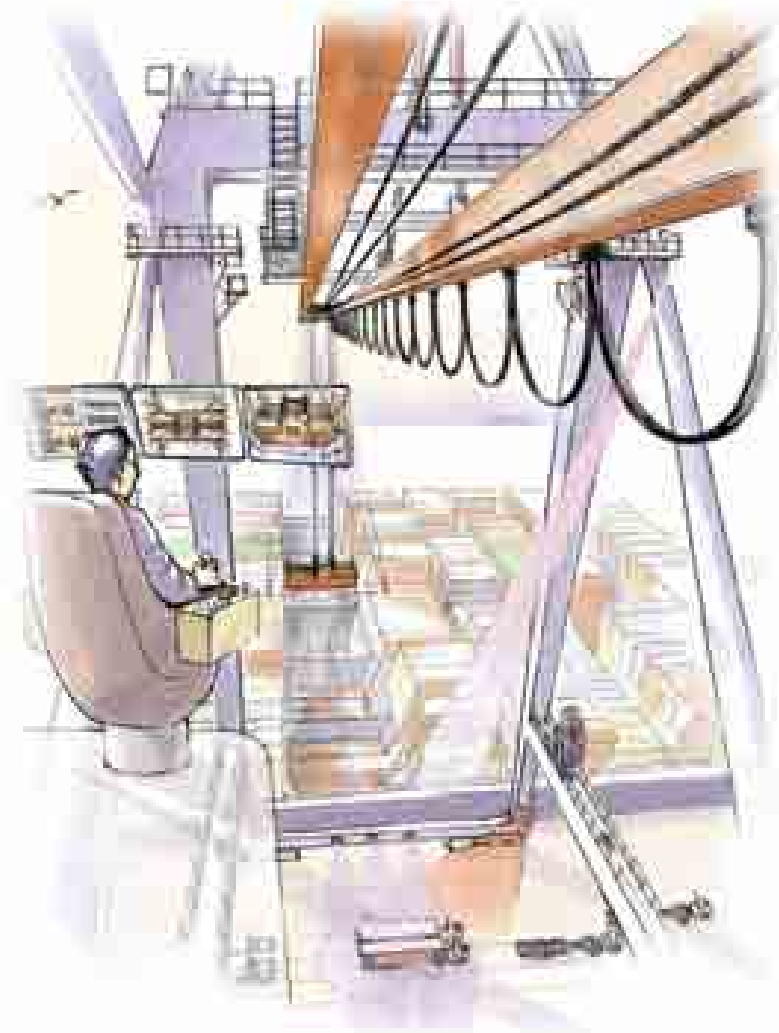
- **Optimization**
 - Optimization of drive tuning for automatic and manual operation
- **Fixed cabin on crane leg**

Fixed cabin



Fixed Cabin

- Increased productivity
- Improved driver visibility
- Improved driver ergonomics
- Less noise for the driver
- Easier and safer change of drivers



Fixed Cabin

- A fixed cabin is mounted on the crane structure
- 2 monitors display video images
- Cameras under the trolley provide a better view than from a cabin on the trolley
- Gantry observation cameras ensure safe operation
- Camera control via AC800 Crane Controller



Fixed Cabin – Improved working environment

- No motion sickness, no need to buckle up and less physical strain
- Better ergonomics for neck and shoulders thanks to video monitors and a forward view
- Low sound level eliminates the risk of impaired hearing and is less tiring for the driver
- No need to bend forward to see if truck is present



Fixed Cabin – Increased productivity

- Enables the use of
 - Shorter trolley ramp times
 - Higher trolley speed
 - Optimum tuned ELC with sway and position controlsince no consideration is needed for the driver feeling dizzy
- No driver's cabin on trolley
 - Reduced weight on the trolley
 - Reduces motor and drive sizes (or improved performance)
 - Reduced energy consumption and running costs
- Fixed cabin together with ABB's crane automation solutions provide optimum travel path and a high and constant production rate

Good driver training

Target

The crane drivers should be trained to

- Utilize the full functionality of the crane
- Reach the optimum productivity
- Operate safely

Training simulator

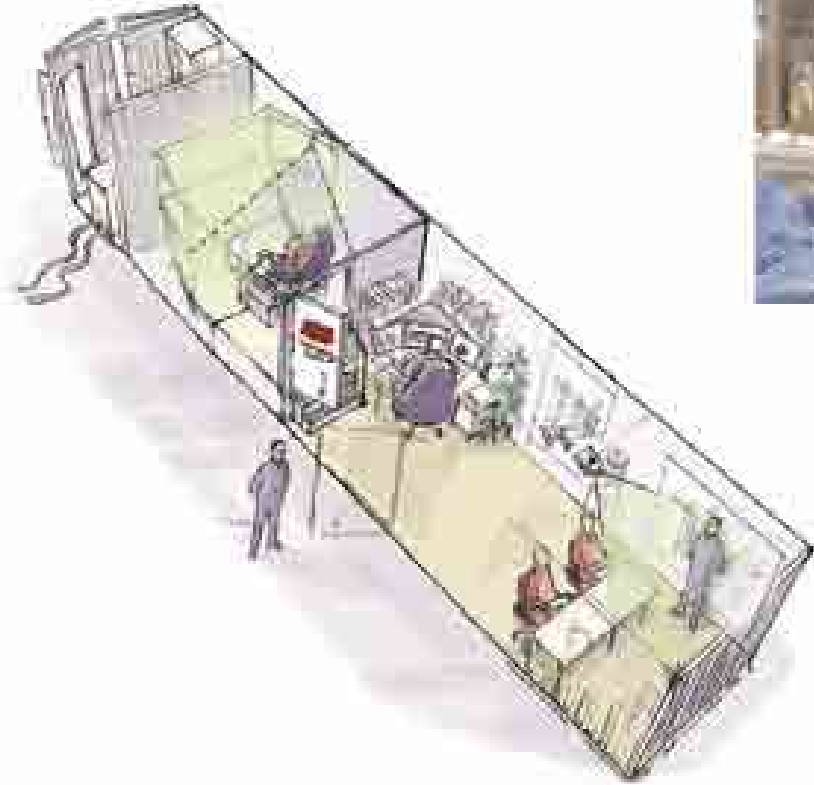


Training simulators with the same crane control system and functions as the crane, with:

- Training scenarios for manual and automatic operation
- Assessment of productivity for manual/automatic operation



Containerized training simulator





Power and productivity
for a better world™