



Automation in Ports: Implications for Security

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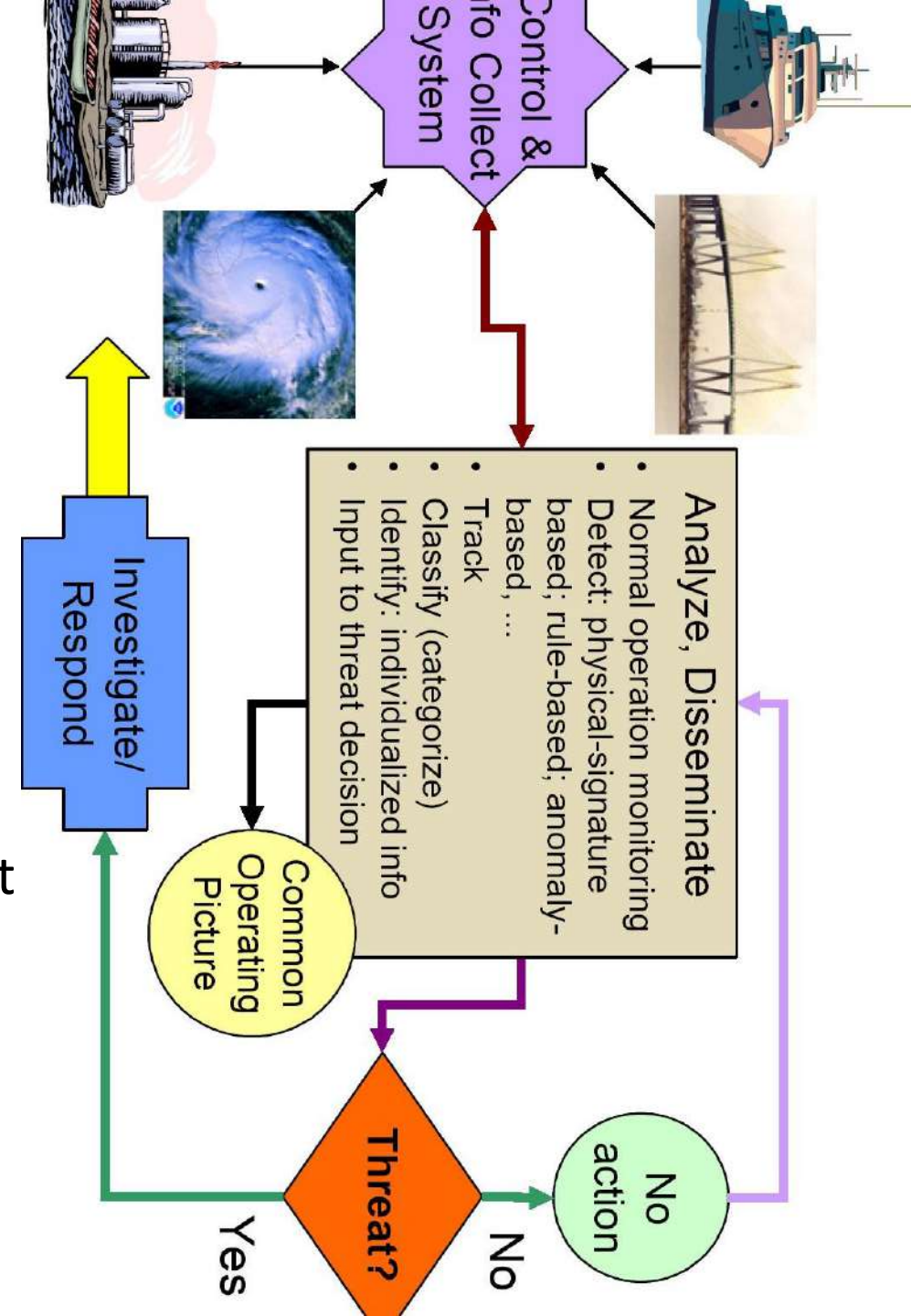
Background



- Industrial automation consists of the use of mechanic, hydraulic, pneumatic, electric, electronic and computerized elements or systems to control equipment and processes, thereby reducing the involvement of humans in such activities.
- It makes it possible to reduce human intervention in industrial activities, allowing for a higher control of the equipment and processes involved. This results in
 - the standardization of performance and service levels,
 - the elimination of uncertainty in response times
 - the reduction in operational costs and human errors. In the 23 years since the opening of the very first automated facility (ECT Delta, Rotterdam, 1993), some 35 automated terminals have been launched around the world. **
- In the port domain the greatest proponents of automation are Port Container Terminals

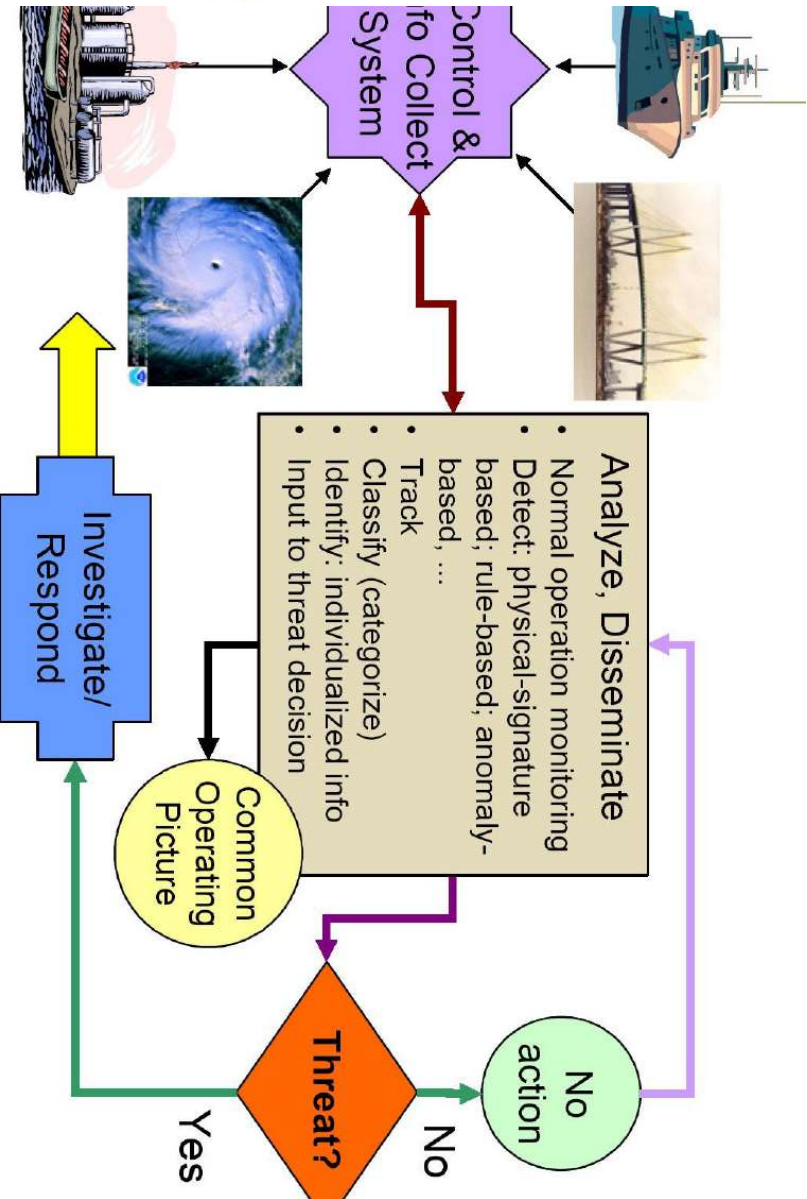
Security Vulnerabilities & Challenges

- Large volume of container movements, relatively high velocity in the international trading system and their uniformity.
- The system is porous; can be relatively easily subverted from legitimate commercial purposes.
- Criminals use containers for smuggling of drugs and contraband goods – need to reduce direct human contact
- Seaports and container staging areas prone to containerized cargo theft.



Security Vulnerabilities & Challenges

- Port container crime is often accompanied by some form of internal conspiracy :
 - Criminals are assisted by individuals legitimately employed in seaports or in the transport industry.
 - These conspiracies enable thieves to correctly identify and target containers carrying high-value goods.



What is Port Automation

Use of integrated technology to develop intelligent solutions for efficient control of traffic and trade flows on the port.

Machines do not require human intervention; software present in all work processes.

SMART PORTS - reduction or elimination of manual processes requiring human interference.

Why Automate?



<https://www.shmgroup.com/blog/everything-need-know-port-automation/>

- The expansion of global communications facilitated the unprecedented globalization of supply chains.
- Port players have also taken on a lot of complexity to accommodate changes in the sector:
 - Port calls had become clunkier,
 - customers have different requirements for different sailings of the same service, and
 - the entire process of managing chassis and equipment gets far more complicated.
- Authorities, operators, service providers, third-party logistics companies, and forwarders—doing more and more to improve the end-to-end supply chain.
- Commercial excellence
- Economics
- Security

Why Automate?

Save Time

Process is optimized saving up to 30% of time spent in ship management.

Save Resources

Time saved –resources saved – e.g. Labour costs

Stability of Processes

Container movement stable predictable and highly efficient
Eliminating manual delays and ensuring safety.

Improved Productivity and Accuracy

Precise control and optimized operation has increased terminal capacity, container traceability and productivity. Manual errors reduced/ eliminated.



Automation on the Ports

Port container terminals (PCTs) have certain features that confer on them the ability to reach a much higher level of systematization than other types of freight terminals such as:

- The standardization of the means of transport – containers:
 - Material unloading and cargo handling equipment
- The standardization of the manner in which freight is handled
 - Digitization of ship records
- The high level of interchanges taking place
 - Inventory management
- The high impact of technology on the profitability of terminals
 - Assisting ship docking and maintenance, and more.

Levels of Port Automation

The principal areas of port automation :

- The gates:
 - Automating entry/exit logs, verification, and docking payments makes the entire process flow much smoother and well-organized.
- The ship-to-shore cranes
 - Automated cranes(controlled by a computer) are used to deliver the containers from the ships to the port by means of unmanned horizontal transportation or unmanned yard cranes.



Levels of Port Automation

- The principal areas of port automation :
 - Automated Stacking Cranes
 - Cargo handlers and stacking cranes are used to stack the containers as per the category specified and managed by the date of departure inland
 - Processes
 - Technological advances make it increasingly possible in real time to dynamically integrate pricing, schedules, bookings, shipment visibility with customers, carriers and marketplaces. (Port Community System (PCS))



Challenges to Automation on the Ports

High Capital Investment Costs

The initial investment cost of automation is extremely high. These costs are not affordable for every port, especially in the under-developed and developing nations.

Pushback from Labour Unions

Automation eliminates the human factor involved in the process. This results in the loss of employment of many workers.

Cyber Security Risks

Cyber security is a growing threat for mega-ports with complete or almost-complete automation.

High Maintenance Costs

Automated systems need to be updated at regular intervals, to keep up with advancements in the software used.

Security & Safety Implications

Areas of Concern	Issues
<p>Security and Safety</p>	<ul style="list-style-type: none"> • Incorporation of security systems - Interaction of many systems, integration loopholes • The quality of arriving containers and/or twist locks cannot be guaranteed • It may be impossible to automatically identify containers due to illegible ID numbers • A truck/chassis appears to be different than expected • Loading sequence is disrupted – due to vehicle break-down, wrong container weights • Stowing groups are filled different than planned due to new information • Truck drivers and or operators may not behave as expected and disrupt the automated process

Security & Safety Implications

Areas of Concern

Issues

Operational Performance

- New scenarios must be previously planned
- More difficulty to react when exceptions occur – Exceptions management
- Lack of information and incorrect or untimely information
- Loss of flexibility in operational planning
- High maintenance requirements of equipment
- The probability of making errors
- Possibility of experiencing demand peaks
- Efficiency of Waterside and Landside Transport
- Equipment breakdowns.

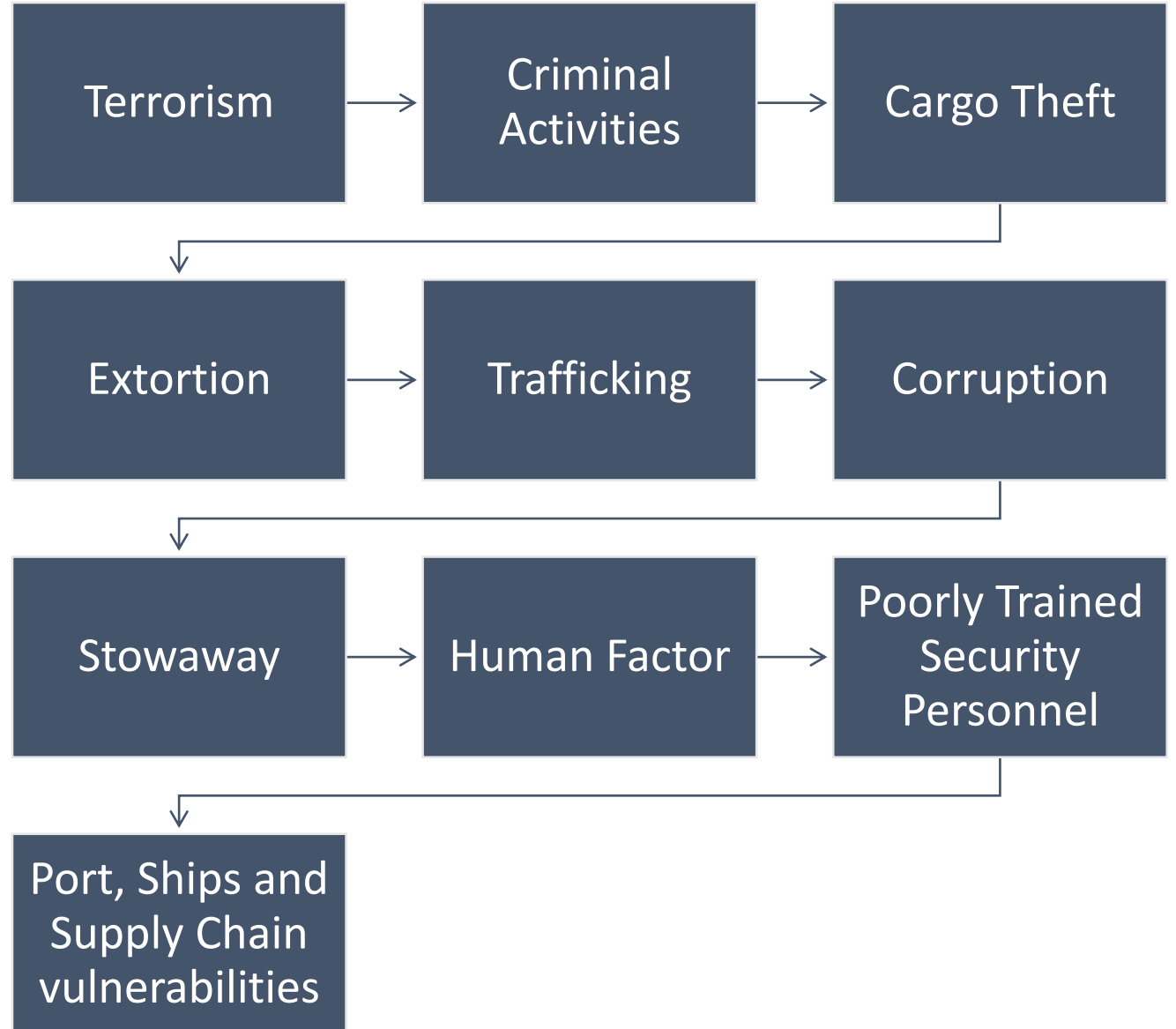
Use of IT, Cyber

- Systems and processes – Terminal Operating Systems (TOS)
- Confidentiality through data encryption throughout the Channel
- Integrity of information
- Lack of Oversight
- Cyber attacks

Security & Safety Implications

Areas of Concern	Issues
Social Responsibility	<ul style="list-style-type: none">• May generate labour conflicts (loss of job positions) – Disenfranchised individuals may want to cause disruption
Economic and Financial Profitability	<ul style="list-style-type: none">• Require a (higher) capital outlay• The port sector is traditional and reluctant to risk, which translates into resistance when facing investments in innovation• Trade unions are especially powerful in ports, meaning that automation can only be introduced after reaching agreements with them or when job positions are not at risk.

Implication of Automation on Traditional Threats:



Focus: Cyber Security Considerations

- Cyber security is a growing threat for mega-ports with complete or almost-complete automation. Despite having secure information sharing methods, automated systems are susceptible to malware attacks and loss of sensitive data. A breach in security can result in great losses for the port and is hence a problem with port automation.
- Cyber security risks must be managed. Automated systems need to be updated at regular intervals, to keep up with advancements in the software used. Ignoring updates can result in fatal security breaches, which is why all systems need to be upgraded.



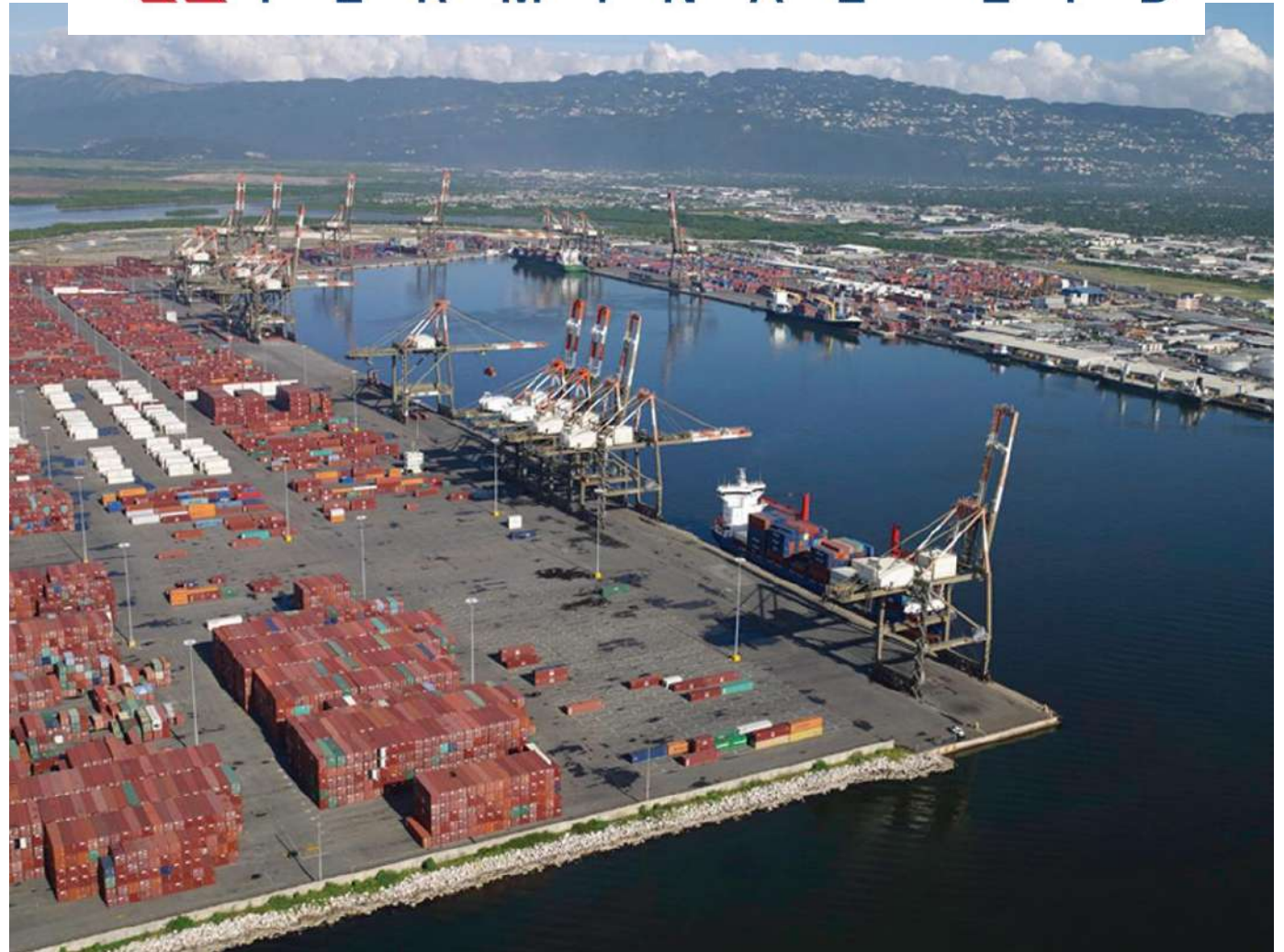
CASE STUDY – JAMAICA



The Kingston Container Terminal began in 1975, in response to the growth in the use of containers as a means of transporting cargo.

The Terminal was developed to be used primarily as a transshipment hub offering shipping lines a stronghold from which they could base and expand their business in the Caribbean region, en-route from the Panama Canal to the US East Coast.

KINGSTON FREEPORT T E R M I N A L L T D





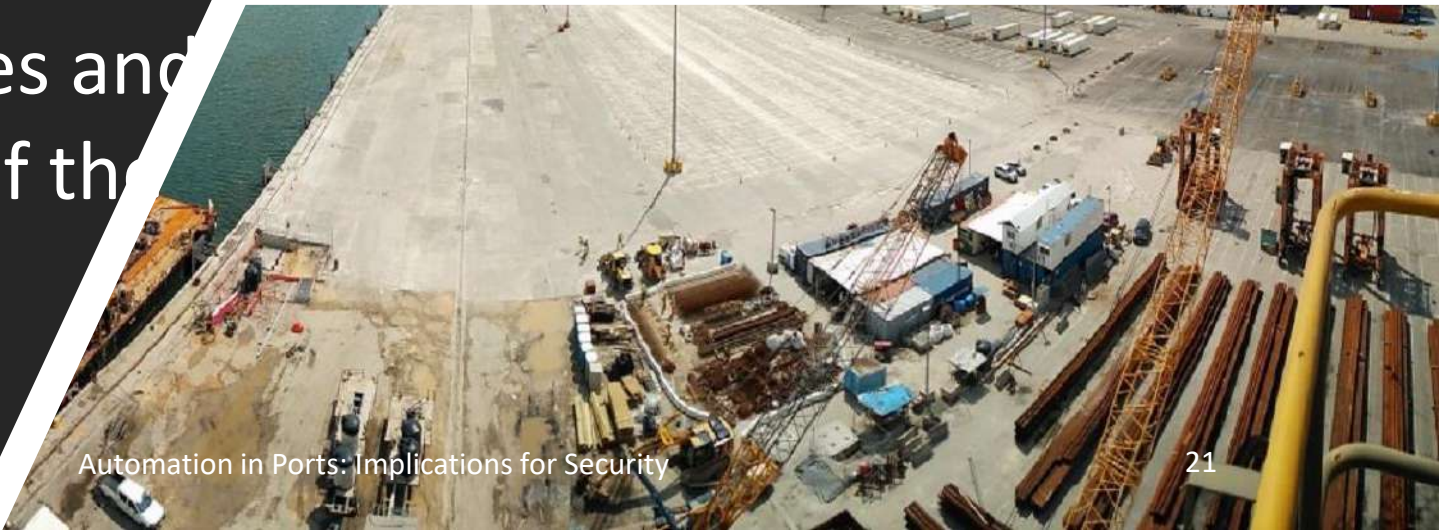
 **KINGSTON FREEPORT**
T E R M I N A L L T D

- In 1997 the rated throughput capacity of the Terminal was increased to 1.2 million TEUS. 2009 saw a further expansion of the Terminal, bringing the infrastructure capacity to 2.8 million TEU.
- In April 2015, the Government of Jamaica granted a 30-year Concession to Kingston Freeport Terminal Limited (KFTL), to develop, maintain and operate the Terminal.
- On July 1, 2016, KFTL assumed control of the Terminal.

Kingston Freeport Terminal Limited Development

This involved the following:

- Dredging of the access channel, turning and shipping basin,
- Expansion and improvement of the infrastructure,
- Upgrading of the ICT facilities and
- Acquisition and upgrading of the operating equipment.



Current Status

- Terminal Operating System – NAVIS 4
- Managing of container movement



Security Challenges - KCT

Manual Systems

Autonomous
Straddle Operators

Internal
Conspiracies

Container theft
and contamination

Mitigating Security Issues at KFTL

- Upgrading of the information and communication technology infrastructure through the implementation of high-speed fibre optic and Wi-Fi systems,
 - New state of the art Terminal Operating System (TOS) will provide an optimized container terminal environment with real-time redundant communication from ship to shore.
 - Changes in vessel operations or yard planning will be instantaneous and secure.

Container Positioning and Container Handling Equipment (CHE) Tracking



- The precise location of any container pick-up/drop off can be determined real-time as a result of CHE positioning being continuously transmitted over the wireless mesh network.
- Automatic cameras and OCR instruments onboard the CHEs will take an image of the container serial number at pick-up and at the drop off destination and the system will correlate that information with the specific CHE location.
- Facilitate detection and rapid response to unauthorized container movement and positioning throughout the terminal.
- This will enable operations and the security department to maintain continuous situational awareness of what is happening in the container yard in real time.

Container Positioning and Container Handling Equipment (CHE) Tracking

- CHE will be equipped with biometric reader devices compatible with the employees' identification card and will be tied to specific assignment and the Access Control System.
- The authorized operator will be able to access his assigned CHE only during the authorized hours of his shift.
- The operator will use his identification card and fingerprint to start the CHE.
- This technology coupled with the automated tracking equipment mentioned in relation to container positioning will increase situational awareness and correct issues relating to improper container moving and positioning throughout the port.

KFTL Automation

System Upgrade

Manual Processes
Reduced

Reduction Security
Incidents



Summary

Technology has been immensely helpful in improving the order and operational productivity of ports. The main driver for the introduction of automation is often to reduce the cost per handled container in the terminal while ensuring a consistent level of productivity and customer service. In enhancing security, it has:

- **Predictability.** Automated systems are designed to work the same way in all circumstances (with some exceptions for platforms driven by machine learning)
- **Reduction of human error.** It's estimated that about 90 percent of cybersecurity breaches are at least partially attributable to human error.
- **Scalability.** Most automated platforms are designed to scale as well; because they function just as efficiently with a few tasks as they do with several thousand

Most importantly from a security perspective it has by removing the manual interference reduced the internal conspiracies and the opportunities for diverting containers

Port 2050

What could shape the port of the future?

TRENDS EMERGING NOW

Physical	Augmentation and Automation	Digital
<ul style="list-style-type: none">• Ports as hubs for wider economic activity – logistics, manufacturing, etc.• Flexible usage of assets• Use of data for real-time utilization• Adaptable buildings / space• Scale port-based value addition• Reactivity• Focused key trade corridors• More & better integrated hub & spoke water borne freight• New modes (e.g. hyper loop)• Strained assets / 'capacity markets'	<ul style="list-style-type: none">• Remotely operated equipment (e.g. cranes)• Autonomous operations (e.g. container yards)• Operators as supervisors & technology users	<ul style="list-style-type: none">• Ports as data platforms (e.g. Port Community Systems and advanced inventory systems)• Providing tracking data• Blockchain and 'smart contracts'• Cyber security as a core skill
<ul style="list-style-type: none">• Further applications of enhanced technology developments• An Internet of Things enabled world• New business opportunities – 'Air Traffic Control' for near UK waters; drone operation hubs, human services to enable remote / autonomous operations• Changed roles for human interface	<ul style="list-style-type: none">• Applying Artificial Intelligence, Machine Learning, 'Digital twins' and other advanced analytics for applications such as predictive planning & operations, self diagnosis• Seamless end-to-end data supply chains – data as a service• Large scale blockchain adoption• More dynamic charging in response to demand	

POSSIBLE FUTURE GAME-CHANGERS

THE HUMAN DIMENSION	THE ROLE FOR G...
<p>Challenges but also opportunities</p> <ul style="list-style-type: none">• Safer jobs – Less man / machine interface, height, confined spaces• Different jobs – e.g. high intensity crawling, data services• Skilled jobs – more skilled, new skills• Diversity – increased gender diversity• Opportunities – ports will remain significant sources and...	<p>Create an enabling framework for development and innovation</p> <ul style="list-style-type: none">• Do – provide infrastructure, consistent long-term direction, framework with strategic...• Don't – pick winners...

Questions & Discussions

