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Digitalisation Leadership Bootcamp

Cyber-security in Manufacturing

Dr Diarmuid Ó Briain

Room
10A06

9 July 2024
16:00 – 17:00 hrs

Topics

- What is Operational Technology?
- The Purdue Enterprise Reference Architecture
- NIST SP 800-82 Guide to Operational Technology Security
- ISA/IEC 62443 Securing Industrial Systems
- Network Information Systems 2 (NIS-2)

What is Operational Technology (OT)?

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Information Technology –v– Operational Technology

- **IT**

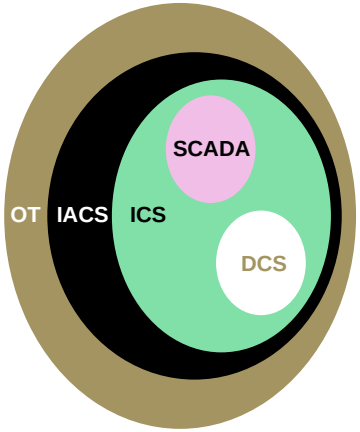
  Any equipment or interconnected system used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by an organisation or by a 3rd party on the organisations behalf.

- **OT**

  Programmable systems or devices that interact with the physical environment, or manage devices that interact with the physical environment. These systems/devices detect or cause a direct change through the monitoring and/or control of devices, processes, and events.

Some OT Terms

- Operational Technology (OT)
- Industrial Automation and Control Systems (IACS)
- Industrial Control Systems (ICS)
- Supervisory Control and Data Acquisition (SCADA)
- Distributed Control System (DCS)



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Exercise #1

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- **What is different about this power station and a typical office environment in terms of computing?**

ESB Aghada, Cork, Ireland

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Exercise #1

- **What is different about this power station and a typical office environment in terms of computing?**
  - Computing interacts with physical processes.
  - There is the potential for physical damage.
  - The size of such facilities and the concerns for operations and security.
  - There is a real risk to human life.
  - Wider implications for society if the station is disrupted.

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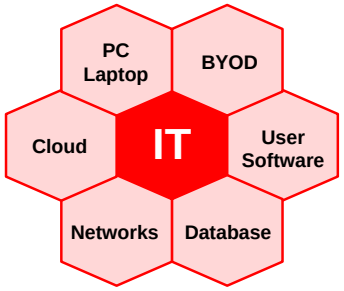
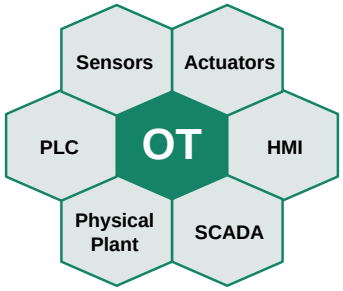
Information Technology -v- Operational Technology





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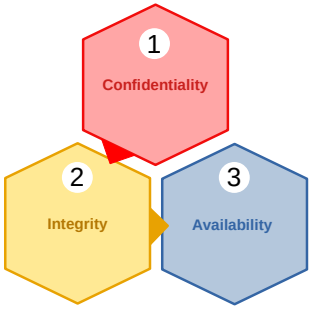
Core Principles IT/OT

IT (CIA Triad)



OT (SAIC)

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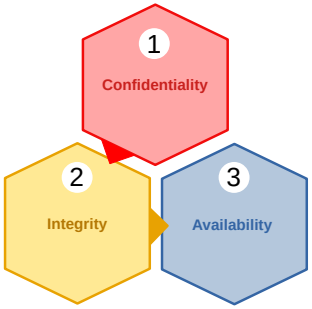
Core Principles IT/OT

IT (CIA Triad)



OT (SAIC)

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Exercise #2

- **A breweries main Production Management Software (PMS), actually running outside of the IACS, in the enterprise network, was affected by malware.**

What are the implications?

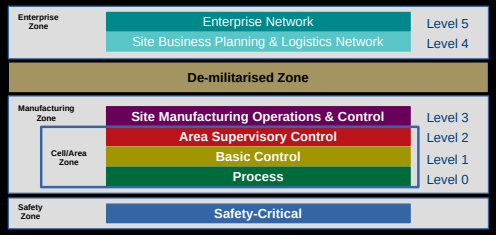
Exercise #2

- **A breweries main Production Management Software (PMS), actually running outside of the IACS, in the enterprise network, was affected by malware.**
  - Because the PMS was down, the production line had to be halted.
  - Because the production line was stopped, no product was coming off the line that could be packed and shipped.
  - The resulting logjam, then also means that goods coming in cannot be unloaded, and production line employees are unable to do their jobs.

Exercise #2

- This is why **Availability** is more important than **Confidentiality** in OT.
- Data is still very important within OT as proprietary knowledge and confidential product information can all be stored and transmitted as part of a OT network.
  - Storage of brewery recipes, process timings, security controls as well as Intellectual Property (IP).

Purdue Enterprise Reference Architecture (PERA)



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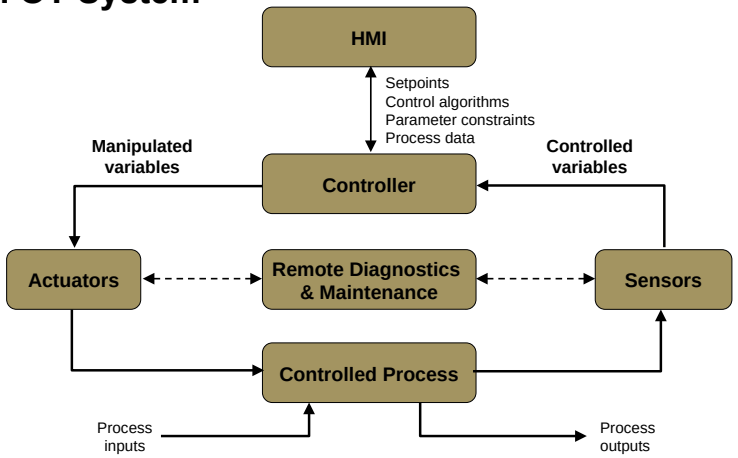
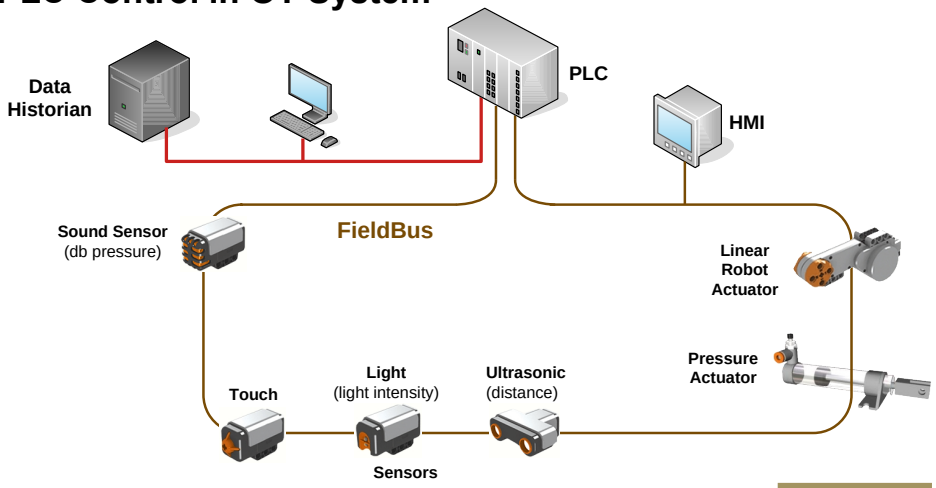
Typical OT System



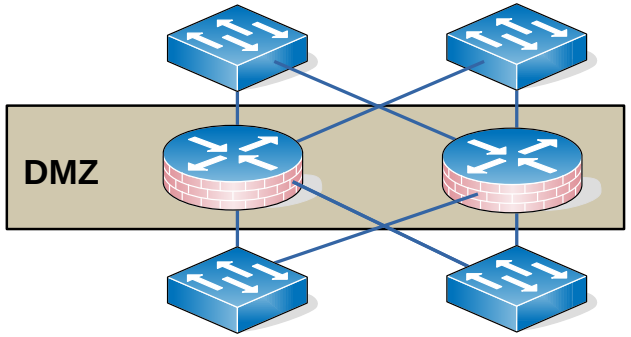
PLC Control in OT System



Functional manufacturing levels

Purdue Model

- **Industrial DMZ** (Level 3.5)
  - This first line of defence in isolating the IACS from IT network.



Data Diode

- **Firewall**
  - Rules based enforced by flexible code.
- **Data Diode**
  - Hardware one-way Ethernet connection between two networks.

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Exercise #3

- **Scenario**: Take a computer parts assembly line:
  - At the end of each line there is packer **robot #1** that takes flat-packed boxes and assembles them, bends the sides, closes the 4 bottom flaps, tapes the base.
  - Another packer **robot #2** packs parts off the assembly line into the boxes and when full allows the box to continue.
  - Packer **robot #3** that inserts the manual and warranty information closes the lid, tapes the lid and affixes the product specification sticker to the box.
  - The box passes on to a sorter robot who places it in a large box along with 99 others until the large box is full, seals it and it is moved to a distribution warehouse.

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Exercise #3

- **Task**: Consider that a software patch was applied to packer **robot #1** that rendered it unworkable.
  - List the consequences that you can foresee for the business, the plant and the employees if this robot is offline for two to three hours as a result.

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Exercise #3

- **Business**
  - Production Slowdown, missed deadlines, production quotas not being met, and potential loss of revenue.
- **Increased Costs**
  - Overtime
  - Expedited Shipping
  - Customer Dissatisfaction
- **Plant**
  - Production Line Inefficiency
  - Inventory Buildup
  - Equipment Wear and Tear
- **Employees**
  - Downtime
  - Frustration and boredom
  - Increased Workload
  - Safety Concerns

The impact can be lessened if there are **mitigation strategies** in place.

NIST SP 800-82 Rev. 3

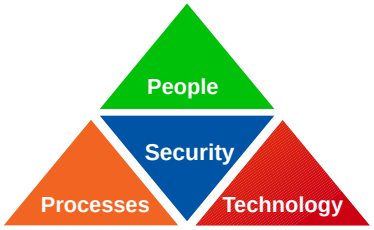
- Guidance on how to secure OT while addressing their unique performance, reliability, and safety requirements
- Identifies common threats and vulnerabilities to OT
- Recommends security countermeasures to mitigate associated risks
- Provides OT-tailored security control overlay that customises controls for the unique characteristics of the OT domain

NIST SP 800-82 Rev. 3

- Establish OTSec governance
- Build and train a cross-functional team to implement an OTSec programme
- Define the OTSec strategy
- Define OT-specific policies and procedures
- Establish a OT specific cybersecurity awareness training programme
- Implement a Risk Management Framework for OT
- Develop a maintenance tracking capability
- Develop an incident response capability
- Develop a recovery and restoration capability

ISA/IEC 62443 Series of Standards

- A series of standards is a comprehensive and internationally recognised framework for securing IACS
- It provides a holistic approach to cybersecurity, addressing all aspects of IACS security throughout their lifecycle, from design and development to operation and maintenance



- **Core Principles**
  - Security by design
  - Security by default
  - Security throughout the lifecycle
  - Security risk management

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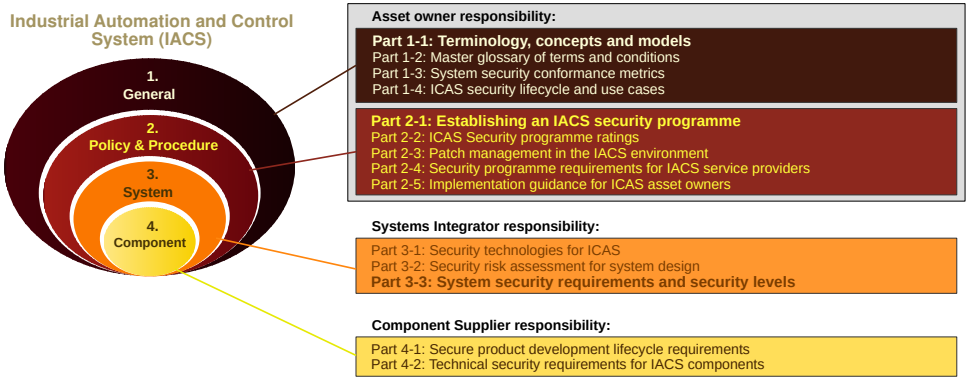
ISA/IEC 62443 Series of Standards



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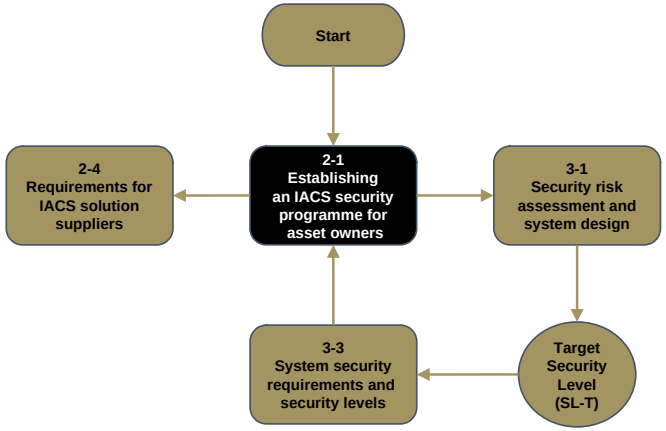
ISA/IEC 62443 Relationship Between Parts



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NIST SP 800-82 || ISA/IEC 62443

Both the ISA/IEC 62443 and NIST SP 800-82 standards aim to improve OTSec;

- **Technical requirements**
  - **SP 800-82** provides a flexible and scalable framework for developing security controls
  - **ISA/IEC 62443** provides a detailed and prescriptive set of security controls
- **Certifications**
  - **SP 800-82** does not provide any specific certifications
  - **ISA/IEC 62443** offers a set of cybersecurity certifications for organisations
- **Flexibility**
  - **SP 800-82** standard is more flexible and can be customised to organisational needs
  - **ISA/IEC 62443** standard is more prescriptive
- **Scope**
  - **SP 800-82** is a broader framework for securing critical infrastructure systems
  - **ISA/IEC 62443** standard is specifically designed for IACS security; ISO 27001 ISMS

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EU and Cybersecurity

- Common market, different OT Cybersecurity approaches.
- Critical National Infrastructure (CNI) risks, an incident in one member state may impact a service in another state.
- Network Information Security (NIS) Directive 2016/1148
  - Common level of security for all member states.
- Network Information Security 2 Directive 2022/2555
  - Broadened the scope of the original directive.
  - Identifies 10 sectors of high criticality and 7 other critical services.

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Essential and Important entities must take appropriate and proportional technical, operational and organisational measures to manage the risks posed to the systems.

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Three main pillars of NIS2

Member State Responsibilities

- National Authorities
- National Strategies
- CVD Frameworks
- Crisis Management
- Frameworks

Company Responsibilities

Risk Management

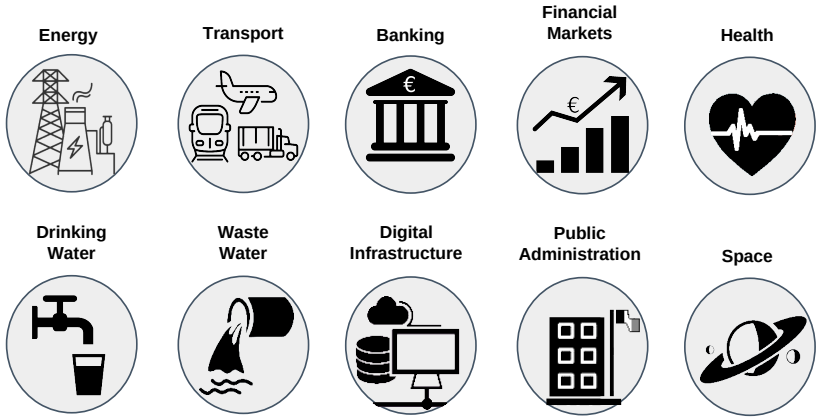
- Accountability for top management for non-compliance
- Essential and important companies are required to take security measures
- Companies are required to notify incidents within a given time frame

Co-operation and Information Exchange

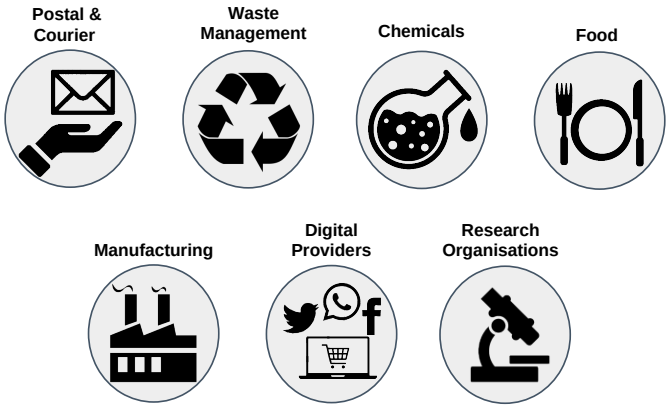
- Cooperation Group
- CSIRTs Network
- CyCLONe
- CVD and European Vulnerability registry
- Peer-reviews
- Biennial ENISA cybersecurity report

Coordinated Vulnerability Disclosure (CVD)
European Cyber Crises Liaison Organisation Network (EU-CyCLONe)
European Union Agency for Cybersecurity (ENISA)

NIS-2 Sectors of high criticality (Essential Entities)



NIS-2 Other critical sectors (Important Entities)



NIS-2 Incident Reporting obligations

Time	Incident reporting
Within 24 hours	**Early Warning** should be communicated, as well as some first presumptions regarding the kind of incident
After 72 hours	**Official Incident Notification** A full notification report must be communicated, containing the assessment of the incident, severity and impact and indicators of compromise.
Upon Request	**Intermediate Status Report** At the request of CSIRT or relevant competent authority.
After 1 month	**Final report** must be communicated.
Every 3 months	Member states CSIRT reports incidents to ENISA.
Every 6 months	ENISA reports on all incidents EU wide.

NIS-2 Penalties

- Essential entities can be fined up to €10,000,000 or at least 2% of the total annual worldwide turnover in the previous fiscal year, whichever amount is higher.
- Important entities can be penalised by fines of up to €7,000,000 or at least 1.4% of the total annual worldwide turnover, whichever amount is higher.

Exercise #4 Scenario: Limerick Cheeses Limited

- Saint Patrick's Day **Limerick Cheeses** was hit with a ransomware attack.
- The attack crippled its operations in Patrickswell.
- On the 1 April **Limerick Cheeses** was contacted by an officer of the NCSC who stated that **Mótar Transport** reported that they had suffered an attack and reported it on the 18 March.
- In the report the CTO of **Mótar Transport** stated that they believe the attack came through a VPN they had with **Limerick Cheeses** logistics system for processing movement orders.

Exercise #4 Scenario: Limerick Cheeses Limited

- Additionally, on the 19 March, **Mótar Transport** reported that they had to rebuild each computer on their network and restore data to their business management system from backups.
- **Limerick Cheeses** responded by stating that they did have a minor issue and that they restored their systems after working to get the systems back up as quickly as possible as the attack was disrupting their production and shipping.
- Further questioning of the IT manager at **Limerick Cheeses** revealed that they had employed the services of **Echo Cyber**, a cybersecurity firm, and the incident cost them €175,000 to get everything restored to pre-incident state.

Exercise #4 Scenario: Limerick Cheeses Limited

What jurisdiction did the NCSC have to contact Limerick Cheeses about their incident?

2

Exercise #4 Scenario: Limerick Cheeses Limited

What jurisdiction did the NCSC have to contact Limerick Cheeses about their incident?

- As a food producer ***Limerick Cheeses*** is part of a ***other critical sectors*** and they are therefore an ***important entity***.
- They are subject to ex-post supervision, meaning that as the CSIRT-IE received potential evidence of non-compliance they had the right to take action.

Exercise #4 Scenario: Limerick Cheeses Limited

Were Limerick Cheeses and Mótar Transport in compliance with the NIS2?

2

Exercise #4 Scenario: Limerick Cheeses Limited

Were Limerick Cheeses and Mótar Transport in compliance with the NIS2?

- ***Mótar Transport***, from a high criticality sector, is an essential entity, they reported the incident within 24 hours and followed up within 72 hours so they were in compliance.
- ***Limerick Cheeses*** did not report the incident, they were solicited by the NCSC because of information received from ***Mótar Transport***, so they were not in compliance.

Exercise #4 Scenario: Limerick Cheeses Limited

Is there a case to answer by either Limerick Cheeses or Mótar Transport in case of either Article 21, risk-management measures, or Article 23, reporting obligations, of the NIS2?

2

Exercise #4 Scenario: Limerick Cheeses Limited

Is there a case to answer by either Limerick Cheeses or Mótar Transport in case of either Article 21, risk-management measures, or Article 23, reporting obligations, of the NIS2?

- ***Mótar Transport***, In terms of Article 23, reporting obligations they have no case to answer; however, in the case of Article 21, Cybersecurity risk-management measures they may have.
- ***Limerick Cheeses*** infringed both Article 21 and Article 23, so they certainly have a case to answer.

Topics

- What is Operational Technology? ✓
- The Purdue Enterprise Reference Architecture ✓
- NIST SP 800-82 Guide to Operational Technology Security ✓
- ISA/IEC 62443 Securing Industrial Systems ✓
- Network Information Systems 2 (NIS-2) ✓

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Ollscoil Teicneolaíochta na Sionainne
Lár Tíre, An tIarthar Láir
Technological University of the Shannon:
Midlands Midwest

EUR ING Dr Diarmuid Ó Briain
Innealtóir Cairte agus
Léachtóir Sinsearach

E diarmuid.obriain@tus.ie | W tus.ie
Campas Maoilis, Páirc Maoilis,
Luimneach, V94 EC5T, Éire

CEng, FIEI
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Thank you

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