



# Industrial Automation 2020

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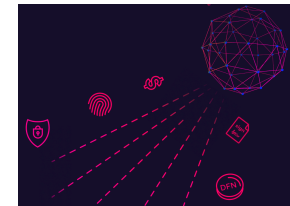
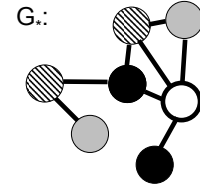
# About me

2006–2009 PhD ETHZ in computer science  
Algorithms for wireless networks

2010–2011 IBM Research, Zurich:  
Moterunner sensor network platform

2011–2018 ABB Corporate Research  
Communication for automation (power grids, factories,  
mines...), fog and cloud computing, blockchain

Since 2019 DFINITY Foundation  
Distributed computing aspects of blockchain technology  
(consensus, networking...)



Make systems reliable and available despite failures and malicious behaviour

# Industry Trends and Challenges

## Artificial Intelligence

WIRED

BUSINESS CULTURE

### Mysterious New Ransom Industrial Control System

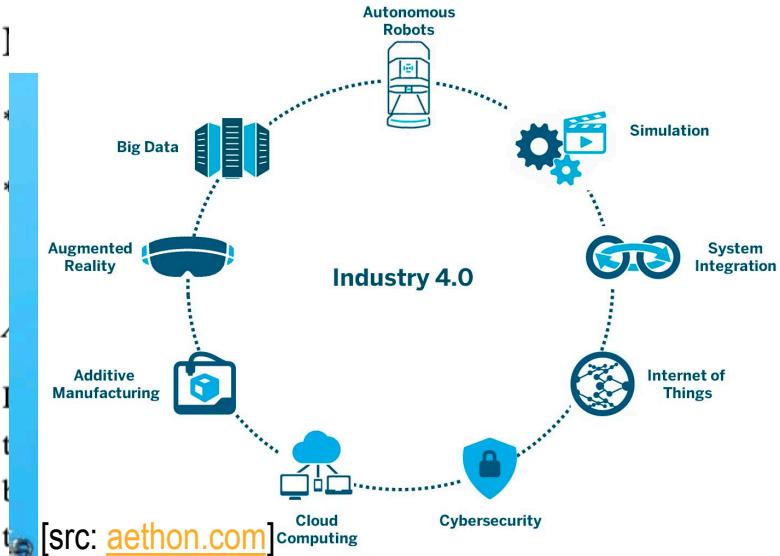
EKANS appears to be the work of cybercriminals, rather than nation state hackers—a worrying development, if so



[src: thomasnet.com]



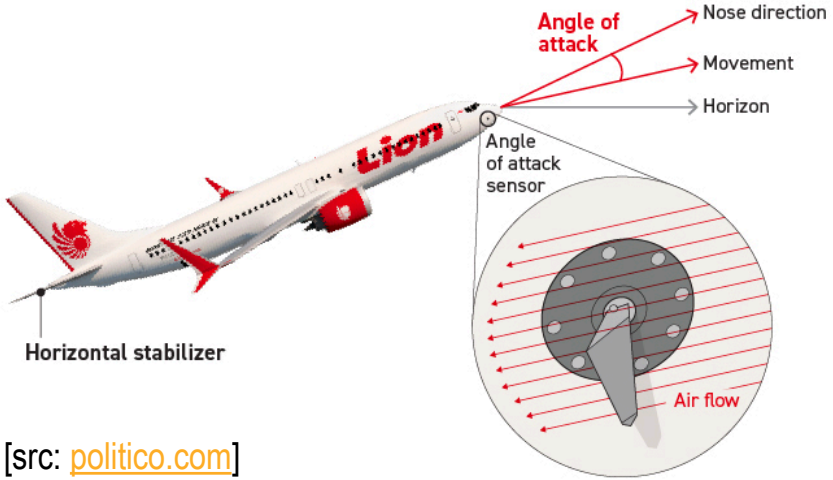
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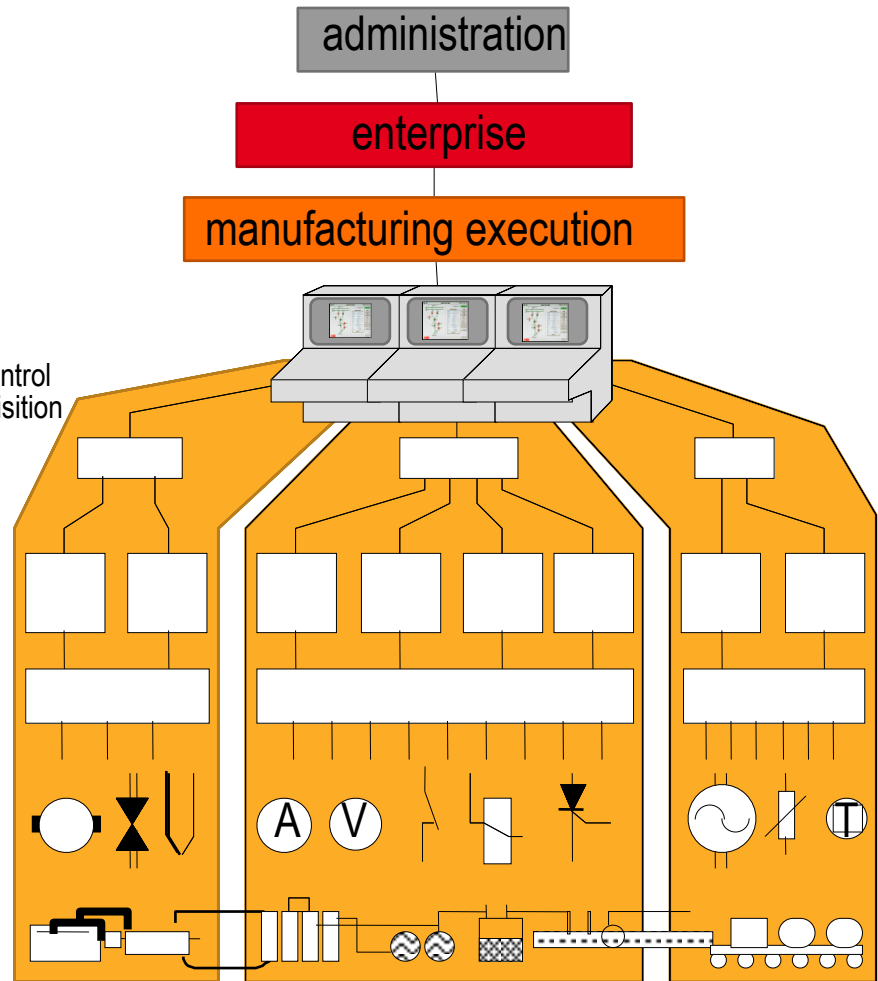
# Course Goals

- Raise interest for industrial automation systems
- Understand industrial control systems (purpose, structure)
- Methods and trade-offs in real time systems
- Understand terms in publications and standards
- Be able to analyze a plant and propose automation solutions
- Compare automation solutions with other domains
- Analyze reliability, availability and safety of systems
- Become productive in an industrial company or utility rapidly

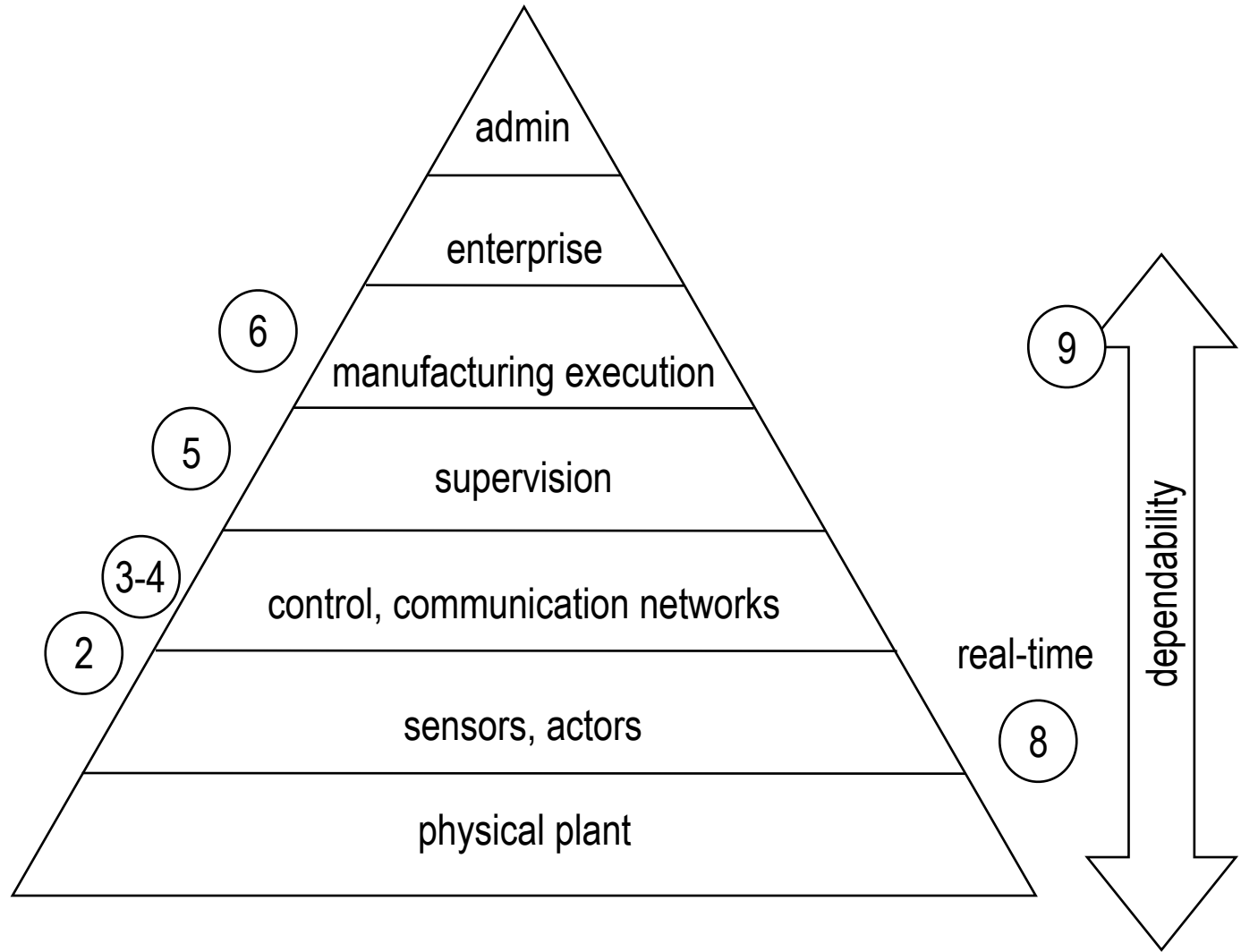
# Automation as a hierarchy of services

- 5 { Planning, Statistics, Finances
- 4 { Production planning, orders, purchase
- 3 { Workflow, order tracking, resources
- 2 { Supervision
- 1 { Control
  - Group control
  - Unit control
- Field
- 0 { Primary technology

SCADA =  
Supervisory Control  
And Data Acquisition



# Automation Hierarchy and Course Chapters



# What you will learn

- instrumentation: hardware: how is the state of a plant read and controlled
- controllers: hardware and software how controllers operate and how they are programmed
- industrial communication networks: how are (real-time) automation data exchanged
- application protocols for devices how do devices appear to the programmer and operator
- software interface to application: how does the application accesses the process data
- operator interface and SCADA: how do operators see the plant they supervise
- manufacturing execution systems: how is production planned and executed
- plant configuration and engineering: how is an automation system planned, engineered and tested
- failures in a control system: how to deal with unreliable elements in a control system
- safety: how to evaluate and prevent safety hazards
- standards: how standards help industry

# Course Organisation

Lecture + exercise lessons

12 x 3h

Group project

20h

Lab at  
Siemens

7h

**Dr Jean-Charles  
Tournier**  
CERN  
Geneva



**Dr Yvonne-Anne  
Pignolet**  
DFINITY Foundation  
Zurich

All components are part of the course. Project to be completed in groups. Link to [lecture notes](#)  
Course slides and questions to prepare for exam are on the web (moodle or website)



# Timeline

Date	Topic	Lecturer
02/18	Introduction, automation and plants	YAP
02/25	Control and programmable logic controllers (PLCs)	DK
03/03	Human interface and supervision	JCT
03/10	Industrial communication networks, field busses	YAP
03/17	Industrial communication protocols	YAP
03/24	Dependability Analysis 1	JCT
03/31	Dependability Analysis 2	JCT
04/07	Dependable Software and Safety Evaluation	JCT
04/14	EPFL Vacation	*
04/21	Programming logic controllers	YAP
04/28	<b>!!! Hands-on lab (Siemens Renens) 9:00-16:00 !!!</b>	*
05/05	Dependable architectures	JCT
05/12	Real-time Aspects and Sensors	JCT
05/19	<b>!!! Hands-on lab (Siemens Renens) 9:00-16:00 !!!</b>	*
05/26	Presentation of homework, Q&A	both

All students attend one of the Siemens sessions, taking place from 8:30 to 16:00, only for registered students, at Siemens in Renens (walk from Renens CFF Station uphill until reaching Avenue des Baumettes, 15min)

# To probe further

Olsson, Gustav & Rosen, Christian – Industrial automation,  
Dept. Of Industrial Electrical Engineering and Automation,  
Lund University, Lund, Sweden.