

# Upgrading to modern computerized I&C

From old analog and computerized equipment to modern technology

Karin Ferm

Christoffer Calås

**SEMCON**

# Agenda

1. Purpose and research questions
2. Limitations
3. Analog versus Computerized
4. Studied systems and equipment
5. Findings and conclusions
6. Summary and recommendations

# Purpose and research questions

Identification and investigation of risks and key success factors for replacing older I&C systems with new modern computerized systems.

## **Research questions to assess:**

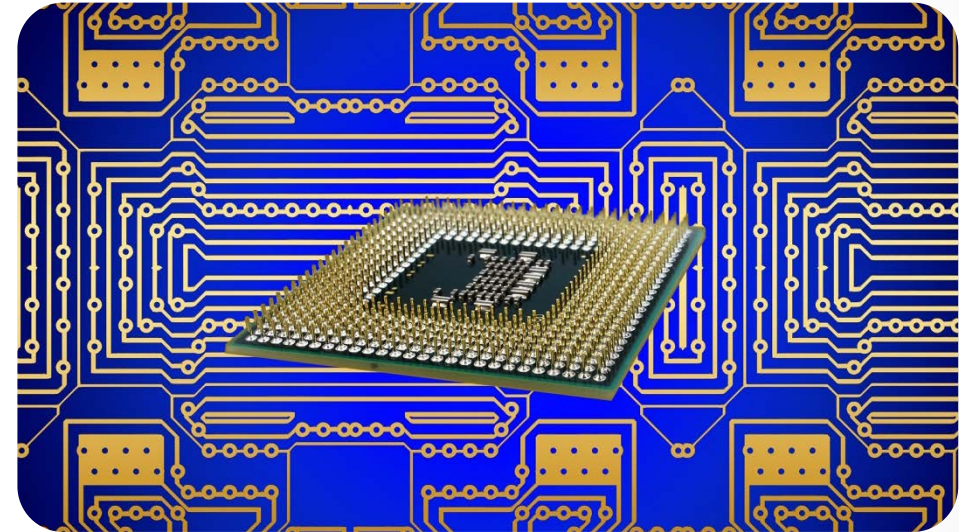
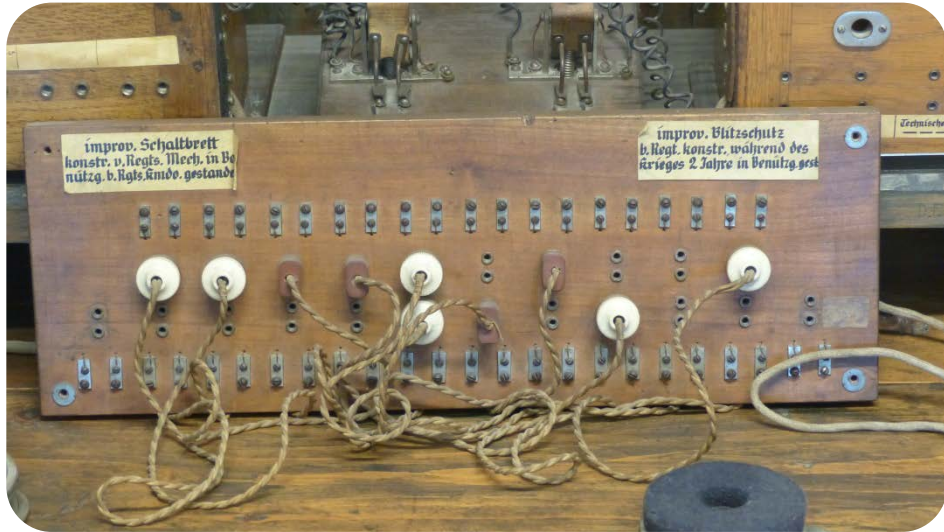
- Pros and cons
- Benefits and risks
- Life cycle
- Qualification and safety demonstration
- Maintenance perspective

# Limitations

- Only partial replacement, not complete I&C system or large platforms
- Systems or equipment not having a sole safety purpose
- Upgraded systems which are based on a CPU
- Supplier's way of working is not included



# Analog vs. Computerized



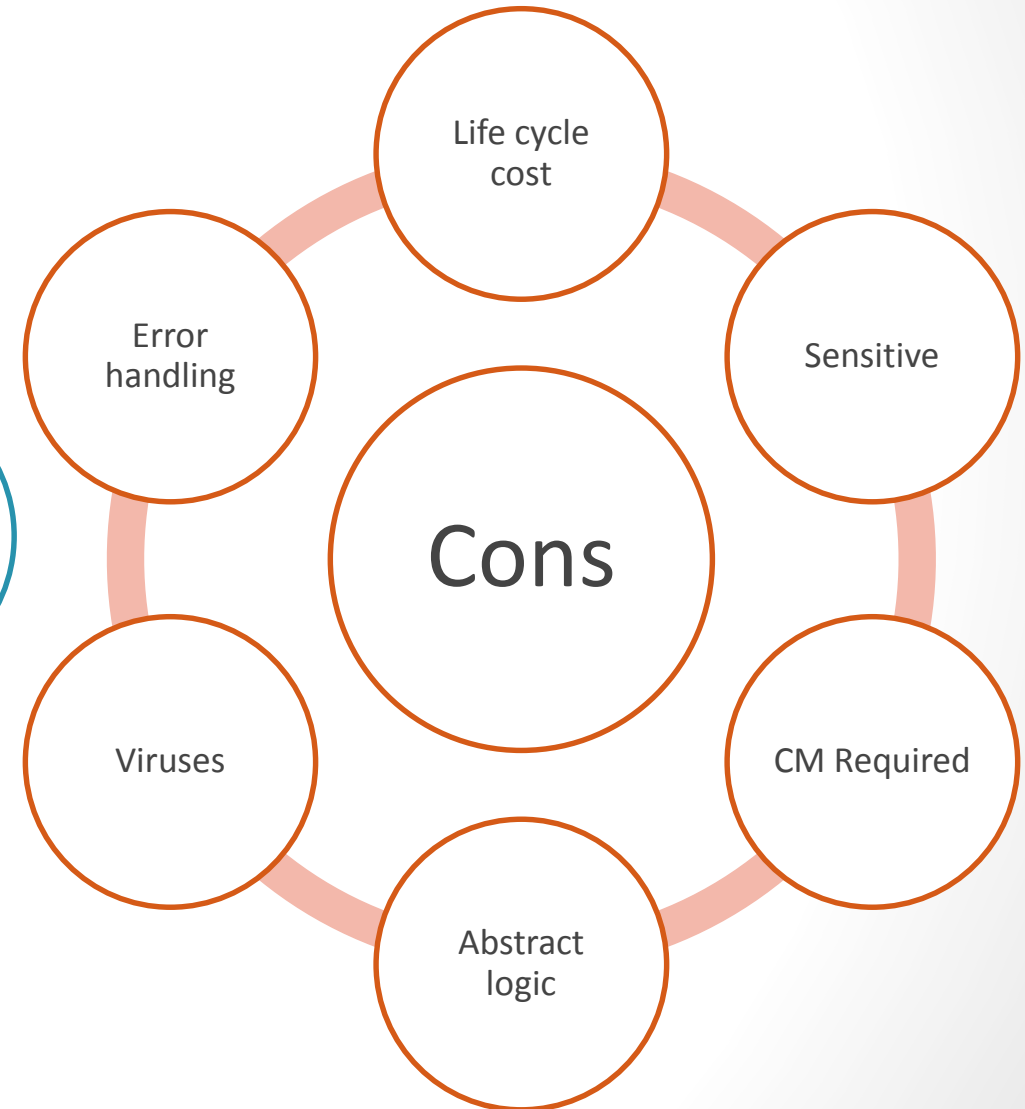
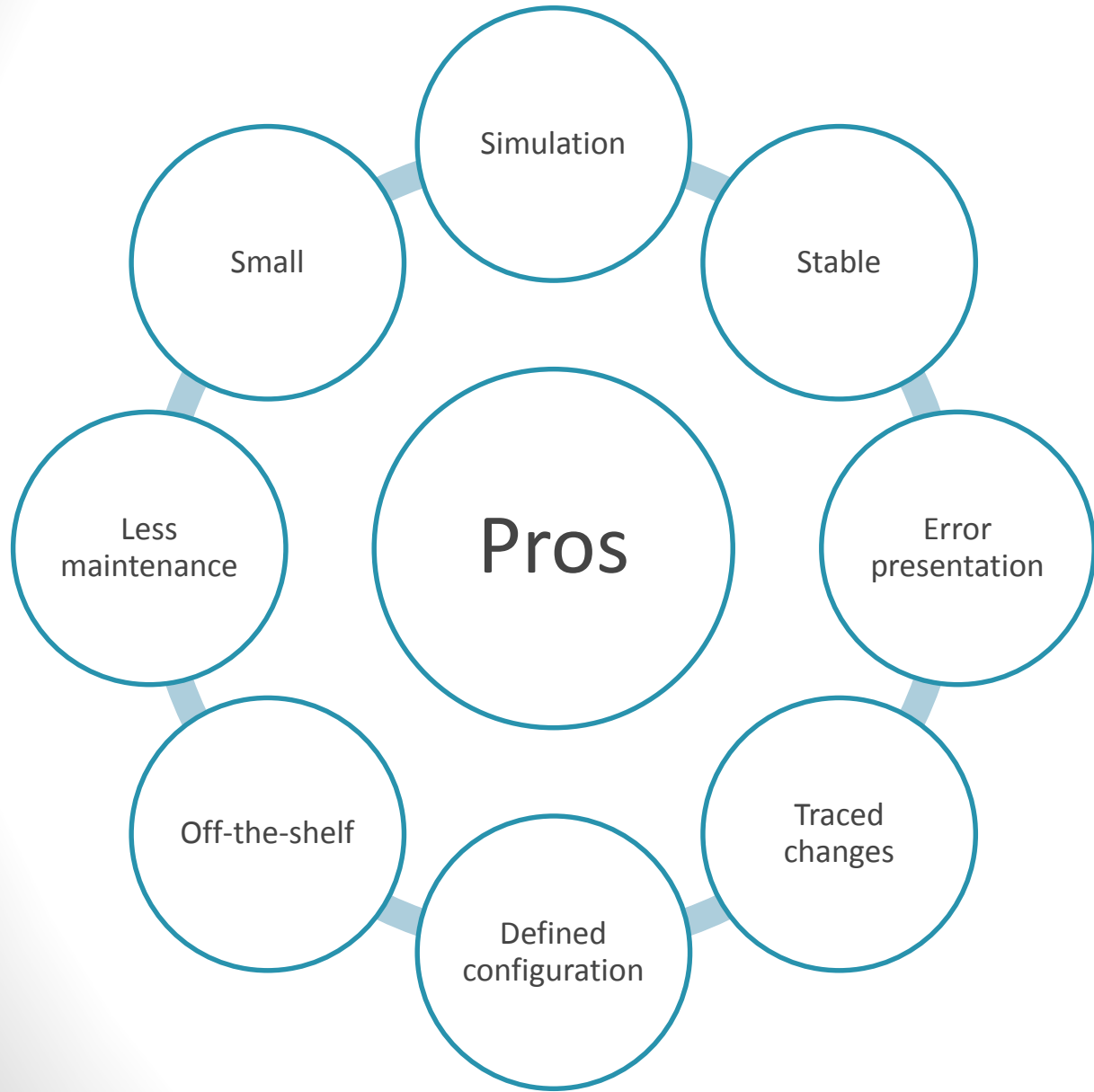
# Studied systems and equipment

Plant	Project	Substituted hardware type	Installed hardware	Safety class	GAMP category
Forsmark	Radiation measurement	Analog	Mirion	2E	SW5
Olkiluoto	Radiation monitoring	Analog	Mirion	2	SW5
Olkiluoto	Turbine automation	Computerized	Siemens Teleperm XP, Siemens S7	No	SW5
Olkiluoto	Control Rod operating	Computerized	Siemens S7 & PC	No	SW5
Oskarshamn	Wasteplant control equipment (measurement equipment for all systems in wasteplant)	Computerized	Siemens S7	2E	SW5
Oskarshamn	Wasteplant control equipment (measurement equipment for magnetic filter)	Computerized	Siemens S7	2E	SW5
Oskarshamn	Temperature measuring	Computerized	PR Electronics 2289A	2E	SW4
Ringhals	Temperature measuring	Computerized	ABB AC800M	2E	SW5
Ringhals	Compensation for vessel level	Analog	H&B TZA4	1E	SW5
Ringhals	Measure temperatures & calculate limit	Computerized	Eurotherm 6100	1E or CAT A	SW4
Ringhals	Reactor control system	Analog	WDPF	1E Control HW 2E SW	SW5

# Findings and conclusions



# Pros and cons





# Benefits and risks



## Benefits

- Handles large data quantities
- Post-processing of data
- Data visualization
- Self-monitoring
- Security and audit trail
- Backup configuration
- Graphical interfaces
- Few maintenance rounds

## Risks

- Different characteristics
- New error modes
- Few maintenance rounds
- Data overflow
- Aging support equipment



# Important features during replacement

## Old systems suitable for replacement

- Non-safety classified
- Well documented
- Well understood
- Degrading performance

## New ideal system

- Dedicated
- Few interfaces
- Experienced supplier
- Previously qualified

# Life cycle perspective and maintenance

## Lower cost

Competition & OTS

Self-monitoring

Less maintenance

Off site verification

General purpose

## Higher cost

Shorter life cycle

Technological aging

Decreasing knowledge

Different troubleshooting

Dependency of supplier

# Qualification and safety demonstration

- Effort depends on
  - SW adds on qualification efforts
  - System customization (e.g. GAMP)
  - Safety classification
  - Use of already qualified equipment
  
- EU standard for qualification of equipment of interest would be beneficial



# Summary and recommendations

## Replacement strategies

Keep commissioned systems  
When forced to change – keep it simple  
There is no technical obstacles with computerized technology.  
Complexity is a matter of design, classification and intended use  
Focus on non-safety related systems and equipment's

## When to change, think about...

- Enough time and right resources is of paramount importance
- RM and V&V strategies needs time investment
- Thoroughly specify all features required
- Beware of differences due to technological shift
- Ensure the scope is clear to all involved

## Suppliers

- Involved early and preferably on site
- Spend time together both at site and at supplier
- Familiar with documentation and qualification routines
- Deep understanding of their equipment

## Maintenance

- Periodic training to ensure system knowledge is maintained
- Designate a versatile off-the-shelf system as a general purpose system
- Use the provided diagnostic tools but select the data wisely

