New digital production technologies - Challenges for machinery safety standardisation

Dr. Gerhard Steiger
VDMA Department Standardisation Mechanical Engineering/
DIN Standards Committee Mechanical Engineering (NAM)

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Impact of digitalization in the machinery sector

Terms „Industrie 4.0“ and „smart manufacturing“ are synomyms for digitalization in the machinery sector

» Definition: smart manufacturing (approved by ISO/SMCC and IEC/SyC SM)

„Manufacturing that improves its performance aspects with integrated and intelligent use of processes and resources in cyber, physical and human spheres to create and deliver products and services, which also collaborates with other domains within enterprises’ value chains.

Note 1: Performance aspects include agility, efficiency, **safety**, security, sustainability or any other performance indicators identified by the enterprise.

Note 2: In addition to manufacturing, other enterprise domains can include engineering, logistics, marketing, procurement, sales or any other domains identified by the enterprise”

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Impact of digitalization in the machinery sector

Thus, digitalization is a cross-sectoral phenomenum with a lot of different interrelated implications

→ Safety of machinery is one of the relevant fields

» In view of current and future digitalization in the machinery sector (i. e. Industrie 4.0/smart manufacturing) the following items with regard to safety of machinery are at present high on the agenda:

- Collaboration between operator and machinery (i. e. collaborative robots)
- Risk assessment in case of autonomous re-configuration of machinery
- Possible implications of embeded technologies comprising Artificial Intellegence (AI) on Safety
- Possible implications of IT-Security on Safety

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Standardisation in ISO/TC 199 „Safety of machinery“

Current activities (1):

» ISO/DIS 21260:2018 “Safety of Machinery - Mechanical safety data for physical contacts between moving machinery or moving parts of machinery and persons” (in cooperation with ISO/TC 299 “Robotics”)

– Specification of limits for physical contacts (forces/speed, energies) to be relevant for collaborating machines/robots

Standardisation in ISO/TC 199 „Safety of machinery“

Current activities (2):

- Revision of ISO 11161:2007 “Safety of machinery - Integrated manufacturing systems -- Basic requirements”
  - incorporating new aspects in relation to Industrie 4.0/smart manufacture (in particular risk assessment in case of autonomous re-configuration of machinery)
- 2018: Allocation of Study Project “Possible implications of embedded technologies comprising Artificial Intelligence (AI) on Machinery Safety” to ISO/TC199/WG5
  - Based on already existing AI-applications in the machinery sector: definition of general conditions being necessary for a “safe” design of machines with those technologies within the context of ISO 12100

Published document:

- ISO/TR 22100-4:2018 “Safety of machinery - Relationship with ISO 12100 - Part 4: Guidance to machinery manufacturers for consideration of related IT-security (cyber security) aspects”; (identical publication as CEN/ISO/TR in progress)

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Machinery Safety vs. IT Security (ISO/TR 22100-4)

European legal framework (Machinery Directive 2006/42/EC) is build on following basic principle:

» Consideration of
- intended use (according to manufacturer‘s specification)
- reasonably foreseeable misuse

→ Not covered: Any kind of intentional violation by third parties (IT Security attacks are de facto criminal acts)!

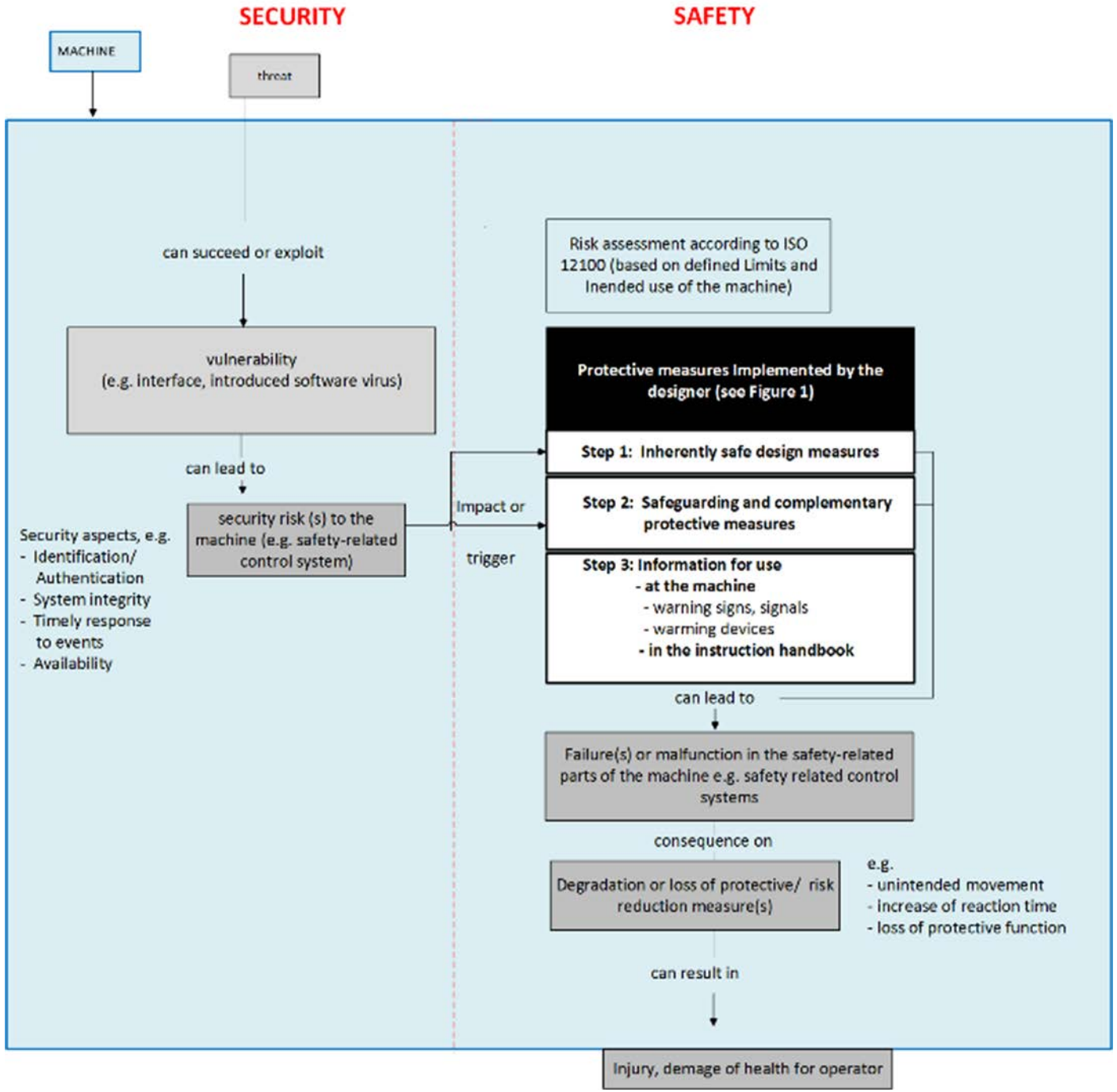
→ However, manufactureres providing machinery which can have vulnerabilities to IT Security attacks and/or threats should take this aspect into account in particular when an impact on machinery safety would be possible!

→ ISO/TR 22100-4 is consisting of two major parts:
- Analysing the roll of IT Security for machinery safety
- Practical guidance for consideration of IT Security aspects by manufactureres

Machinery Safety vs. IT Security (ISO/TR 22100-4)

Principle characterization Safety vs. IT Security

	Machinery safety	IT-Security/Cybersecurity
Objectives	Accident prevention, health	Availability, integrity, confidentiality
Conditions (risks, methods, measures)	Transparent	Intransparent/Confidential
Dynamics	Rather static field (intended use, reasonable foreseeable misuse)	Highly dynamic field; moving target (intentional manipulation, criminal intent)
Risk reduction (mitigation) measures	Mainly by machine manufacture at a dedicated time (when providing the machine for the first use)	By various actors (machine manufacturer, system integrator, machine user, service provider) at any time along the overall lifecycle



Relationship between Machinery Safety and IT Security (ISO/TR 22100-4)

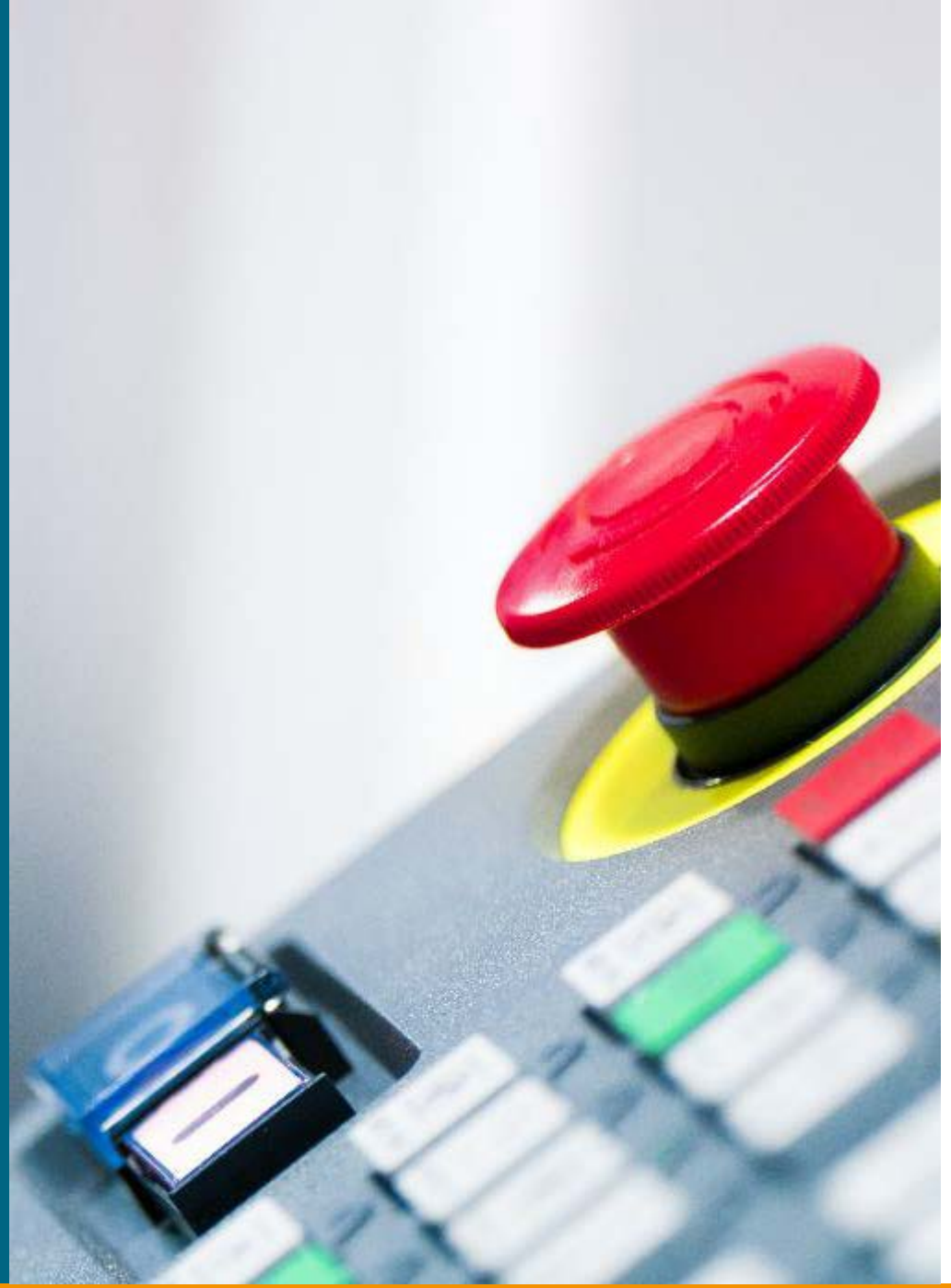
Machinery Safety vs. IT Security (ISO/TR 22100-4)

Relevance of IT Security for Machinery Safety (risk evaluation)

Case	Threat	Manipulation of machinery/plant	Relevance for safety of machinery
1	Access to data/know how from the machine manufacturer or from the machine user (Process know-how)	None	-  +
2	Creation of economic damage of the machine user	During use	
3	Creation of damage to infrastructure and/or people (operator, bystanders), e.g. a terroristic act	During use	

For cases 1 and 2 the intentional (extern) violation is often hidden and, therefore, difficult to detect even after the intrusion.

Case 3 has a much higher probability of occurrence for machinery/plant used in so called critical infrastructures (generation of electric power, water supply etc.) compared to other machinery and plant intended for „normal“ manufacturing purposes.



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Machinery Safety vs. IT Security (ISO/TR 22100-4)

Requirements for machine manufacturers

1) Selection of appropriate components (hardware/software)

2) Approriate design of the machine considering IT Security aspects

3) Instruction handbook (Guidance to the machine user with regard to IT Security aspects)

→ ISO/TR 22100-4 provides guidance for machine manufacturers

- regarding these 3 essential elements
- how to connect the risk assessment (safety) with consideration of possible IT Security risks

Impact of digitalization in the machinery sector

VDMA/NAM is actively involved in a lot of standardisation activities to support the implementation of Industrie 4.0/smart manufacturing especialy in small and medium sized companies of the machinery sector

» Top-down activities:
- Diverse initiatives at ISO, IEC, CEN and CENELEC level
- Founding member of nationalen Standardisation Council Industrie 4.0

» Bottum-up activities:
- Development of OPC-UA Companien Specifications in many machine specific subsectors to facilitate integration/interoperability for typical Industrie 4.0 use cases (https://opcua.vdma.org/)

Contacts

Dr.-Ing. Gerhard Steiger
Head of Standardization Department
German Mechanical Engineering Federation (VDMA)

DIN-Mechanical Engineering Standards Committee (NAM) (hosted by VDMA)
General manager
Lyoner Str. 18
60528 Frankfurt

Tel. +49 69 6603-1341

E-Mail: gerhard.steiger@vdma.org

Source: DIN-Normenausschuss Maschinenbau (NAM)

Thank you

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for your attention!