XXI WORLD CONGRESS ON
SAFETY & HEALTH
AT WORK 2017

3-6 September 2017

issa | INTERNATIONAL SOCIAL SECURITY ASSOCIATION

Section on Machine and System Safety

Symposium 05:
Occupational safety and health in the new digital world

Monday, Sept. 4th, 2017

P r o c e e d i n g s

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Program

Moderation:	Marek Rolinec	Institute of Integrated Safety, Slovak University of Technology, Bratislava
16:00 – 16:10 hrs.	**Introduction of the session**	
	Juergen Schulin	Section Machine and System Safety, Germany
16:10 – 16:25 hrs.	**Changes and challenges for prevention: Experiences gained and new approaches**	
	Dr Liliana Frusteri	INAIL, Italy
16:25 – 16:40 hrs.	**Efficient risk management as a part of digitalization in the production technologies (processes) within the context of philosophy industry 4.0**	
	Prof Juraj Sinay,	
	Prof. Hana Pacaiova	Technical University of Kosice, Slovakia
16:40 – 16:55 hrs.	**Smart manufacturing with safe machines**	
	Otto Görnemann	Sick AG, Germany
16:55 – 17.10 hrs.	**INRS foresight study on uberisation by 2025**	
	Marie Defrance	INRS, France
17:10 – 17:25 hrs.	**The future safety and health professional**	
	Cameron Stevens	Percolate Ideas, Australia
17:25 - 17:40 hrs.	**Relevance of human and social capital in the new digital world**	
	Liisa Hakala	Ministry of Health and Social Affairs, Finland
17:40 – 18:00 hrs.	**Discussion & Closing**	
	Prof Juraj Sinay	Technical University of Kosice, Slovakia

World Congress Singapore
Symposium S05 „OSH in a new digital world“
Introduction Jürgen Schulin

Welcome to the symposium “occupational safety and health in a new digital world” organized by our ISSA-Section Machine and System Safety at the 20th World Congress on Safety and Health in Singapore. Thank you for participating in this symposium. In the next two hours speakers coming from Europe and Australia we will present their ideas of occupational safety and health in a new digital world. Welcome and thank you to our speakers and our moderator.

Technological developments towards smart manufacturing (industry 4.0) and their possible risks for safety, health and security at work have a high priority for us from the perspective of occupational risks.

Let me start the symposium with some statements and keywords some of which the speakers will perhaps pick up:

- Digital manufacturing creates new chances for industry:
  Intelligent networking of production, big data, connection of manufacturers, users and clients, smart factory. But: Cyber Physical Systems (CPS) can be real complex.
- Additional risks from digital manufacturing can be managed:
  Systemic risks, system and risk analysis, risk assessment for each identified risk, requirements for people working in a CPS, comprehensive management strategy.
- The human factor still plays an important role:
  Impact on workers, training, qualification and early participation in the change process, consideration of individual physical and mental performance capacity, ergonomic design of user-interfaces.
- Develop solutions with partners:
  break down complex CPS (modularization), international surveys, concrete examples from branches (good practice)

Our Section will start an international project soon with partners in this complex field. If you are interested in a co-operation please put your business card in this box.

I wish us an interesting symposium pointing out some perspectives for the future. I also invite you to come tomorrow at 12.30 h to the ISSA Technical Session “The 4th Industrial Revolution”.

And now I pass over to our moderator: Marek Rolinec, Institute of Integrated Safety, Slovak University of Technology, Bratislava

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ISSA Machine and System Safety Section

OSH in the new digital world

Mon, 4 September 2017

CHANGES AND CHALLENGES FOR PREVENTION: EXPERIENCES AND NEW APPROACHES

Fabrizio Benedetti, Liliana Frusteri

National Institute for Insurance against Accidents at Work (INAIL)

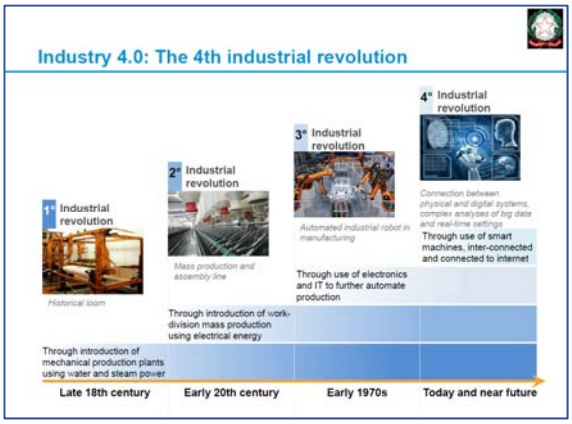
Italy, Rome

Inail

INAIL (National Institute for Insurance against Accidents at Work) is a public non-profit entity safeguarding workers against physical injuries and occupational diseases.

An integrated system of protection: **preventive measures** at the workplace, **medical services, financial assistance**, **research** activities in OHS, **rehabilitation** and **reintegration** of victims of workplace accidents or professional diseases to social life and work.

National Industry 4.0 Plan



From «Italy's Plan *Industry 4.0*" » of Ministry of Economic Development

New employment patterns and technologies: changes and risks for occupational health and safety

1. **Digital innovation** as opportunity for economic growth, competitiveness and greater safety at workplaces (Internet of Things, artificial intelligence, robotics, bionics, augmented reality, additive manufacturing, ….)
2. **New employment patterns** (flexible working patterns, virtual workplaces, crowd-working, fluid co-working spaces, human cloud, workforce on demand, digital labour…)
3. **Highly-skilled professionals** (designer engineer, cyber security specialist, business intelligent analyst, data scientist and data specialist, new specializations, skills and abilities linked to search engine optimization (SEO) techniques, social network or blog management, ….)
4. **Advanced technologies** will increasingly perform the heaviest and dangerous works and support the workers in the most complex tasks (reduction of traditional hazards)
5. **Enormous variety** of **tasks** and **locations** in which the work is carried out indicates a wide range of health and safety risks (e.g. psychosocial risks, musculoskeletal problems, nanotechnologies, electromagnetical fields, complex human-machine interfaces …)

The impact of Industry 4.0 on Inail mission

Inail and the insurance coverage

To redefine the **insurance relationship**: new protected activities and new insurance protection system.

Currently, the identification of insured people is carried out according to criteria of the Presidential Decree 1124/65, that is the main Italian Law on insurance on occupational diseases and injuries at work: the employee acts and works according to time, mode, use of machines, equipment and chemicals that are established by the employer.

New forms of work and **new working cycles**, with own **new risks**, require **to actualize and extend the insurance and performance safeguards** provided by the Presidential Decree 1124/1965.

It is necessary **to rethink the concept of insurance coverage** in more extensive terms, as an inalienable right of the worker, irrespective of the contractual nature:

- to define the temporal and spatial limits for insurance coverage
- to adopt remote monitoring systems
- to take into account privacy concerns
- professional and generic risks

Inail to improve OHS and implement technological innovation

- Supporting the development of OSH, in particular in SMEs
- Developing collaboration with the Social Partners and institutions (OSH-MS guidelines)
- Supporting safety as a competitiveness factor, by transforming social costs of injuries and occupational diseases in economic benefits for organizations and the system
- Promoting a OSH management approach and its integration in overall organisational management

Regulation

- Standardized procedure for risk assessment - Decree of 30th November 2012
- Simplified procedures for the adoption of management and organizational models - Ministerial Decree of 13th February 2014
- Regulation on smart working
- ISO 45001
- ……

Education and training

- Information (Workshops – press - video)
- Education and training to:
  - ✓ responsible of the service of prevention and protection
  - ✓ employers, managers, workers
  - ✓ OSH-MS Auditor
  - ✓……
- Production of informative tools/softwares/apps for employers and workers

Financial support

- insurance premium reduction for having improved OSH measures
- Economic fundings for innovative and preventive interventions

Risk assessment and prevention in the new digital world: the activity and the role of OSH and ICT Inail experts

Semantic engine and artificial intelligence to encode automatically injuries on the base of European Statistics on Accidents at Work

Software for workers and employers, IoT, active and passive radio frequency identification, augmented reality, …..

Cognitive systems to study the causal agents and the trend of occupational diseases

Tablet and mobile apps to support the risk management and prevention

Inail and the regulation: the example of Smart Working

Inail collaborated in the drafting of the "**Guidelines for the preparation of the information to be delivered to the employee performing the work in smart work**" implemented by the Presidency of the Council of Ministers. The Legislative Decree 81/2017 is the first regulatory intervention on the ongoing change in the increasingly technological and digital world of work.

In the guidelines some **preventive measures** are reported: the employee, properly informed and trained, will have to self-control, provided that the **company must provide adequate equipment for the purposes** and **comply with the legislative and technical standards**.

For instance, there are **indications** to reduce possible risks related to poor postures in domestic or similar environments, visual fatigue hazards for prolonged use of mobile devices other than the classic workstation with the PC.

It is necessary to clarify the **limits** of protection against a combination of personal / family / work activities, taking into account the reasonableness of work and transit activities between the places where they are carried out.

Inail to support safety at work and innovation by economic incentives

Inail financially supports businesses - SMEs, and the craft and agricultural businesses – that improve the levels of technological innovation and protection of the health and safety of workers.

Since 2010 Inail has invested around **1.5 billion Euros** in the financial support to projects whose aim is to adapt and improve safety conditions in the workplace.

Strategic intervention lines are based on **different schemes** and **highly diversified** depending on the compartment of belonging, size, geographic context of reference and are carried out by different schemes.

INAIL financial incentives to promote OSH and innovation: schemes

1) Insurance premium variations

Automatic bonus / malus
(experience rating)

'OT24 Model' reduction
(tariff premium reduction for companies that realized interventions to improve health and safety at workplace during the year before the application; measures must go beyond minimum legal requirements)

2) Economic incentives for the implementation of projects aimed at improving health and safety at workplace and for the realization of innovative technological and organizational solutions

'ISI' scheme
('first come, first served' procedure)

'FIPIT' scheme
(cost/quality ranking procedure)

Inail 'OT24' Tariff premium reduction for acting preventive measures

Workers/year*	Rate of reduction (%)
up to 10	28
11 to 50	18
51 to 200	10
more than 200	5

* INAIL calculation based on salaries

Preventive measures: some examples

- health and safety management systems
- development and adoption of best practices
- automation of manual handling
- innovative solutions

Inail 'FIPIT' funding to safety at work and technological innovation

New incentive schemes, only for **micro and small enterprises**, aimed at reducing risks through **technological innovation** in 3 target fields (high-risk activities):

- **Agriculture** (installation of rollover protection structures (ROPS), seat belts for the protection of the operator in case of tractor rollover, other innovative safety devices
- **Construction** (material-handling equipment for the movement of materials, lifting appliances for the transport of materials and/or persons and goods, others)
- **Mining and quarrying** (humidification systems / dust aspiration machines, suction pads for slab lifting systems, machineries for quarrying, machineries for stone products manufacturing, machineries for aggregate materials processing)

Total budget: 30 million €

- agriculture: about 15,5 million €
- construction: about 9,4 million €
- quarrying and stone processing: 5 million €

Inail 'ISI' scheme

Three funding strands, for investment projects aimed at:

1. reducing **occupational risks** through replacing old machines and not to current standards, refurbishment of work premises, **reengineering** of systems and processes
2. implementing **Organizational and Management Systems (OH&S-MS, CSR)**
3. removing **materials containing asbestos** present in the work premises

Inail and healthcare, rehabilitation, work reintegration

Inail aims at the full recovery of mental and physical integrity by financial and medical support, rehabilitation and reintegration at work and in social life of workers victims of injuries or occupational diseases.

2016: a **new regulation** and **economic fundings** to support innovative technological measures for the reintegration at work of people with disabilities, by means of three kinds of interventions:

1) **architectural barriers and automation**, until 95,000 euros

2) **adaptation of workstation and equipment** with furnishings, technological tools, computer and automation devices, until 40,000 euros

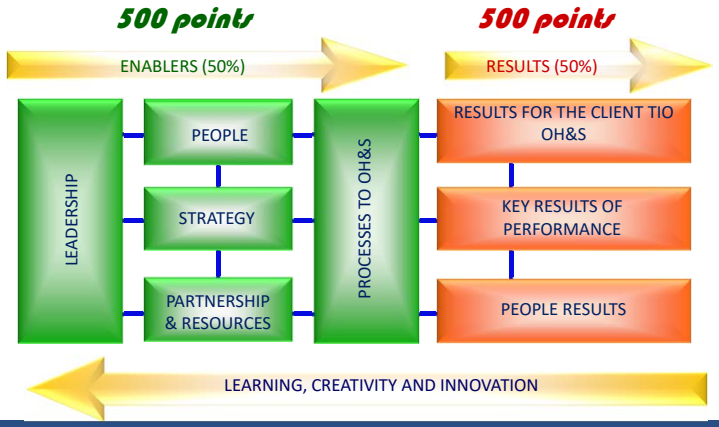
3) **training** until 15,000 euros

CONFINDUSTRIA

INAIL
ISTITUTO NAZIONALE PER L'ASSICURAZIONE CONTRO GLI INFORTUNI SUL LAVORO

Enterprise Award for Safety and Innovation

FRAMEWORK TO OCCUPATIONAL HEALTH AND SAFETY



Associazione Premio Qualità Italia

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

Conclusive remarks

- The 4th industrial revolution is providing **continuous challenges** that all the key actors have to raise: companies, employers, employees, governments, authorities, OSH experts and insurance institutes
- A **close cooperation** is necessary to encourage the opportunities and to reduce the risks
- We have to rethink all together a more comprehensive and an always **more dynamic approach to risk assessment, health and safety management and social security protection**, and we should try to anticipate the solutions in order to create a win-win situation.
- Even though we are going to live and work in an always more connected, automated and digital world, **people have to remain at the centre of work and prevention**.
- We need to shape the future continuing **to put workers first and safeguarding them**.

Thank you for your attention

l.frusteri@inail.it

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Effective Risk Management
as a part of the manufacturing technologies digitization in the context of Industry 4.0 Strategy

Hana Pacaiova, Juraj Sinay
Faculty of Mechanical Engineering
S&QP Department
Technical University of Kosice, Slovakia

issa | INTERNATIONALE VEREINIGUNG FÜR SOZIALE SICHERHEIT | IVSS

Structure of presentation

I. Introduction
II. New trends in Risk Management
III. How to manage Smart process in Smart factory
IV. Risk parameters identification in SF: *Machinery safety vs. Process safety and Scurity*
V. Effective risk management – model GRAM (*first generation*)

I. Introduction

Safety & Quality production department (2001y.).

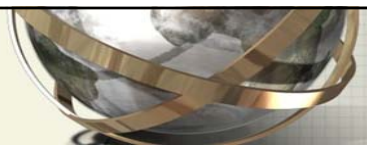
Safety of technical systems

- Machinery safety
- OH&S
- Major Accident prevention
- Maintenance Management

Quality production

- Management systems
- Statistic management tools

II. New trends in RM



History of RM perception:

→ from potential consequences identification (harm, financial losses ...)

Risk = Probability x Consequences

→ to identify these effects which have influence on **company objectives ...**

RM

AS/NZS 4360:2004

ISO/IEC Guide 73:2009 Vocabulary for Risk Management

ISO 31000:2009

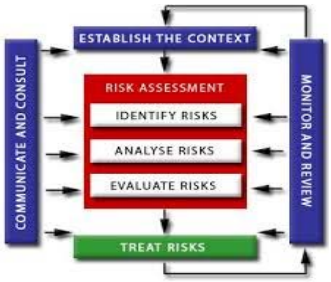
Risk = The Effect of uncertainty on Objectives

II. Actual RM philosophy

ISO 31000:2009

Risk management encompasses three processes:
Risk assessment, Risk evaluation and Risk mitigation!

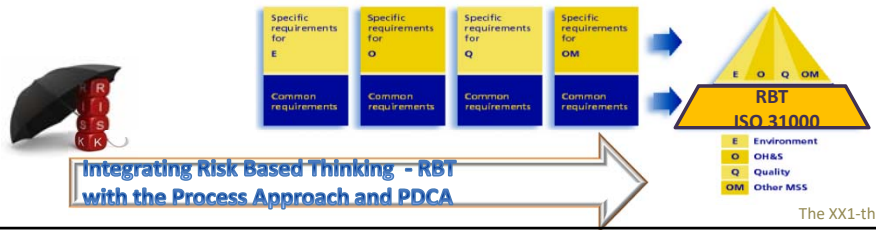
- ✓ should be a continuous process that supports the development and implementation of the strategy of an organization;
- ✓ it should methodically address all the **risks associated with all of the activities of the organization.**



COMING FROM BUSINESS OBJECTIVES

II. HLS and RBT principles

- The technical management board (TMB) within ISO central and the joint technical coordination group (JTCG) have determined that all management systems standards follow a new format, called the "High-Level Structure - HLS," as defined in Annex SL (previously Guide 83) – *2012y, new **2015**y.*
- Based on the HLS, all management systems shall, in principle, use consistent structure, common text and terminology so that they are easy to use and compatible with each other.



II.HLS ad RBT principles

Area	Standard		HLS			CE*
			10 chap.	PDCA	RBT	
Quality	ISO 9001:2015	QMS	X	X	X	X
	ISO/TS 16949		-	X	-	X
	IATF 16949:2016		X	X	X	X
OH&S	STN OHSAS 18001:2008	OHSMS	-	X	-	X
	ISO 45001:2017		X	X	X	X
Environment	ISO 14001:2015	EMS	X	X	X	X
Energy	ISO 50001: 2011	EnMS	-	X	-	X
Asset	ISO 55001:2014	AMS	X	X	X	-
Medical devices	ISO 13485:2016	QMSMD	X	X	X	X
Food Safety	ISO 22000:2005	FSMS	-	X	-	X
	(ISO 22000:2018)		(X)	(X)	(X)	(X)
Business Continuity	ISO 22301:2012	BCMS	X	X	X	X
Information Security	ISO/IEC 27001:2013	SMIB	X	X	X	X
Sustainable development	ISO ISO 37101:2016	MSSD	X	X	X	X

**** CE – certification of management system***

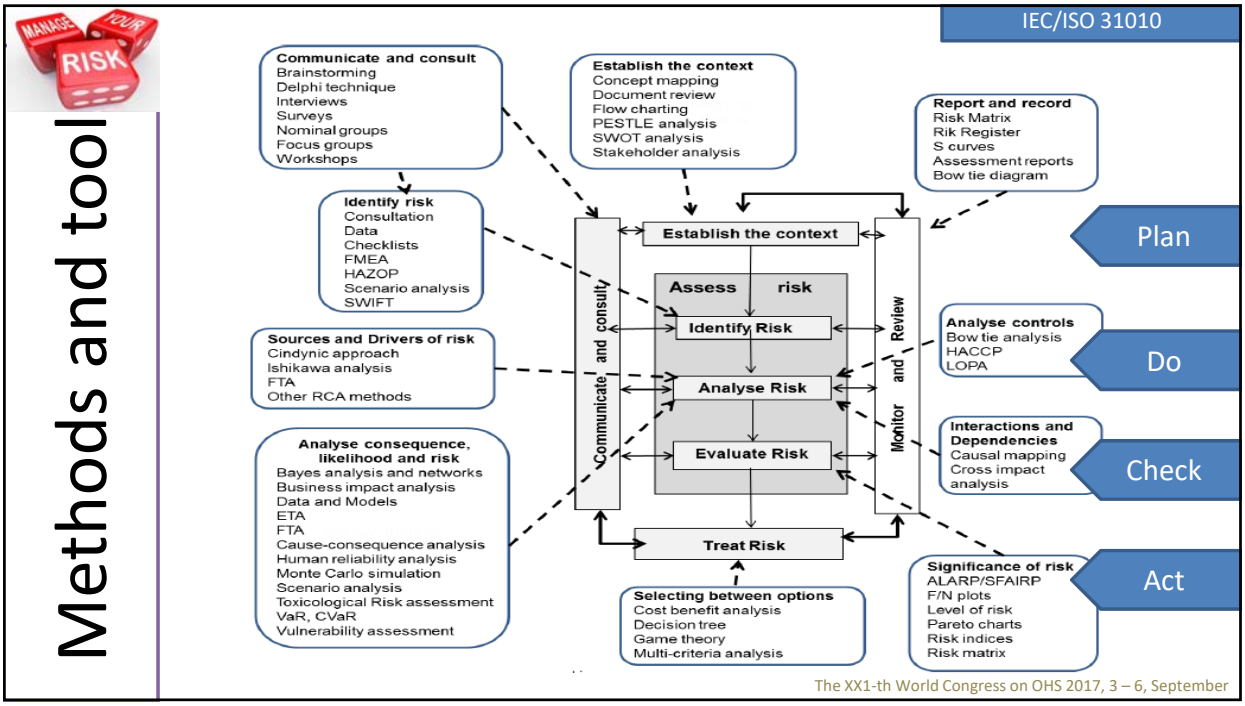
Methods and tool

IEC/ISO 31010

	Methods and tools	Risk assesssment				
		*IIR***	Risk analysis			RE
			P	*C*	*RS*	
Kvalitatívne (semikvantitatívne) metódy	Brainstorming	SA*	NA	NA	NA	NA
	Kontrolný zoznam (*angl.* Check – List)	SA	NA	NA	NA	NA
	Štúdia bezpečnosti a prevádzkovateľnosti (*angl.* Hazard and operability studies - HAZOP)	SA	A	SA	A	A
	Analýza koreňových príčin (*angl.* Root cause analysis - RCA)	NA	SA	SA	SA	SA
	Analýza príčin a dôsledkov porúch (*angl.* Failure mode and effect analysis - FMEA)	SA	SA	SA	SA	SA
	Spoľahlivostne orientovaná údržba (*angl.* Reliability Centered Maintenance - RCM)	SA	SA	SA	SA	SA
	Analýza príčin a dôsledkov (*angl.* Cause and effect analysis)	SA	NA	SA	NA	NA
	Matica rizika (*angl.* Risk Matrix)	SA	SA	SA	SA	A
Kvantitatívne (semi-kvantitatívne) metódy	Analýza stromu chýb (*angl.* Fault tree analysis – FTA)	A	SA	NA	A	A
	Analýza stromu udalostí (*angl.* Even tree analysis – ETA)	A	A	SA	A	NA
	Analýza typu motýlik (*angl.* Bow- tie analysis)	NA	SA	A	SA	A
	Analýza ochranných vrstiev (*angl.* Layer protection analysis - LOPA)	A	A	SA	A	NA
	Analýza spoľahlivosti človeka (*angl.* Human reliability analysis – HRA)	SA	SA	SA	SA	A
	F-N krivka (*angl.* F-N curve)	A	SA	SA	A	SA
	Analýza prínosov a strát (*angl.* Cost/benefit analysis – CBA)	A	SA	A	SA	SA
	Multikriteriálna rozhodovacia analýza (*angl.* Multi-criteria decision analysis - MCDA)	A	A	SA	SA	A

*SA - Strong applicable, NA – Non applicable, A - Applicable

**IR - Risk identification, P – Probability, C – Consequence, RS – Risk estimation, RE – Risk evaluation



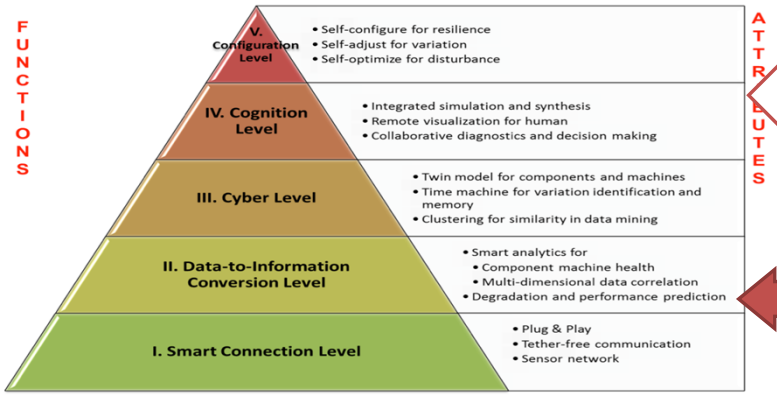
III. Industry 4.0

- **Internet of Things – IoT**
  but also ...
- *Internet of – Service (IoS), Internet of People (IoP), Internet of Energy (IoE), Internet of Media (IoM)*

The goal of the **Industry 4.0 Strategy** is to contribute to risk reduction in the work environment through automatic communication of its components, i.e. to improve health and safety of employees, increase their performance, comfort at work as well as during their personal activities.

"What most people need to learn in life is how to love people and use things instead of using people and loving things. It is not because things are difficult that we do not dare, it is because we do not dare that things are difficult." Seneca

III. Industry 4.0 – Concept IoT



Which types of relationships ?
M2ME,
M2M,
ME2ME,
M2WE...

Which types of hazards/threats are coming?
M2ME2ME2WE

Kagan Pitman (engineering.com) declaring, that I 4.0 represents connection between new technologies, based on IoT, with automation and "clouds" technology. Blood circulation of this system are data ways.

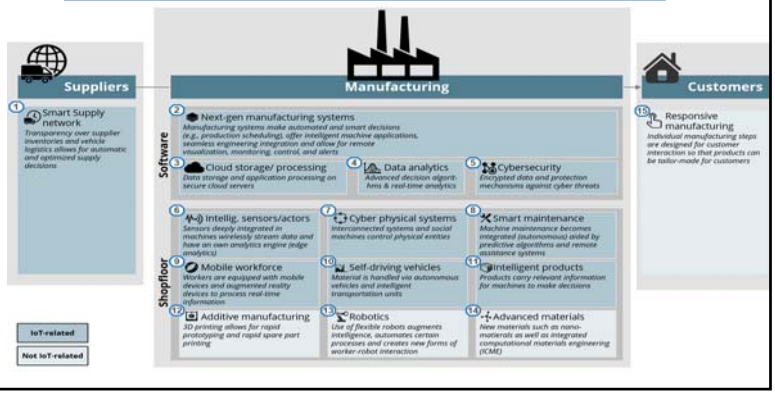
III. Industry 4.0 – Smart factory

Modular structure of SF is created by elements:

- *Cyber-physical system (CPS),*
- *Tangible processes,*
- *Internet of things (IoT),*
- *Communication network.*

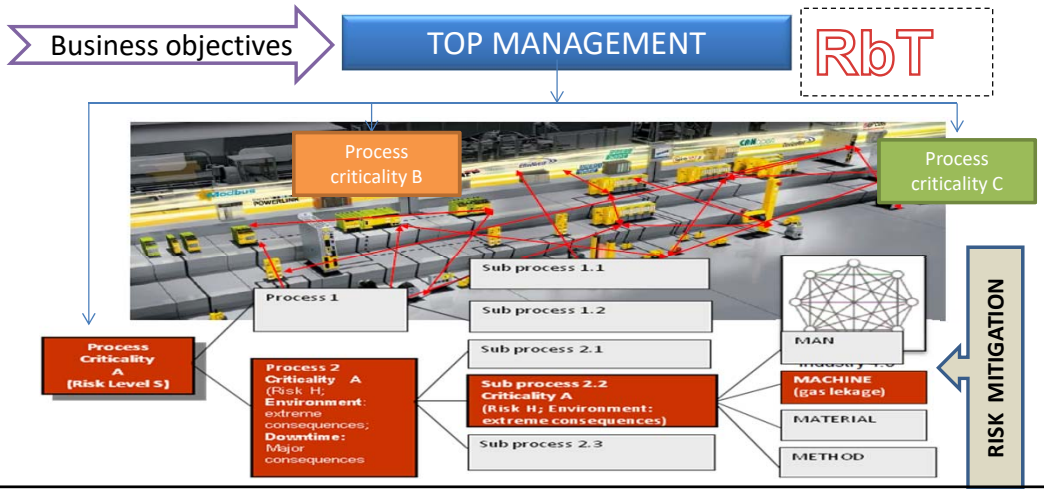
Basis of SF function is dynamic decisonmaking, which ensured to fulfil objectives in frame of ***„core-business" requirements.***

83% expect data to have a significant impact on their decision-making in five years;
only about half are currently using data to drive decisions.



IV. Risk parameters identification

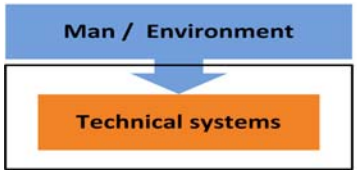
Smart processes in Smart factory with Smart elements 4M?

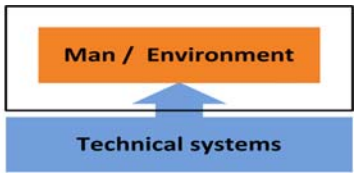


IV. 4M PROBABILITY LEVEL IDENTIFICATION

Probability of harm - effect of uncertainity					
LEVEL (Scale)	Frequency	**MAN**	**MACHINE**	**MATERIAL**	**METHOD**
		Effect of uncertainty			
		Fault (error)	*Failure*	*Damage/error*	*Effectivness*
5	From 1 to 5	intentional error (sabotage)	irreversible damage to the machine	unobserved strength characteristics	work instruction does not exist
4		unintentional error of large extent	significant damage to the machine (big corrective action)	unobserved material composition	training system does not exist
3		unintentional error of middle extent	small damage (simple maintenance action)	unobserved dimensional error	traing of the employees was not carried out
2		unintentional error of small extent	replacement of working tool	significant visual damage	the employee was not instructed
1		negligible error	short downtime for setting the machine	minor visual damage	new employee

IV. Safety vs.Security



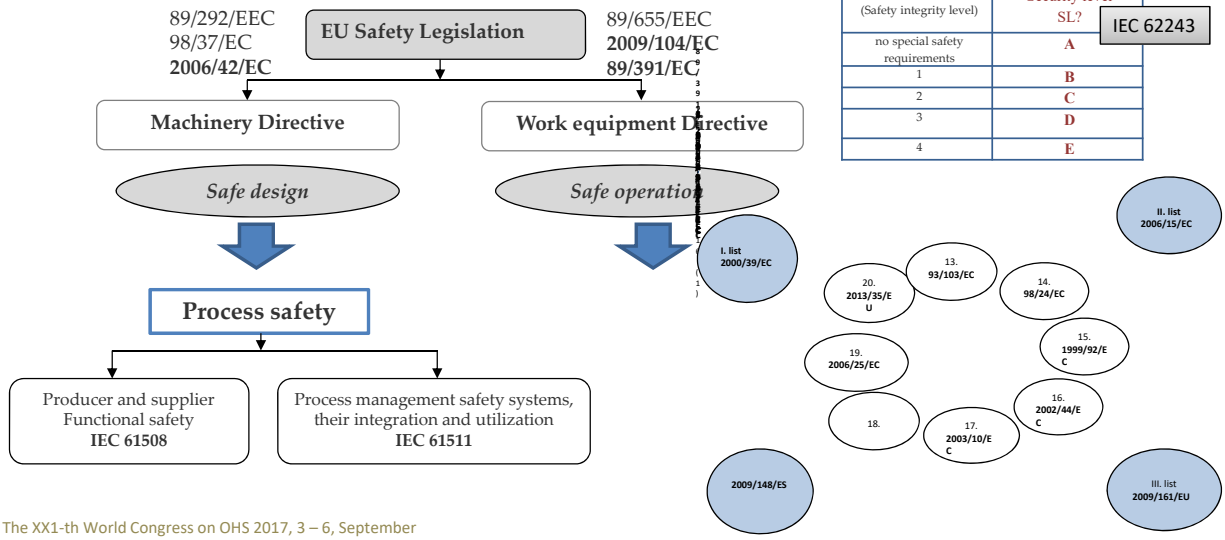


Threats vs. Hazards

PL	PFD_{avg} (Average probability of a dangerous failure per hour)	SIL (Safety integrity level)	Security level SL?
a	$\geq 10^{-5}$ to $< 10^{-4}$	no special safety requirements	A
b	$\geq 3.10^{-6}$ to $< 10^{-5}$	1	B
c	$\geq 10^{-6}$ to $< 3.10^{-6}$	2	C
d	$\geq 10^{-7}$ to $< 10^{-6}$	3	D
e	$\geq 10^{-8}$ to $< 10^{-7}$	4	E

PL	PFD_{avg} (Average probability of a dangerous failure per hour)	SIL (Safety integrity level)
a	$\geq 10^{-5}$ to $< 10^{-4}$	no special safety requirements
b	$\geq 3.10^{-6}$ to $< 10^{-5}$	1
c	$\geq 10^{-6}$ to $< 3.10^{-6}$	2
d	$\geq 10^{-7}$ to $< 10^{-6}$	3
e	$\geq 10^{-8}$ to $< 10^{-7}$	4

IV. Mitigation tools and methods



SIL (Safety integrity level)	Security level SL?
no special safety requirements	A
1	B
2	C
3	D
4	E

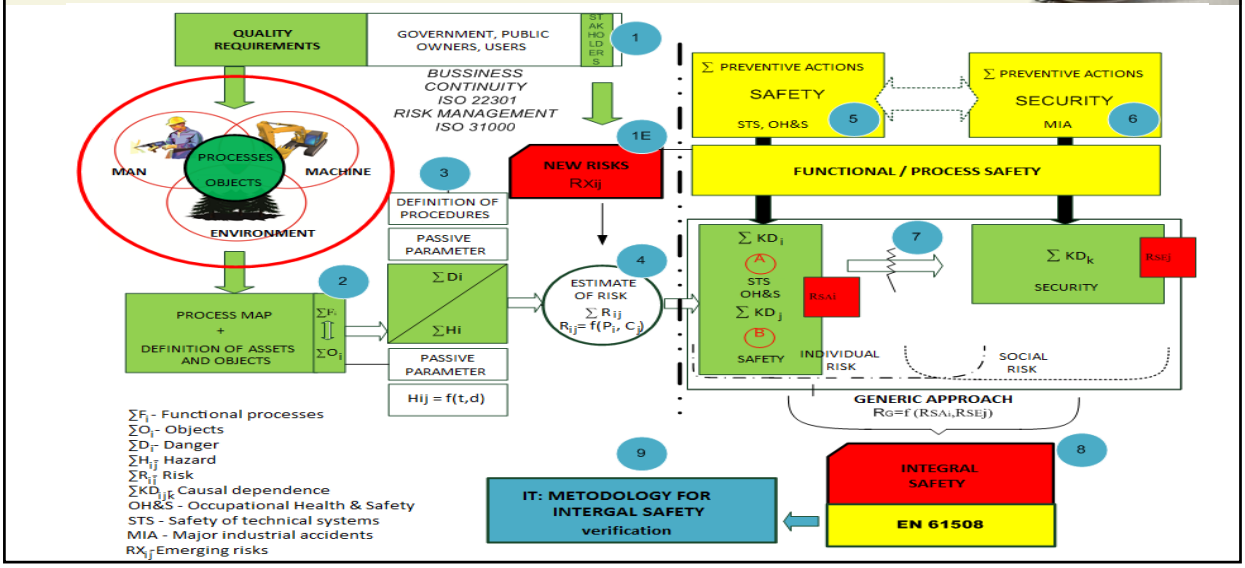
IEC 62243

V. Generic Risk Assessment Model

- **History**: *projects* - APVV, iNteg-Risk (7FP); *companies cooperation* - PIMS, Seveso, RCM, RBI, …
- **Present:** first version of GRAM – processes orientation.

Future: improvement according GRAM verification from practical studies.

V. Base GRAM scheme



V. GRAM parameters $R = \sum_{i=1}^{n} P_i C_i$

The aim of the second stage was to identify the areas of possible correlations of individual processes in risk management processes by identifying critical objects.
Areas of potential adverse impacts of CCS and their assessment:

- Health and Safety (OH&S) - Safety - CSa
- Environmental leaks and pollution - Environment - CE
- Downtime - the duration of the service interruption - Downtime - CD
- Quality - Customer Satisfaction - Quality - CQ
- The cost of repairing the equipment - Repair Cost - CR
- Financial losses and property losses - Financial loses / Property - CF.

V. MULTI-CRITERIA MATRIX FOR EACH AREA OF LOSSES CCS

Category of losses – CCS		Level of loss							
		I. Minor		II. Moderate		III. Critical		IV. Catastrophic	
CSa	OH&S	S1	no impact on human	S2	Injury or a partial harm to health	S3	Serious injury, significant damage to health	S4	Higher number of people death
CE	Environment	E1	No damage (e.g. contamination)	E2	Damage/contamination in operation manageable by own resources	E3	Extent of damage/leakage in operation is serious, help is necessary during its removal	E4	Extent of damage/leakage is disastrous and has long-term impact on the area around the plant
CD	Operation (downtime)	D1	Operation downtime is negligible	D2	Operation downtime up to 2 hours.	D3	Operation downtime is from 2 hrs. to 24 hrs.	D4	Operation downtime is more than 24 hrs.
CQ	Quality	Q1	Product defect has no impact on the product quality	Q2	Product defect must be additionally removed	Q3	Product defect requires repeated production (recasting)	Q4	Product defect requires the change of technology. Dissatisfaction of customer
CR	Cost of repairs	R1	Repair will not exceed cost planning	R2	Repair cost exceeds 1000 Euro	R3	Repair cost is over 1000 and less than 5000 Euro	R4	Repair cost exceeds 5000 Euro
CF	Financial loss - property	F1	Minimal impact on the budget	F2	Higher energy consumption up to 5000 Euro	F3	Losses exceed 5000 Euro, less than 20000 EUR	F4	Losses are high and exceed 20000 Euro

V. MULTI-CRITERIA MATRIX - EVALUATION

$$Cg_i = f(Sa_i, E_i, Q_i, D_i, R_i, F_i, IS_i)$$

Criticality level RK_i	Safety CSa	Environment CE	Operation CD	Quality CQ	Repair costs CR	Financial loss CF
	V *4	V*3	V=1	V*2	V=1	V=1,5
A3: V = 8	32	24	8	16	8	12
A2: V = 7	28	21	7	14	7	10,5
A1: V = 6	24	18	6	12	6	9
B2: V = 5	20	15	5	10	5	7,5
B1: V = 4	16	12	4	8	4	6
C3: V = 3	12	9	3	6	3	4,5
C2: V = 2	8	6	2	4	2	3
C1: V = 1	4	3	1	2	1	1,5

Risk assessment of an object RKI:
Very high risk VVR: points from 75 to 100; High risk VR: points from 41 to 74;
Medium risk SR: points from 28 to 41; Low risk NR: points to 27.

Remark 1: Weight of RK_i is related to the analysis of criticality of objects – category A, B, C. Probability is defined at max. 5 levels.

V. MULTI-CRITERIA MATRIX - EVALUATION

$$Pg_i = f(Pa_i, Pe_i, LCm_i, Eu_i)$$

To determine the estimates of probability of the risks (hazards/threats), point scores were applied and divided into five levels. However, taking into account all aspects and impacts on the probability of a negative event) in the space of Sa & Se (hazard and threat) led to modeling of the probability.

Where:

Pa_i – the probability of the *i* risk (hazard/safety),

Pe_i – the probability of the *i* risk (threat/security),

LCm_i – taking account the impact of life cycle stage

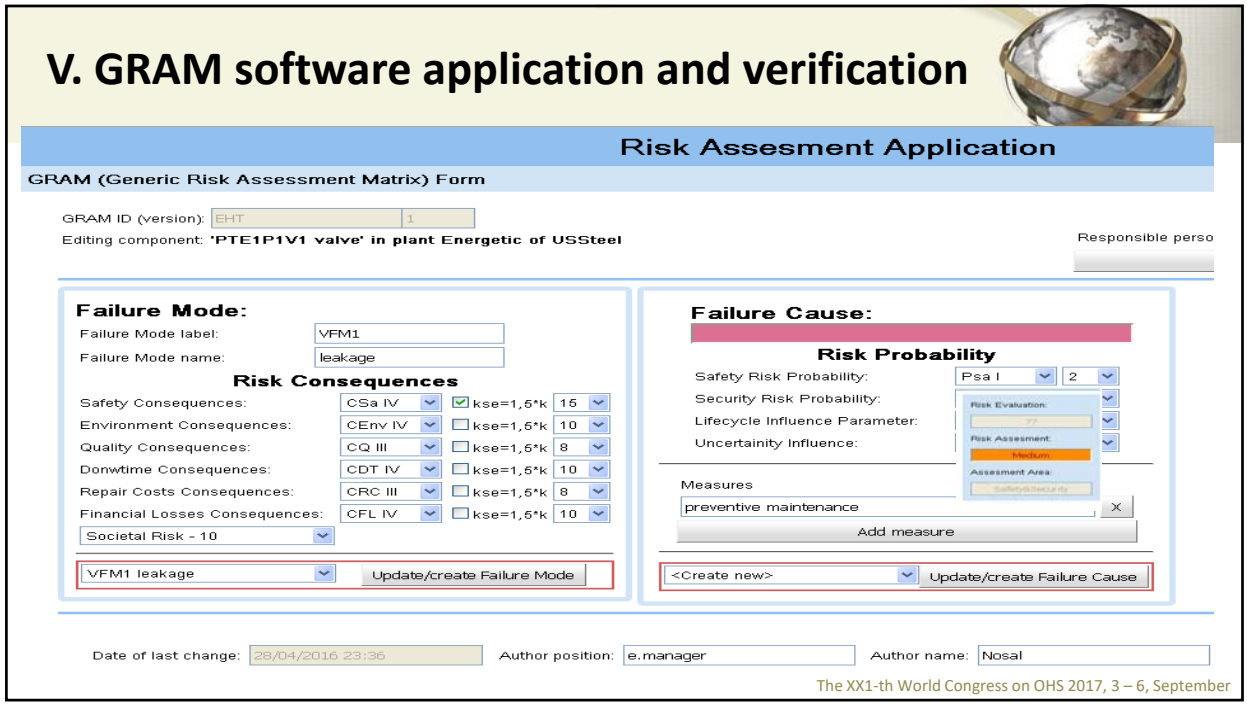
Eu_i – the impact of uncertainty as a factor in the type of risk.

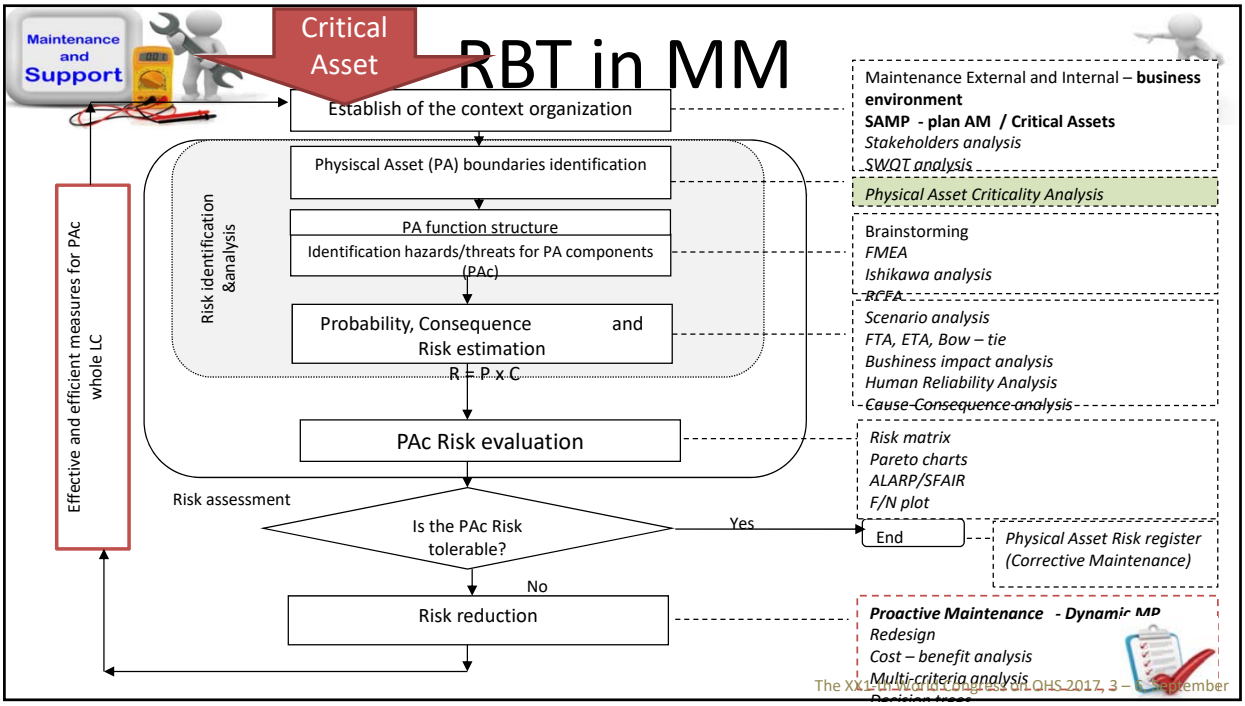
V. GRAM - RISK MATRIX

Cg = Sa+E+Q+D+R+F+IS *Pg = Pse+Psa+LCm+Eu*	CI	CII	CIII	CIV
PI	22-39	29-58	48-74	64-115
PII	34-45	41-64	60-80	76-121
PIII	39-54	46-73	65-89	81-130
PIV	49-64	56-83	75-99	91-140

Low risk (22 – 58)	There is no need to take action - *residual risk*
Medium risk (59 – 83)	It is necessary to adopt measures - ***ALARP principle (As Low as Reasonable Possible)***
High risk (84 – 140)	It is necessary to investigate all the effects and take immediate action!

V. GRAM software application and verification




Maintenance and Support
Critical Asset
RBT in MM
Establish of the context organization
Physiscal Asset (PA) boundaries identification
PA function structure
Identification hazards/threats for PA components (PAc)
Probability, Consequence and Risk estimation
R = P x C
Risk identification &analysis
PAc Risk evaluation
Risk assessment
Is the PAc Risk tolerable?
Yes
No
Risk reduction
Effective and efficient measures for PAc whole LC
Maintenance External and Internal – business environment
SAMP - plan AM / Critical Assets
Stakeholders analysis
SWOT analysis
Physical Asset Criticality Analysis
Brainstorming
FMEA
Ishikawa analysis
RCFA
Scenario analysis
FTA, ETA, Bow – tie
Bushiness impact analysis
Human Reliability Analysis
Cause-Consequence analysis
Risk matrix
Pareto charts
ALARP/SFAIR
F/N plot
End
Physical Asset Risk register (Corrective Maintenance)
Proactive Maintenance - Dynamic MP
Redesign
Cost – benefit analysis
Multi-criteria analysis
The XX1-th World Congress on OHS 2017, 3 – 6, September


THANK YOU FOR YOUR ATTENTION!
CONTACT:
Hana Pacaiova
Technical University of Kosice,
Faculty of Mechanical Engineering,
Safety and Quality Production Department
Letna 9, 040 01 Kosice
Slovakia
hana.pacaiova@tuke.sk
+421 903719474
The XX1-th World Congress on OHS 2017, 3 – 6, September

SAFE MACHINERY

KEY FOR SMART MANUFACTURING

SICK
Sensor Intelligence.

Otto Görnemann

Industrial Safety Systems

2017 – 09 – 01

SICK AG AT A GLANCE
AS OF 2017

➜ SICK – worldwide one of the leading manufacturers of sensors and sensor solutions for industrial applications

70 Years of experience. Founded 1946.

8000 Employees worldwide

90 Countries with SICK presence : More than 50 subsidiaries and participations as well as numerous specialized agencies

1267 Million euros Group sales in the fiscal year 2015

40,000 Products and thus widest product and technology portfolio in the sensor industry

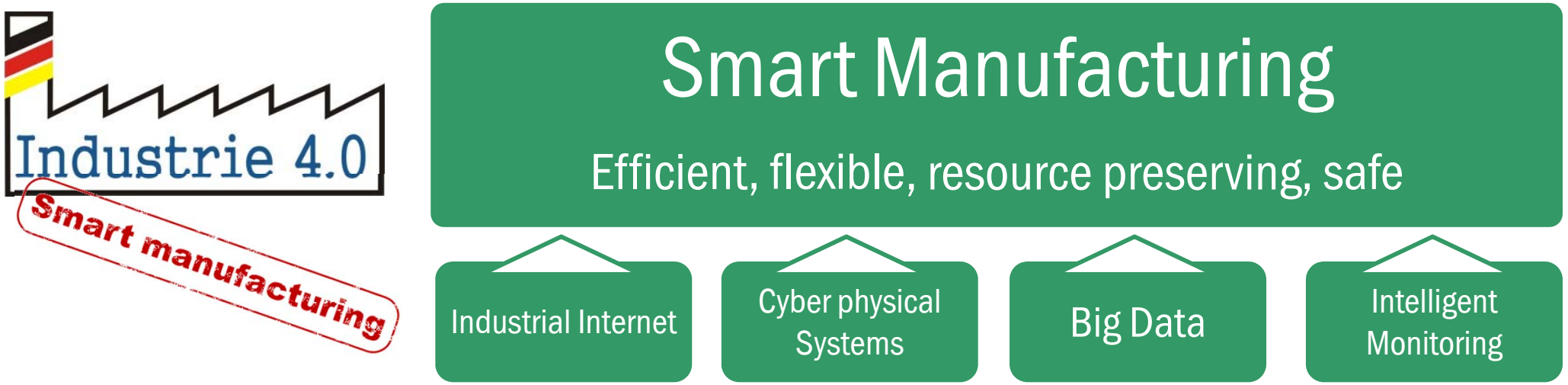
3000 Patents and thus leading in developing innovative sensor solutions

SICK
Sensor Intelligence.

Otto Görnemann

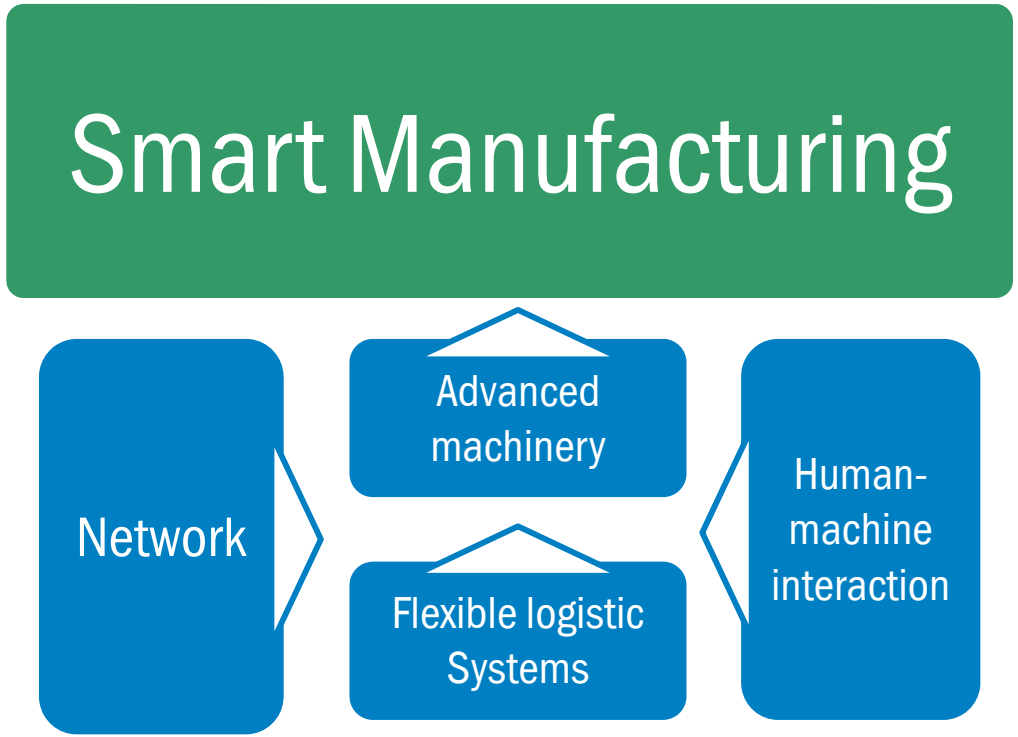
- Manager for machinery safety
  - Standards & regulations -
- Since 1995 employee of SICK AG
  - Industrial Safety Systems Division –
- FS Expert (TÜV Rheinland, #263/16, Machinery)
- Member of different standardization committees of ISO – IEC – CEN – DIN – AENOR – ISSA
- ISO/TC 199 Safety of Machinery
  Elected Chairman, effective 1.1.2018
- CEN/TC114 Safety of Machinery - Chairman
- ISO/TC110 Industrial vehicles
- ISO/TC 299 Robotics
- ISO/TC 39 Machine tools – Expert & Liaison officer
- CEN/TC 146 Packaging Machinery
- IEC TC 44 Safety of Machinery – Liaison officer

- The goal of “Smart manufacturing” (Industry 4.0) is an efficient production through integration of IT Technologies & Processes in manufacturing



SMART MANUFACTURING
RISKS

- Advanced machinery
  - On demand manufacturing
  - Mobile robotics
- Flexible logistic systems
  - Driverless industrial trucks, AGV's
  - Robotic load handling & cranes
- Human Machine Interaction
  - Loading & unloading stations
  - Collaborative robots
- Network
  - Cybersecurity
  - Availability

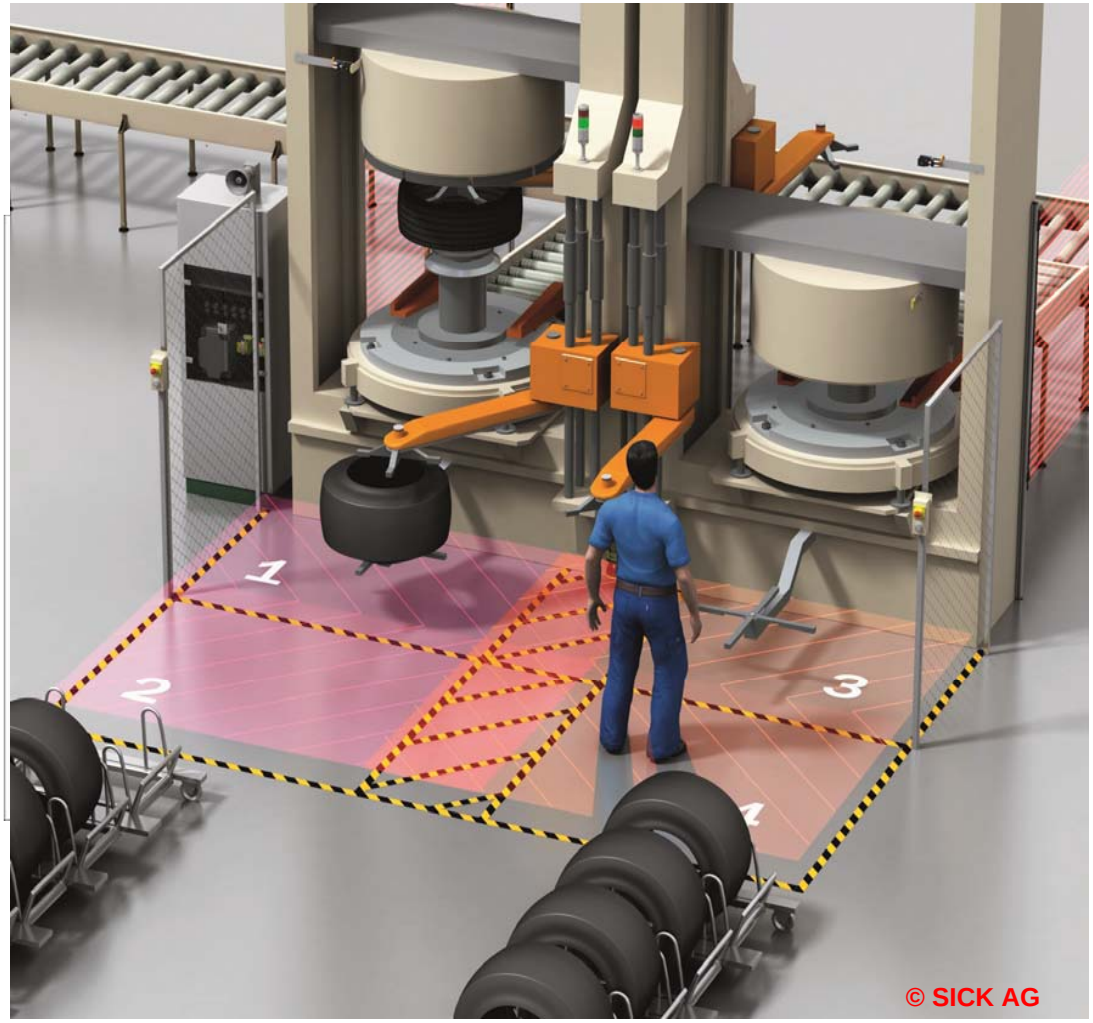


No "Smart manufacturing" is possible without eliminating or controlling these risks !

ADVANCED MACHINERY
ON DEMAND MANUFACTURING

SICK
Sensor Intelligence.

- Risks
  - Increasing demand for flexible machinery
  - Fixed & movable guards unsuitable for the safeguarding of loading and unloading stations
  - Higher number of accessible hazardous points
  - More unexpected movements of machine parts
- Measures
  - More detailed risk assessment
  - Consideration of complex interacting scenarios
  - Application of sensitive protective equipment (especially ESPE – Electro-sensitive protective eq.)
  - Application of high performance safety controllers



- Requirements
  - Flexibly deployable robots / mobile robots
  - Industrial robot requirements + Driverless industrial trucks requirements
  - Not a “new” technology but needs careful consideration
  - 3D – Safeguarding nearly imperative
- Measures
  - More detailed risk assessment
  - Consideration of stability during complex operation (Translation + Handling)
  - Application of sensitive protective equipment (especially ESPE – Electro-sensitive protective eq.)
  - Application of high performance safety controllers

FLEXIBLE LOGISTIC SYSTEMS
DRIVERLESS INDUSTRIAL TRUCKS & AGV'S

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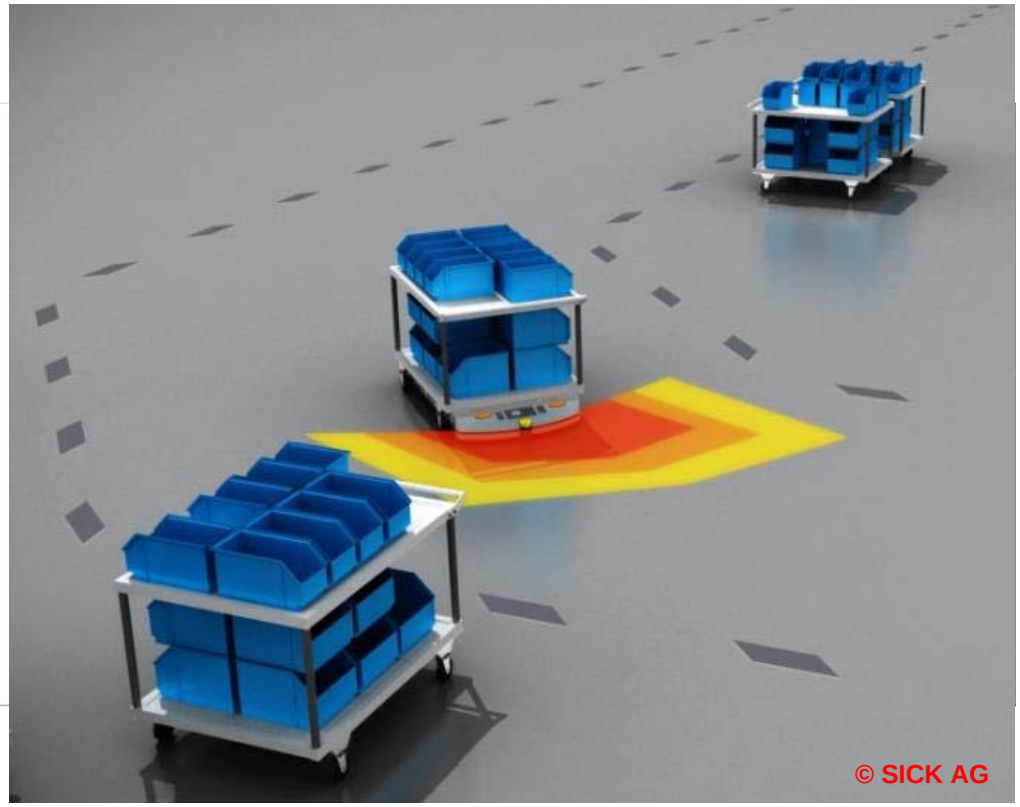
- Requirements
  - Increasing number of vehicles = higher likelihood of collisions. = PL "d" safeguarding functions
  - Proven in use technology
  - 3D – Safeguarding required for some applications
- Measures
  - More detailed risk assessment
  - Consideration of stability during autonomous driving
  - Application of adaptive sensitive protective equipment (especially ESPE – Electro-sensitive protective eq.)
  - Application of high performance safety controllers
  - Networking with navigation & dispatching SW



FLEXIBLE LOGISTIC SYSTEMS

SAFEGUARDING OF AN AGV LOADING & UNLOADING STATION

SICK
Sensor Intelligence.

- Area safeguarding with AOPDDR (Safety Laser Scanners)
- Passage enabled by combined signals of the navigation computer + location sensors
- Production line, palletizing robot & AGV can be used for a broad range of products

FLEXIBLE LOGISTIC SYSTEMS

RELIABLE AND REAL TIME DETECTION AND DIFFERENTIATION PERSON-MATERIAL

SICK
Sensor Intelligence.

- Heavy duty industrial driverless truck for transport and stacking of concrete stone products (Lintel Betonwerke / Germany)

FLEXIBLE LOGISTIC SYSTEMS

HEAVY DUTY OUTDOOR INDUSTRIAL DRIVERLESS TRUCK – NETWORK OVERVIEW

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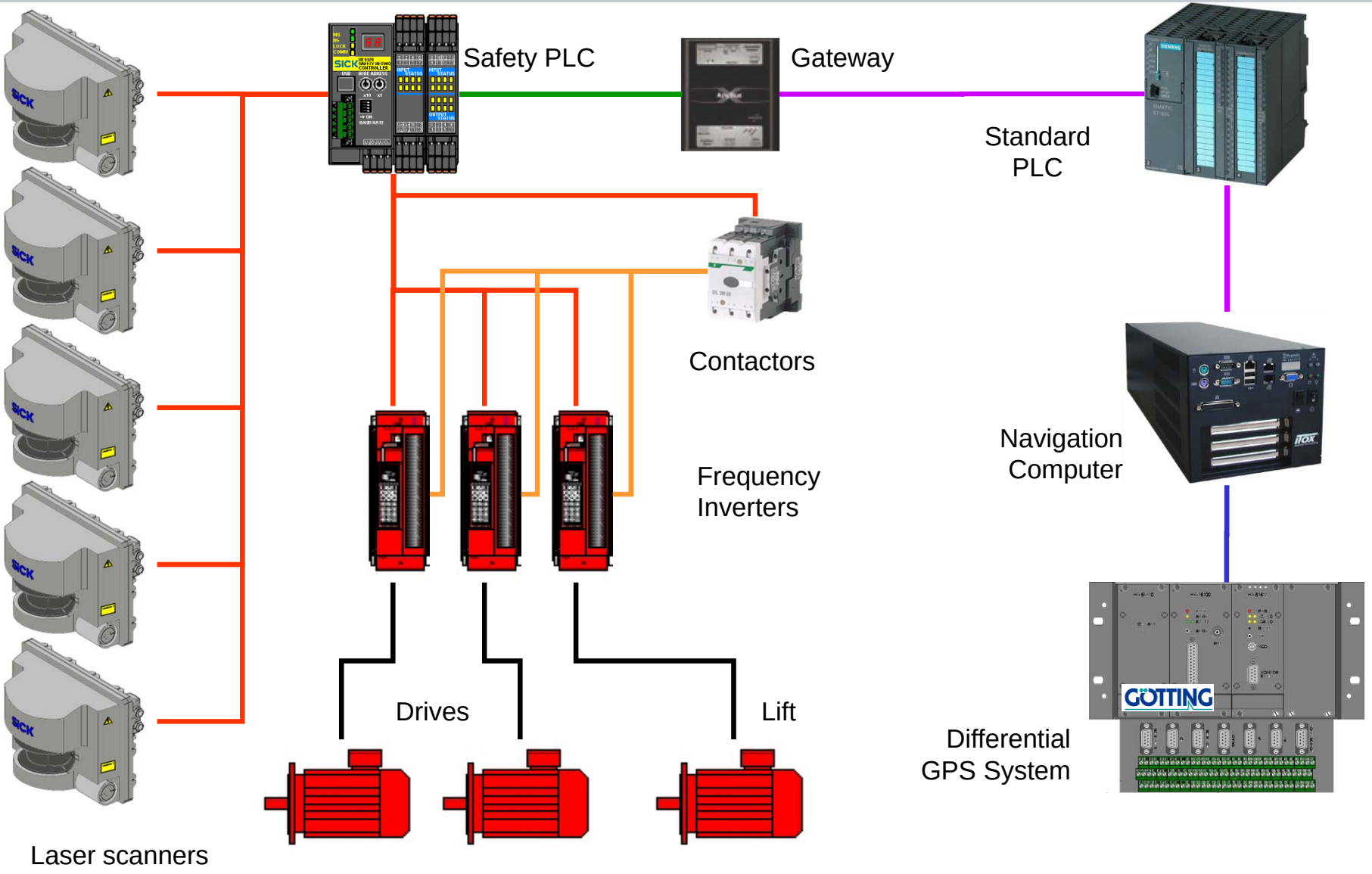
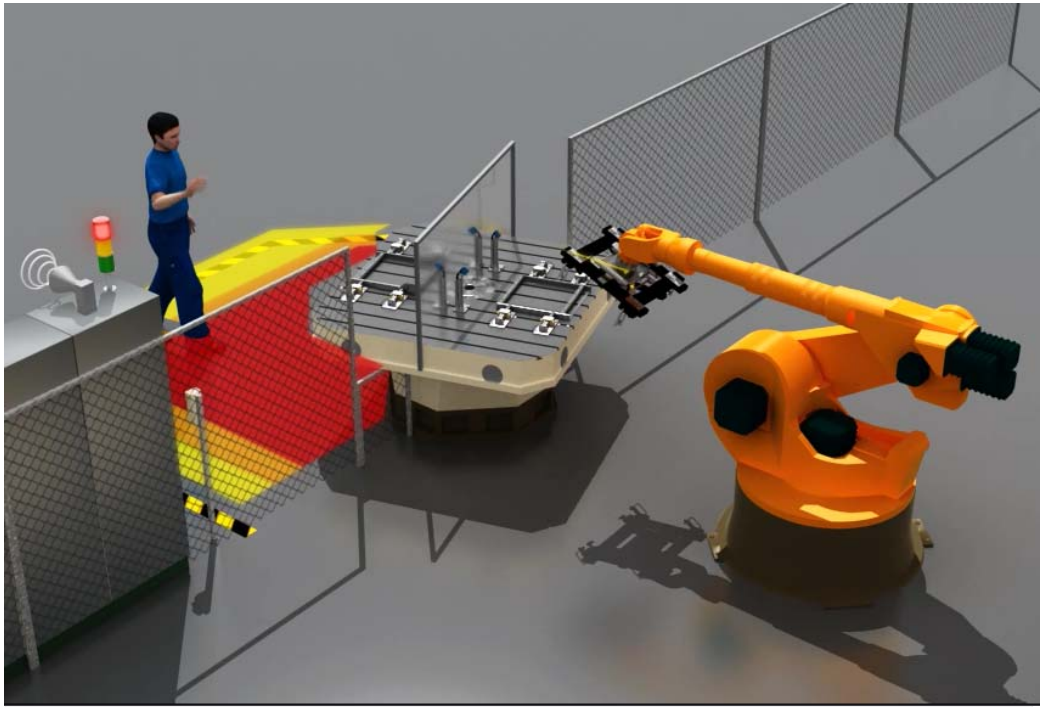


HUMAN MACHINE INTERACTION

LOADING & UNLOADING STATIONS / ENTRY – EXIT STATIONS

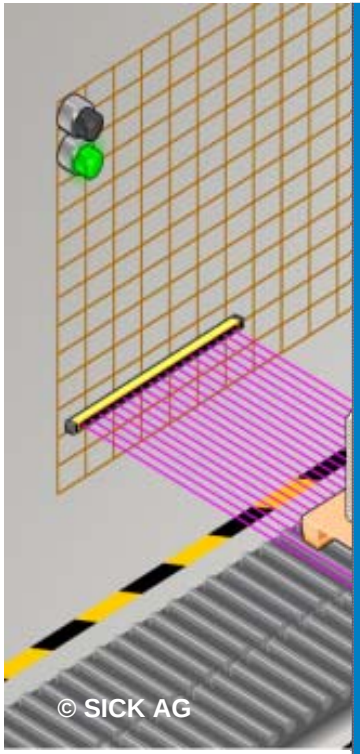
- Requirements
  - Increasing number of loading and unloading tasks due to small batches
  - Complex interaction due to changing product characteristics
  - Complex safeguarding tasks
- Measures
  - More detailed risk assessment
  - Application of adaptive protective equipment (especially ESPE)
  - Application of high performance safety controllers
  - Networking with other machines of the IMS

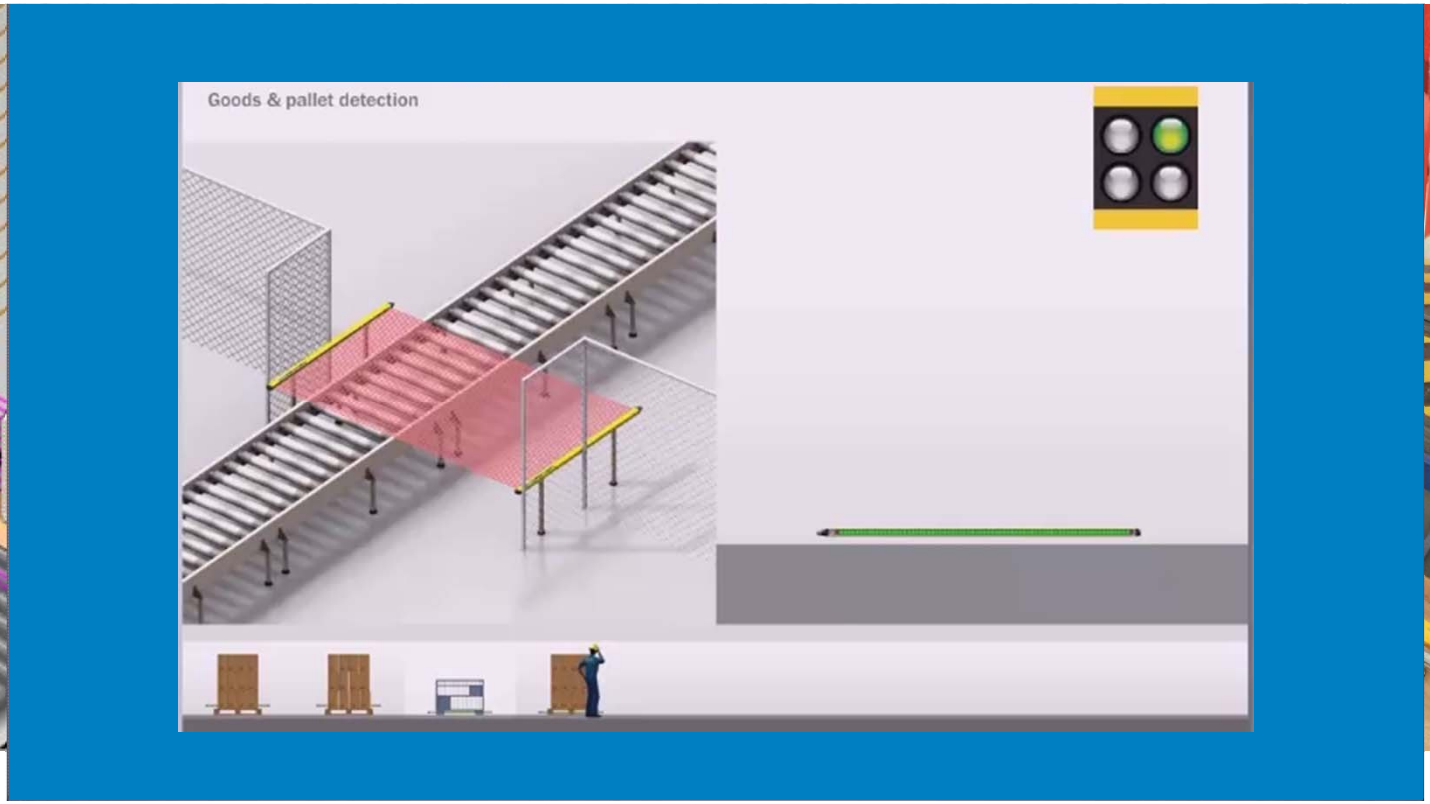


HUMAN MACHINE INTERACTION

LOADING & UNLOADING STATIONS / ENTRY – EXIT STATIONS

- Fast & reliable person differentiation is required
- Differentiation of persons from objects is only possible in a small number of applications !
- Standard solutions are available for many applications !
- In future : Sensor-fusion !

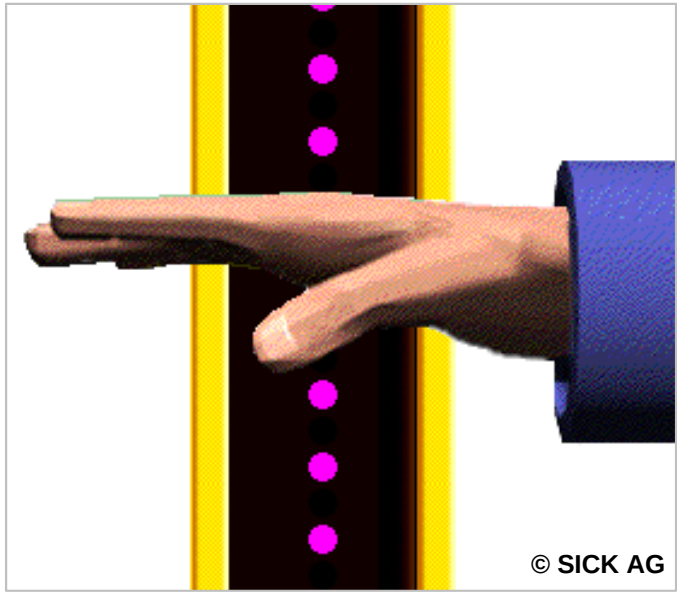


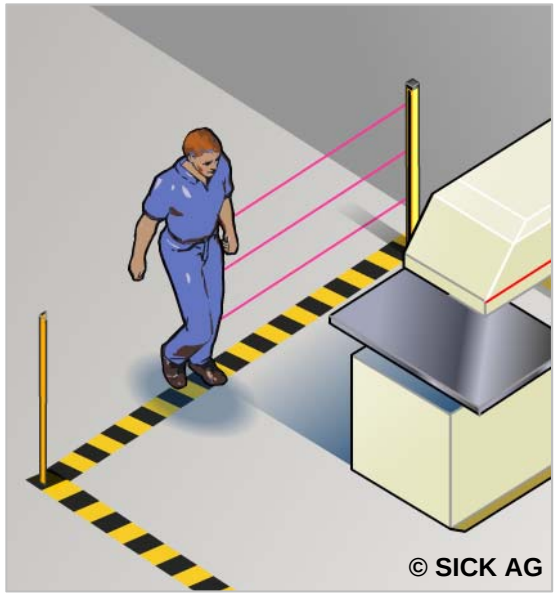


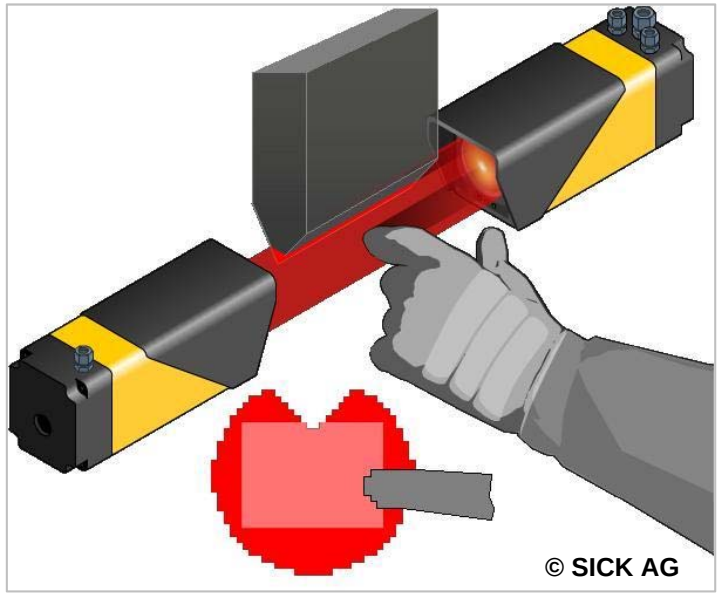
HUMAN MACHINE INTERACTION

FAST & RELIABLE PERSON DIFFERENTIATION

- Actually only the detection of objects with certain geometrical properties is possible (Body parts)

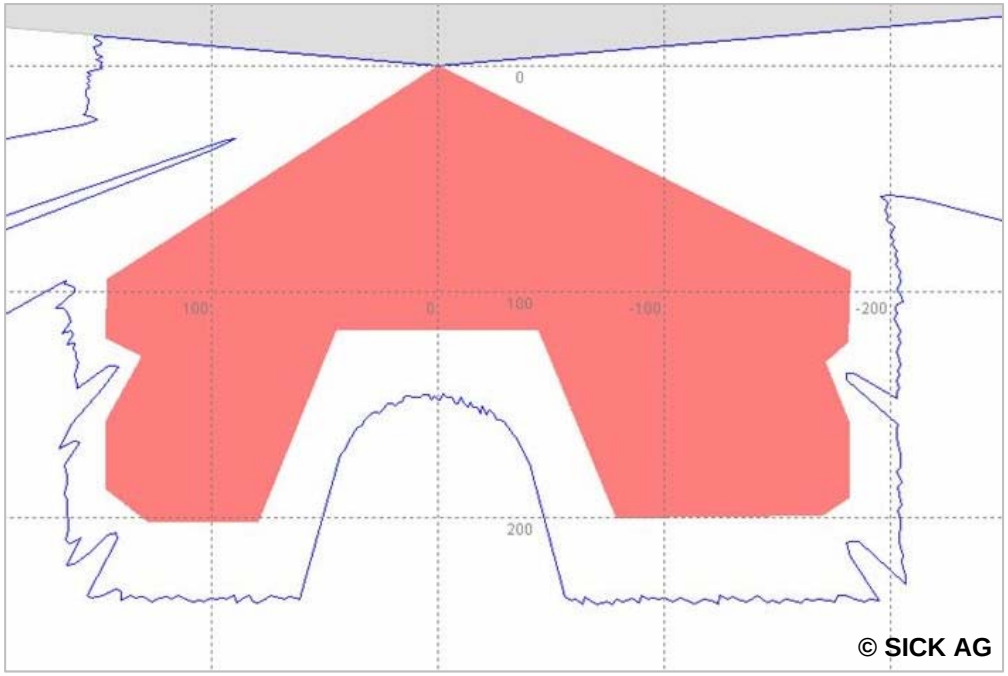






HUMAN MACHINE INTERACTION
LOADING AND UNLOADING STATIONS

- Application of AOPDDR for the safeguarding of a product line exit (Safety Laser Scanner)
- The information of the Barcode scanner is used to switch the proper detection field od the AOPDDR



- Decentralization through task based separation
- Systems perform their tasks autonomously
- At exceptions, interferences or conflicts, tasks are delegated to a higher level.
  (this is no applicable for safety !)

RISK REDUCTION

SAFE DECENTRALIZATION @ SENSOR–LOGIC–ACTOR LEVEL

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Sensor Intelligence.

- Classic decentralization through Field & Remote safety I/O's

- Risks
  - Complex Networking - Different layers & Partners
  - Increasing number of access points for criminals
  - Cyber attacks may lead to collateral damage like loss of the safety functions, wrong parametrizing
  - Direct cyber attacks to induce accidents are not expected.... but possible !
- Measures
  - At component level
    - Device programming protected e.g. by password
  - At machine manufacturers level
    - Securing machine parametrizing & communications
  - At machine users level
    - Securing physical access to interfaces and networks
    - Securing virtual access to networks

Framework for Improving Critical Infrastructure Cybersecurity - Version 1.0 - NIST
(U.S). National Institute of Standards and Technology
February 12, 2014

CONCLUSIONS - OUTLOOK

SAFE MACHINERY & SMART MANUFACTURING ?

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- Unsafe machinery may be the source for:
  - Increased risk of hazardous contacts due to flexible logistics and human-machine cooperation
  - Undesirable high stress to operators caused by the uncertainty about machine reactions
  - Collateral damage to persons due to cyber attacks

Safe Machinery is therefore a key element for smart manufacturing

- Proper integration of IT technologies and the use of process data can be applied :
  - To improve the safety of machines through reduction of uncertainty in control systems
  - To significantly reduce costs by covering existing safety gaps
  - To significantly improve ergonomics of the workplace

THANK YOU FOR YOUR KIND ATTENTION

SICK
Sensor Intelligence.

Otto Görnemann
GBC - Industrial Safety
Tel.: +49 7681 202 5420
Otto.Goernemann@sick.de

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XXI WORLD CONGRESS ON SAFETY & HEALTH AT WORK 2017

Promoting excellence in social security

Symposium
OSH in the new digital world

INRS FORESIGHT STUDY ON UBERISATION 2025

Possible consequences on the health and safety of employees in France by 2025

Marie Defrance
INRS

Singapore, 4 September 2017

Website: http://en.inrs.fr

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UBERISATION

- **Definition:**

Use of computing platforms, such as mobile applications, in order to facilitate peer to peer transactions between clients and providers of a service, often bypassing the role of centrally planned corporations

- **Promotes the use of items rather than ownership**
- **Has been made possible by the development of digital technologies (enable potential customers to be put in direct contact with potential providers of a service)**
- **This new type of consumption meets new expectations of consumers.**

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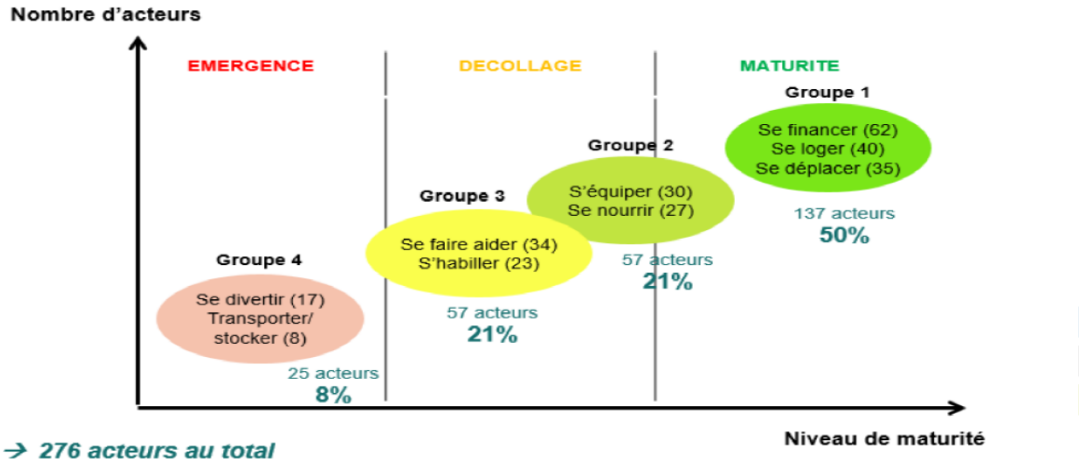
COMPUTING PLATFORMS IN FRANCE



→ *276 acteurs au total*

www.issa.int

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inrs 70 years

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WHY FORESIGHT?

- To have a vision of the main transformations occurring in work and employment that can be imagined for 2025 and **their impacts in the field of OSH**
- In foresight studies, we do not claim to describe the future and the way things will happen.
- We only **give elements that can help decision-makers to define policy**.
- Foresight **can help us stay alert to emerging signals**, providing an overall vision of the main issues which are likely to become important in OSH in the coming years.

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FORESIGHT METHOD

1. Teams put together for foresight must be pluridisciplinary → Constitution of the project group with 6 external partners.
2. Analysis of the subject addressed: Determining the different variables that have had significant influence on the evolution of the subject addressed over the past years.
3. **Various scenarios** are built by **combining the different hypotheses of the different variables**.
4. Focus on 3 sectors: **retail trade**, **health** and **interior fit-out**

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CURRENT STEPS

- **The scenarios are proposed for discussion by experts and field players in charge of identifying possible factors that may cause a break or discontinuity in trends.**
- **The last step will consist in translating these scenarios into consequences for occupational safety and health.**

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RETAIL TRADE: EVOLUTIONS LEADING TO THE SCENARIO

- Social evolutions (low growth, under-employment, changes in labour law, ageing population)
- Changes in consumption (mass consumption, development of e-commerce, “everything now” mentality/ delivery within one hour),
- Technological progress (artificial intelligence, automation, robotisation)
- Greater environmental constraints hindering urban freight transport

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SCENARIO FOR RETAIL TRADE

- In 2027, households use these platforms almost exclusively for their consumption purposes
- Neighbourhood logistics are set up through multi-service outlets (food, services, reception/dispatch)
- Some shops continue to exist but they are mostly showrooms rather than retail outlets

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HEALTH AND SAFETY CONSEQUENCES

Early on, development of increasingly responsive logistics can have different consequences:

- Increase in man/robot collaboration situations in warehouses, in particular with situations where the operator's work is directed by AI (voice-picking) or co-activity between autonomous vehicles and operators.
- Handling and lifting under time constraints
- Unusual working hours (night work, fragmentation of working time),
- Weakening of the collective unit of workers because of a drop in staff and heavy rotation of workers

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HEALTH AND SAFETY CONSEQUENCES

Later on, it is the last mile in logistics that generates the most risk, in particular road risks and risks associated with handling:

- Independent workers left to manage their work equipment, working pace and hours
- Workers made to compete with each other, lack of a collective working unit
- Work done according to algorithms with no regard for the work situation out in the field
- Handling and lifting tasks against changing contexts, deliveries to our doors, changes in weight and dimensions of loads, etc.
- Lack of job orientation, low qualifications, operators not aware about prevention
- Exposure of delivery persons to dissatisfaction of clients

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FIT-OUT TRADE: EVOLUTIONS LEADING TO THE SCENARIO

- Emergence of B2C platforms, or DIYs to consumer platforms (about 150 in 2017)
- Merging of the general social security scheme and the social security scheme for self-employed workers
- The government promotes the creation of enterprises
- Mediation between individuals and professionals
- Development of the internet of things and home automation (preventive maintenance, energy savings)

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SCENARIO FOR FIT-OUT TRADE

- In 2025, all transactions between individuals and providers of fit-out services take place via platforms.
- These platforms do not act only as intermediaries but offer a range of other services: consulting, project funding, guarantees, sale and lease of material and equipment. They may be affiliates or partners of hardware stores or distribution outlets, building product manufacturers or insurance companies.

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HEALTH AND SAFETY CONSEQUENCES

- The use of platforms as intermediaries regulates the market by avoiding low quality services and concealed employment.
- Improvement of working conditions (information and training proposed by the platforms to tradesmen, lease of suitable material and equipment) to improve their quality and safety image
- Professionals no longer have to perform administrative and commercial tasks and can therefore devote more time to providing proper professional service.

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HEALTH AND SAFETY CONSEQUENCES

- Strong or even complete dependence of tradesmen on the platform leaving them little latitude to negotiate the type of contract, the price of the service and the conditions under which it is performed. However, the platform takes none of a traditional employer's responsibility for occupational risk prevention.
- Mandatory use of a platform can dehumanise the client relationship and isolate the building professional.

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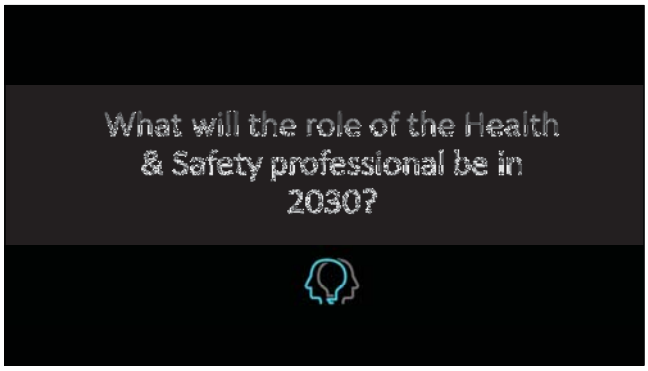
GLOBALLY: A REAL CHALLENGE FOR PREVENTION

- **A revolution for OSH:**
  - Prevention policy is based on the analysis of real work (vs prescribed work) and the working team (the workers cooperating) is considered as a major contributor to that analysis.
  - Given the difficulties encountered in implementing efficient OSH policies in small and medium-sized enterprises (SME), a specific new reference framework should be designed to deal with OSH for self-employed workers: several experiments have already been carried out in France.

- **Workers cooperating in a digital world:**
  - Is the relationship between workers cooperating in a digital world and their boss similar to that between classically salaried staff and their boss?


THE
FUTURE
SAFETY & HEALTH PROFESSIONAL
Cameron Stevens
- Percolate Ideas -

1


What will the role of the Health & Safety professional be in 2030?

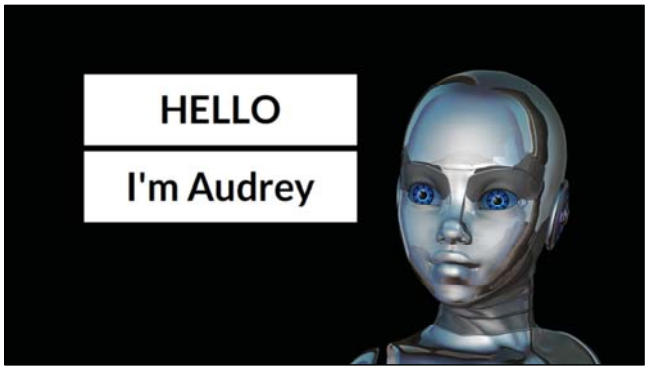
2

It's the year 2029

3

a relatively new company Spinifex Petroleum has a field of onshore gas wells located approximately 575km South East of Broome in the Canning Basin. Something is up with Spinifex Petroleum's Charlie 3 well.

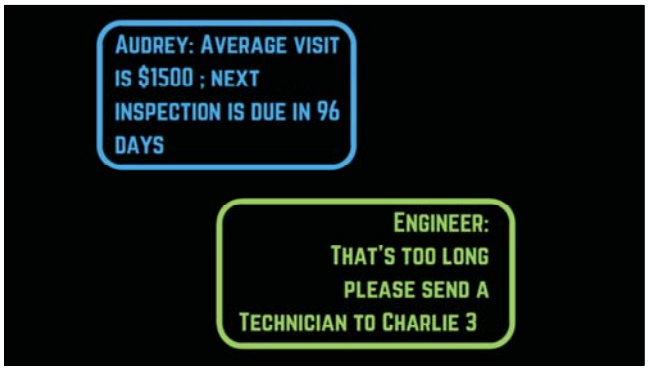
4



Its lost pressure and an artificial intelligence machine learning program called Audrey, which monitors thousands of wells, has looked at 27 similar incidents and suspects a leaking gasket on a wellhead connection.

Audrey sends a text to the Spinifex duty engineer asking permission to dispatch a field technician to inspect the Charlie 3 well.

The engineer sends a text back, asks about the cost, and the next planned inspection date. Audrey looks up the ten most recent field visits and reports that an inspection visit will likely cost $1500 and that the next scheduled visit is in 96 days.



The engineer texts, "Ok that's too long, send out a technician to Charlie 3 for troubleshooting" -

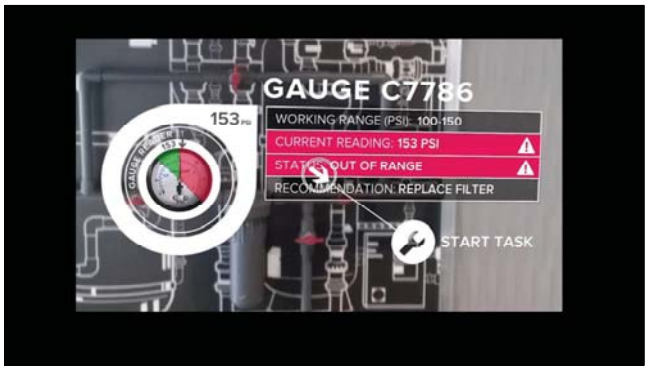
Audrey issues a work bid request to TheOilProfessionalsList, an online oil and gas professionals marketplace. The bid request specifies the required technical and HSE certifications for a field technician, sets a minimum supplier review rating, describes the job in detail, and provides the delivery window.

Thirty minutes later, Audrey has received and considered 22 offers. It selects Sally, who bid $990, and included a free light detection and radar survey of the well site with her proposal.

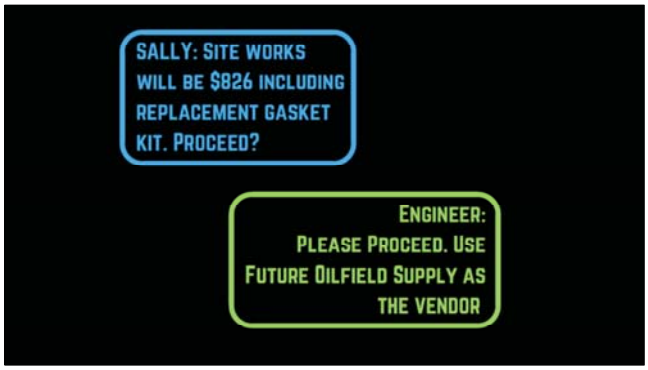
Audrey sends Sally a smart-contract which she accepts. $990 is transferred into a blockchain-based escrow holding account.

Sally receives confirmation of the deposit, hops into her truck, and drives to the site.

When she gets to the turn-off from the main road, she launches a drone from the back of her truck to fly ahead and locate the Charlie 3 well. She does this to avoid exposure to well-site hazards, and to avoid wrong turns and to scout washed-out roads.

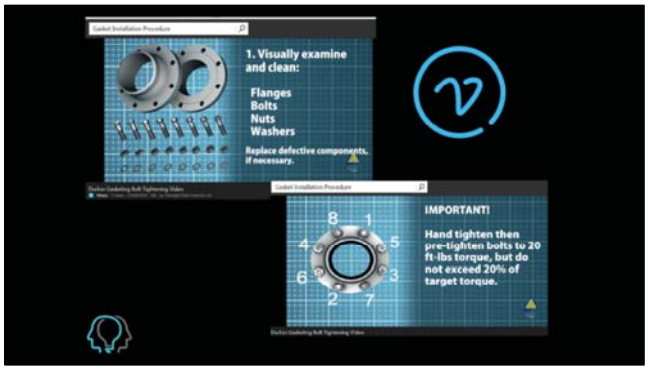


As the drone guides the truck to Charlie 3, the drone begins to inspect the well with visible, infrared, ultraviolet, radio, X-ray, and acoustic sensors. Sally reviews the drone's data as the truck drives itself the last 20 kilometers to the well. When she arrives, she gets straight to work. It looks as though Audrey was right; a gasket on a wellhead valve is leaking.

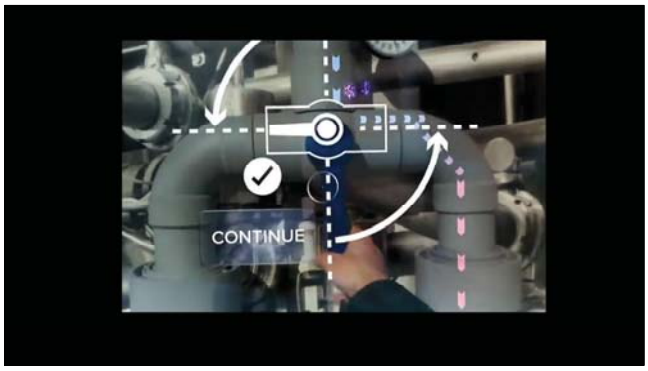


After a few confirmation tests, Sally texts a status report to Audrey and quotes a price to replace the leaking gasket. Audrey confers with the Spinifex duty engineer, who approves.

The gasket weighs a couple of kilos, so Audrey orders a replacement gasket kit from FutureOilfieldSupply and 35 minutes later a drone drops the package at the Charlie 3 well site where Sally is waiting.



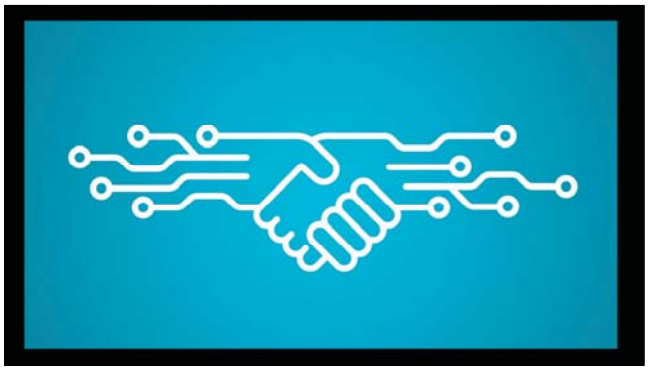
While FutureOilfieldSupply's drone was on-route, Sally watched a video tutorial describing exactly how to replace the gasket and the risks involved. She also read in the comments section about the best bolt securing sequence and tool selection to avoid crawling between pipework to access the other side of the wellhead.



The gasket in hand, tools in the pouch, she executes the repair in the standard 90 minutes, each step recorded and audited by the camera on her smart hardhat, and by the drone circling behind her. Her smart hat also confirms the well is back to standard operating pressure with no leaks

When she has packed up all her gear, Sally uses her chatbot, WorkDataManager, which automates a work package of forms, videos, annotated photos, and inspection scans for Audrey's approval.

19



After Sally has made a small edit, WorkDataManager sends the package; Audrey reviews it; confirms that Charlie 3's pressure has returned to normal; releases the escrow funds; awards Sally a 5-star review on OilProfessionalsList; updates the maintenance logs; and sends a partial billing statement to Spinifex Petroleum's working-interest owners - once received Audrey closes out the work order.

20


THE
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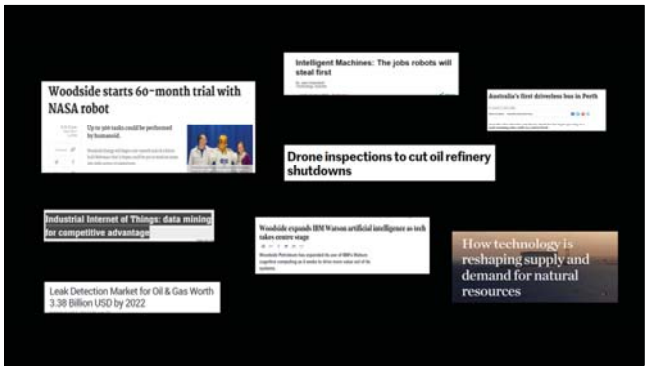
21


Woodside starts 60-month trial with NASA robot
Intelligent Machines: The jobs robots will steal first
Drone inspections to cut oil refinery shutdowns
Industrial Internet of Things: data mining for competitive advantage
Leak Detection Market for Oil & Gas Worth 3.38 Billion USD by 2022
How technology is reshaping supply and demand for natural resources

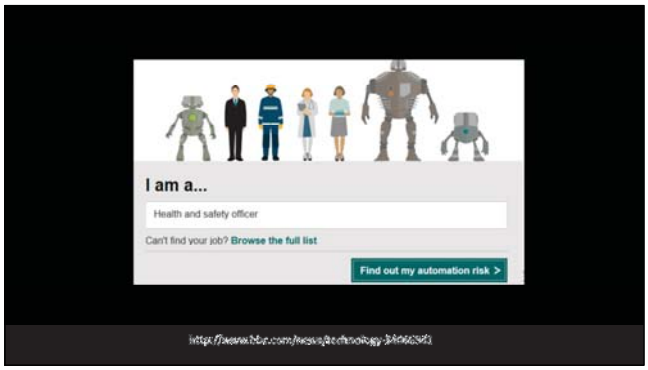
22

What will the role of the Health & Safety professional be in 2030?

WILL A ROBOT TAKE YOUR JOB?

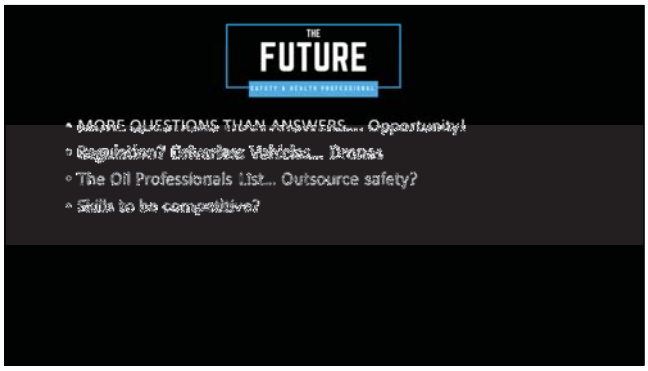

Sheet metal workers
Likelihood of automation?
It's fairly likely (78%)
How this compares with other jobs:
102nd of 366
100%
75%
50%
25%
0%
Most likely
Least likely
Plant and machine operatives (other)
Likelihood of automation?
It's quite likely (92%)
How this compares with other jobs:
46th of 366
100%
75%
50%
25%
0%
Most likely
Least likely

25


I am a...
Health and safety officer
Can't find your job? Browse the full list
Find out my automation risk >


Health and safety officers
Likelihood of automation?
It's too close to call (53%)
How this compares with other jobs:
171st of 386
100%
75%
50%
25%
0%
Most likely
Least likely
Share my result

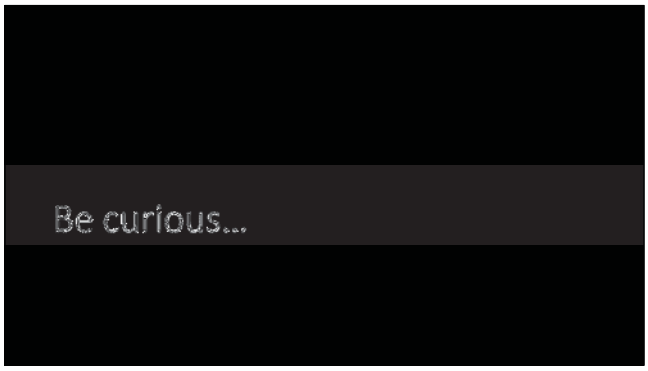
27


THE
FUTURE
SAFETY & HEALTH PROFESSIONAL
MORE QUESTIONS THAN ANSWERS… Opportunity!
Regulation? Driverless Vehicles… Drones
The Oil Professionals List… Outsource safety?
Skills to be competitive?

28


• Design
• Curiosity
• Digital literacy
• Creativity
• Critical thinking
• Strategy
• Empathy
THE
FUTURE
SAFETY & HEALTH PROFESSIONAL

29


Be curious...

30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RELEVANCE OF HUMAN AND SOCIAL CAPITAL IN THE NEW DIGITAL WORLD

Marja-Liisa Manka1, Liisa Hakala2,
Kirsi Heikkilä-Tammi1, Riitta-Liisa Larjovuori1

1 University of Tampere, Finland
2 Ministry of Social Affairs and Health, Finland

Background

- Changes in the working life
  - digitalization
  - changing employee -employer relationship, self-employment increasing in the digitalized working life
  - platform economy, collaborative economy
  - demographic change
  - changes in the content of work, in workplaces and how the work is performed, new professions, new exposures (perceived psychosocial strain, mixing of work and leisure etc)
  - polarization

(Commission Communication on "Safer and Healthier Work for All - Modernisation of the EU Occupational Safety and Health Legislation and Policy", 2017, COM(2017) 12 final; European Parliament Resolution on 15 June 2017 on a European Agenda for the collaborative economy 2017/2003(INI) ; "Digitalization changes the world – are new statistics needed to support economic policy?", Prime Minister's Office, 28 April 2017, 2/2017.)

- Future needs due to the changes in the working life
  - A need to increase inclusion and employment
  - A need to have new capabilities and working life skills to promote health, capacity for work , productivity and innovativeness and to increase employability in the new working life
  - Human and social capital
  - A need to increase occupational safety and health (OSH) promotion and empowerment in addition to risk prevention

2

OSH objectives in Finland

(defined by the Ministry of Social Affairs and Health, department for Occupational Safety and Health)

- Well-being at work
- Increased capacity for work and employment
- Increased inclusion
- Working careers will be prolonged at their beginning, middle and end:
  - occupational diseases reduced by 10%
  - frequency of workplace accidents reduced by 25%
  - perceived harmful strain, physical and psychological, reduced by 20%
- Increased productivity, competitiveness and innovativeness
- Reduction of lost labour input (current level around EUR 24 billion per year)

(Policies for the work environment and well-being at work until 2020, Cost of lost labour input 2014)

→ Socially sustainable society, wellbeing of people and workplaces, positive economic development

3

What is digitalization?

- Gartner's IT glossary (2016) defines digitalization on a broad level and adopts a business transformation viewpoint: "Digitalisation is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business". https://research.gartner.com/definition-whatis-digitalization?resId=3237920&srcId=1-8163325102
- Business Dictionary defines digitalization: "Integration of digital technologies into everyday life by the digitization of everything that can be digitized". http://www.businessdictionary.com/definition/digitalization.html
- IGI Global: "Digitalization also means the process of making digital everything that can be digitized and the process of converting information into digital format". https://www.igi-global.com/dictionary/digitalization/7748

4

Human and social capital

- Definitions
  - Human capital is a part of intellectual capital
  - Human capital consists of psychological capital, knowledge and know-how and attitudes
  - Psychological capital consists of mental resources like resilience, self-confidence, optimism, hope
  - Human capital of an organization refers to those intellectual resources of the personnel which help the organization to succeed
  - Social capital consists of relations between people, networks, trust, shared values and norms, acting for the mutual benefit

(Human capital. Well-being at work, improved performance, longer working careers? Larjovuori et al. 2015; Luthans et al 2006; Luthans et al. 2007;)

5

Human and social capital related to organizational-level competencies

- Digitalization in all sectors is crucial to maintain and enhance the compatibility of enterprises (European Parliament resolution on 15 June 2017 on a European Agenda for the collaborative economy 2017/2003(INI)).
- Finnish organizations have not utilised the full potential of digitalization to create business value, but they are among the leaders (Kaupan liitto et al. 2016).
- Organizational-level competencies to digitalize operations are important components of modern firms' intangible capital. Highly digitalized companies are growing more rapidly than others (Digibarometer , Digibarometri 2016).
- Recognising and enhancing these capabilities is vital
- Human and social capital help organizations and individuals to utilize digitalization
- In the new digital world, added value can be achieved by increasing attitudinal capacities like entrepreneurship, resilience, networking skills, the capacity to lead oneself and the ability to use one's own resources in a sustainable way.
- Occupational safety and health issues are of strategic value to avoid health and safety risks, to lengthen working careers, to decrease costs of lost labor inputs and to improve productivity and innovativeness. We also need to increase human and social capital in workplaces and in society to achieve the best results when improving work ability and productivity in the digital world.

6

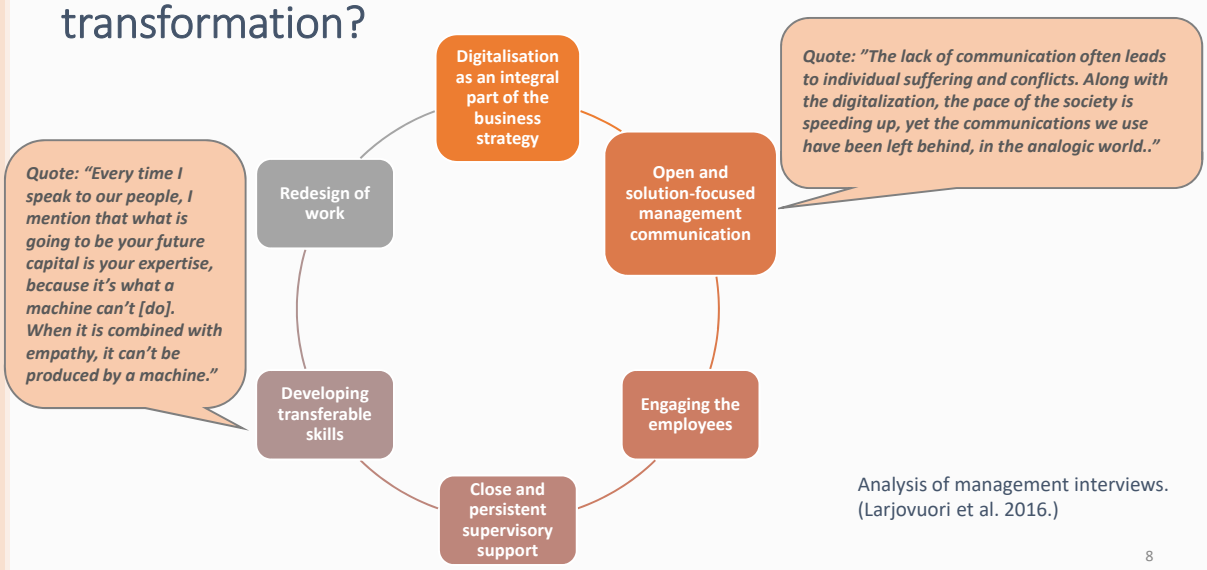
What is essential in leading digital business transformation – quantitative study results

- **Strategic leadership in digital transformation** and **readiness for strategic value co-creation** were statistically significant predictors of levels of business digitalization
- Unexpectedly, **servant leadership, empowering leadership** and **open innovation climate** were not associated with the level of business digitalization.

(Larjovuori et al. 2017. "How are leadership and organisational culture associated with levels of business digitalisation?" IFKAD 2017, 12th edition of the International Forum on Knowledge Asset Dynamics.)

7

How to lead and develop human capital in digital transformation?



Analysis of management interviews. (Larjovuori et al. 2016.)

8

What is the role of human resource management in developing relevant human and social capital in digital transformation?

- Human resource management and development is increasingly "mingled" with strategic leadership, business and service development: business and customer understanding and "co-creation" with both employees and customers are essential capabilities.
- In the digitalizing world, the knowledge of how the human mind works and thrives is maybe more important than ever: information ergonomics, learning and training, efficient communication…
- Human resource professionals should be increasingly involved in renewing and redesigning the digitalizing work practices and organizational structures.

(Larjovuori et al. 2016.)

9

Conclusions

- Digitalization is crucial for the compatibility of the enterprises and other organizations
- In order to utilize digitalization to its full potential, digitalization should be seen as an integral part of the business strategy
- In the digitalizing world, the knowledge of how the human mind works and thrives is maybe more important than ever
- Change of culture and leadership, new strengths, skills and know-how, new sense of community and new work practices are needed in the digital and changing working life

  -> human and social capital are of strategic value in the changing working life
- Human and social capital
  - enhance well-being at work and promote OSH, improve work ability, enhance personnel performance, productivity and innovativeness
  - help organizations to utilize and develop digitalization
  - help to find new business opportunities

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Thank You!

Contact information:

Liisa Hakala, Director
Ministry of Social Affairs and Health, Finland
PO Box 33, FI-00023 Government
Tel: +358 295 163 566, +358 50 575 6447
liisa.hakala@stm.fi

Kirsi Heikkilä-Tammi, Research Director
School of Management, University of Tampere
Tel: +358 50 4201532
kirsi.heikkila-tammi@uta.fi

Riitta-Liisa Larjovuori, Programme Director
School of Management, University of Tampere
Tel: +358 50 433 6260
riitta-liisa.larjovuori@uta.fi

Marja-Liisa Manka, Docent
School of Management, University of Tampere
marja-liisa.manka@uta.fi

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- Working anytime, anywhere: The effects on the world of work. Joint Eurofound & ILO Report. Web: ISBN: 978-92-897-1569-0. https://www.google.fi/search?hl=fi&q=Working+anytime,+anywhere%3A+The+effects+on+the+world+of+work.+%0BJoint+Eurofound+%26+ILO+Report.+Web%3A+ISBN%3A+978-92-897-1569-0.&rls=com.microsoft:fi-FI&ie=UTF-8&oe=UTF-8&startIndex=&startPage=1&gws_rd=ssl

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Section on Machine and System Safety

C o n t a c t :

ISSA-Section Machine and System Safety
Dynamostrasse 7 – 11
D – 68165 Mannheim
Germany
scholl@ivss.org