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PITA PAPER*matters!* 2018 Conference & Exhibition at Lancaster University

Safeguarding human-machine interactions
in the Paper Industry
Alex Bryce (Pilz)

PAPERmatters 2018!

The Presentations

Alex Bryce

Pilz Automation

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THE SPIRIT OF SAFETY

Alex is a TÜV Certified Machinery Safety Expert with an electrical engineering background and over 30 years of experience in industrial automation. Alex has been with Pilz – a leading supplier of machinery safety products, consultancy, engineering and training - for 21 years. During this time he has accumulated a wealth of experience across a wide variety of industries and applications; He is therefore perfectly placed to discuss and advise on commonly encountered machinery safety issues and solutions.




The author may be contacted via the **PITA Office**
Telephone: 0300 3020 150 or E-mail: info@pita.co.uk


Safeguarding human-machine interactions in the Paper Industry



Alex Bryce, CMSE ©
 Certified Machinery Safety Expert (TÜV Nord)
 Business Development Manager – Consultancy, Engineering and Training

EU Directives are the basis of H&S requirements



Machinery Directive 

responsibility of the manufacturer (or his authorised representative) to ensure that machinery supplied is in conformance with EHSRs*


The “manufacturer” includes OEMs, **and** end users who build, significantly modify or integrate machines together.

Implemented in UK through “Supply of Machinery (Safety) Regulations”

Use of Work Equipment Directive

responsibility of employers to take necessary measures to ensure the safety, health & welfare of employees achieved through use of safe systems of work to ensure a safe working environment, risk assessment of machinery, and proper validation and maintenance activities

Implemented in UK through “The Provision and Use of Work Equipment Regulations” aka PUWER



The requirements of these Regulations are mandatory under UK Law
 You could be affected by both these Regulations (e.g. supplying yourself with machines)

*Essential Health & Safety Requirements

Other relevant UK H&S Legislation



Health and Safety at Work Act. Section 2, Section 3

Section 2: Requires employers to provide safe equipment to employees

Section 3: ..& a safe environment for anyone else who could be affected

Management of Health and Safety at Work Regulations 1999

This is where the legal requirement emanates to carry out suitable & sufficient (proportionate) risk assessment to justify that equipment is safe



Provisions and Use of Work Equipment Regulations (PUWER) requires that work equipment is:



- suitable for the intended use
- safe for use, maintained in a safe condition and inspected to ensure it is correctly installed and does not subsequently deteriorate
- used only by people who have received adequate information, instruction and training;
- accompanied by suitable health and safety measures, such as protective devices and controls, including emergency stop devices, adequate means of isolation from sources of energy, clearly visible markings and warning devices.

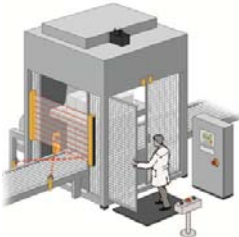
PUWER Regulation 11:

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Measures must be taken to prevent access to any dangerous parts or to stop dangerous movement before any part of a person enters a danger zone.

These measures shall consist of:

- the provision of fixed **guards**;
- the provision of **other guards or protection devices**;
- the provision of jigs, holders, push-sticks or similar protection appliances;
- and the provision of such information, instruction, training and supervision as is necessary.




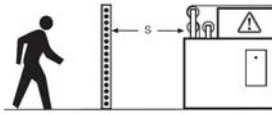
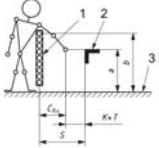


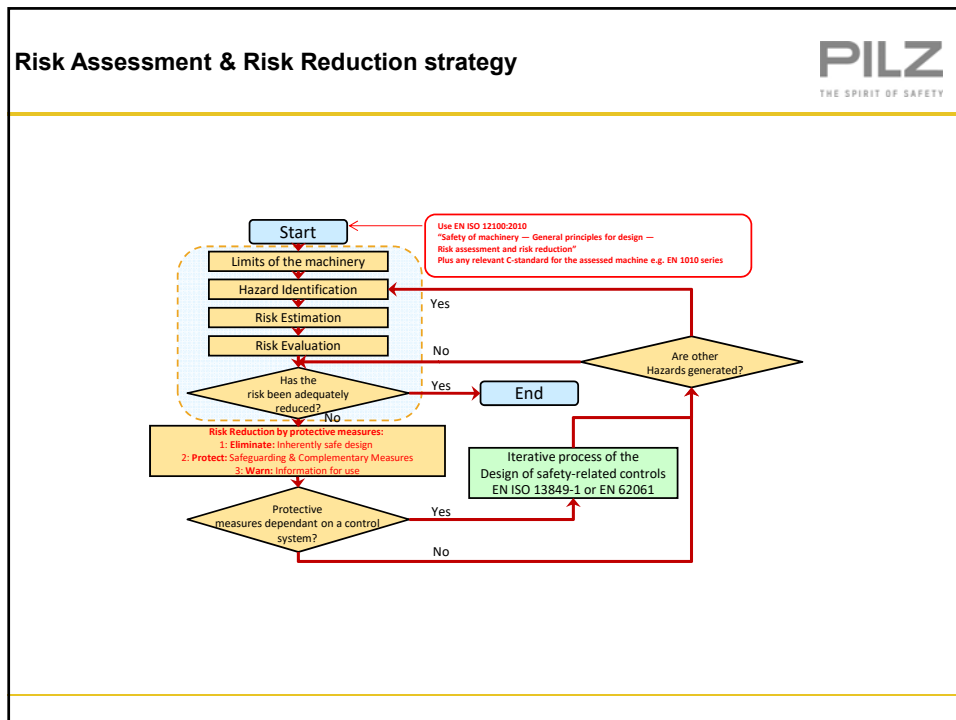
PUWER Regulation 11:


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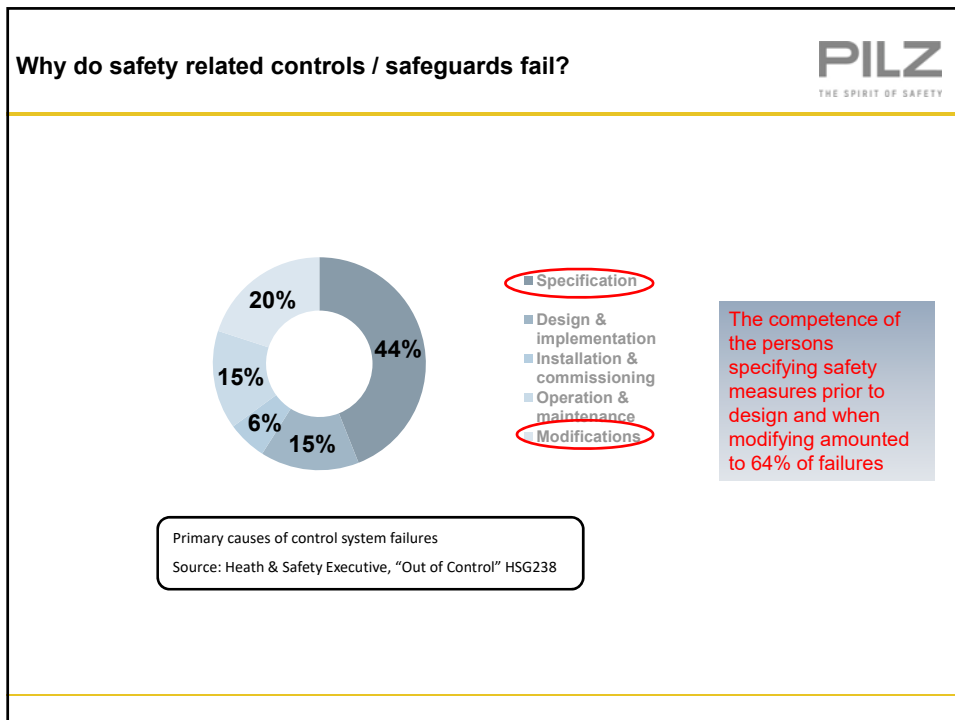
All guards and protection devices shall:

- not give rise to any increased risk to health or safety;
- **not be easily bypassed or disabled**;
- be situated at a **sufficient distance** from the danger zone (taking in to account reach over, reach through and stopping / run-down times)



- ### Multiple combined contributory factors lead to safety incidents
- 
- **Safety management** – lack of risk assessment & SSOW
 - **Modifications** – lack of testing / validation /documentation
 - **Safeguards missing / defeated** (e.g. to avoid restart procedures)
 - **Isolation** – lack of proper isolation, or relying on e-stops / interlocks
 - **Maintenance** – e.g. cleaning, removing blockages, fault finding
 - Failing to heed frequent repairs (is this device actually suitable?)
 - Lack of periodic inspection e.g. on e-stops and light curtains
 - Lack of training for high risk fault finding in automated systems




Competence in context of machine safety


General Definition:
Competence: having sufficient skill, knowledge, etc; capable suitable or sufficient for the purpose ⇒ a competent answer (law) (of a witness) having legal capacity; qualified to testify, etc

In machine safety....
validation tests to be carried out with the highest degree of professional integrity and technical **competence**
Competence is a requirement of every engineer assessing a plant or machine or providing a service

Accredited machine safety training can form part of developing, maintaining and proving competence ... together with experience

Building safety into Machinery






Safe machines start in the mind of the designer

Use of inherently safe design measure:
 A protective measure which either eliminates hazards or reduces the risks associated with hazards by changing the design or operating characteristics of the machine without the use of guards or protective devices

Use of Safeguarding:
 A protective measure using safeguards to protect persons from the hazards which cannot reasonably be eliminated or risks which cannot be sufficiently reduced by inherently safe design measures

How can I influence the designer? Detailed specification is a key component.

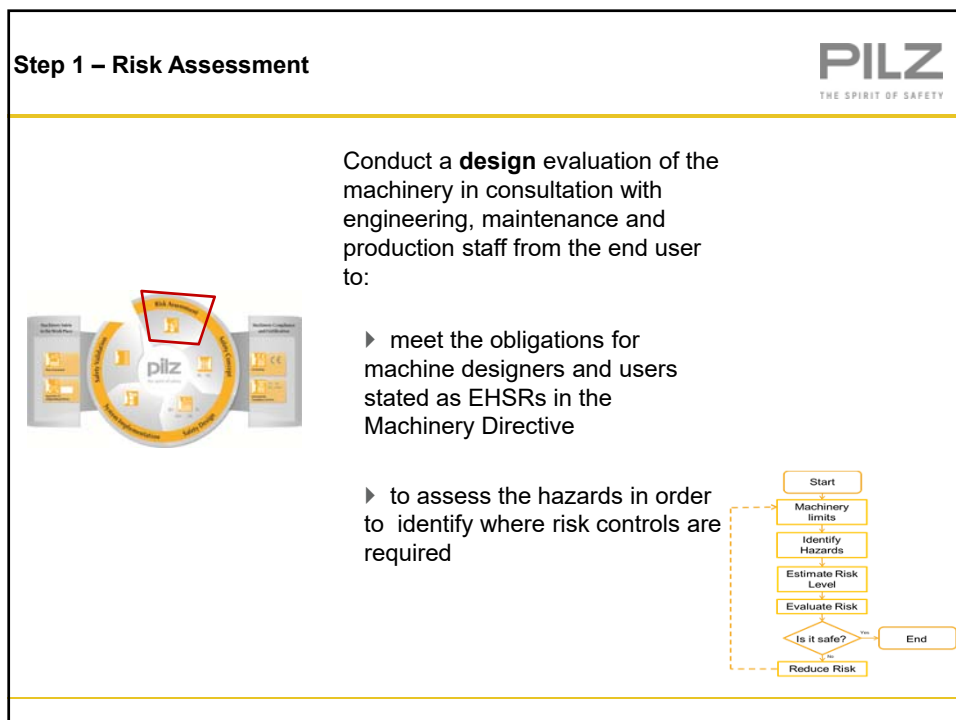
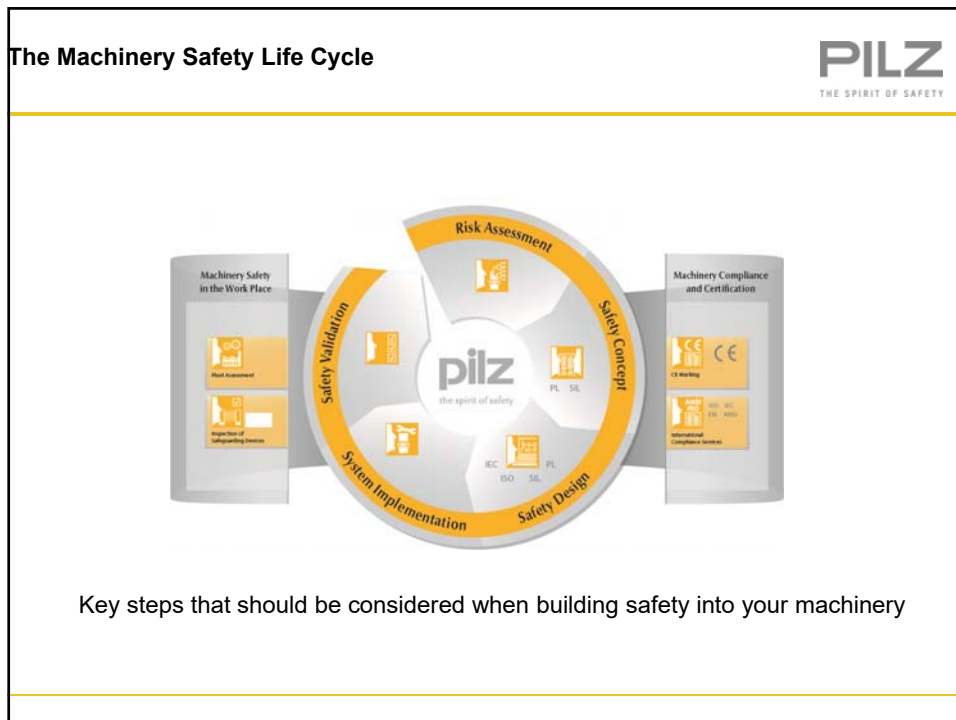


Have a machinery safety specification that describes:

- European legislative requirements to be met
- Guidance documents to be followed e.g. From CPI / PABIAC
- A list of standards that need to be met e.g. EN 1010, EN 1034, EN ISO 13849-1, EN 60204-1 etc
- required documentation such as the risk assessment, and user manuals etc

Purchase orders should include:

- Reference to meeting your machinery safety specifications
- State money will be withheld until any deviations to the specification have be addressed
- Pre-delivery inspection
- Site acceptance testing criteria


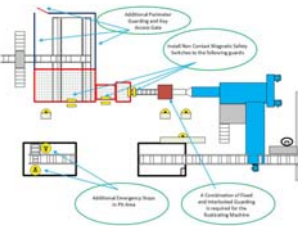
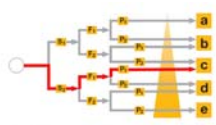


Step 2 – Safety Concept

Following from Risk Assessment a review of the machine should be conducted to:

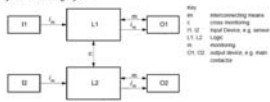
- ▶ identify areas for risk controls
- ▶ develop concepts required to achieve compliance and safety
- ▶ select technical measures in consultation with those that work on the machinery
 - ▶ Operators
 - ▶ Maintenance staff
 - ▶ Cleaners

Step 2 – Safety Concept

The safety function should be implemented to meet Performance Level required (PLr) c.

The recommended architecture of the Safety Related Parts of the Control System is Category 3.




OI: interlocking output
 OI2: interlocking output
 OI: interlocking output
 OI2: interlocking output
 OI: interlocking output
 OI2: interlocking output

Picture 2 Concept 2, Fall back gate

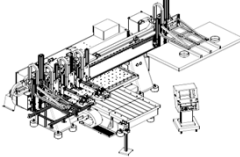
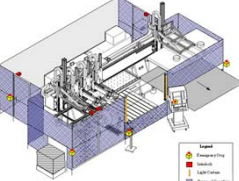
Picture 3 Concept 2, Fall back gate

Step 2 – Safety Concept

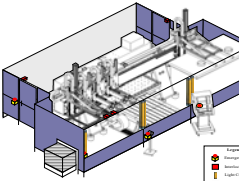
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Original Machine Layout: Machine without Safety Measures


Safety Concept 1



Safety Concept 2


Step 3 – Safety Design

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At the design stage the following should be defined:

- ▶ safety requirements specification (SRS)
 - ▶ Function of emergency stops
 - ▶ Function of interlock devices
 - ▶ Function of presence sensing devices
 - ▶ Function of Guarding
- ▶ generation of detailed designs e.g. guarding, electrical, pneumatic and hydraulic circuits
- ▶ planning System Implementation and System Validation stages



Step 3 – Safety Design

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The diagram on the left is a circular process flow with 'Safety Design' highlighted. The technical drawing on the right shows a safety cabinet with components like relays, fuses, and safety modules labeled with callouts.

Step 3 – Safety Design

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The diagram on the left is a circular process flow with 'Safety Design' highlighted. The top right diagram shows a 'SafetyBus Network' with a 'SafetyBus' and 'SafetyBus Network' components. The bottom right diagram shows a 'SafetyBus Network' with 'CCM de Subida' and 'CCM de Entrada' components.

Step 4 – System Implementation

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This step includes installation and commissioning systems:




- ▶ project planning and controlling
- ▶ procurement of components
- ▶ selection of suppliers and contractors
- ▶ mechanical and electrical construction and erection
- ▶ programming of control devices
- ▶ installation and commissioning
- ▶ training



Step 4 – System Implementation


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Guarding and light curtain installation




Step 4 – System Implementation

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The diagram shows a circular process with 'pilz' in the center. A red diamond highlights the 'Safety System Implementation' section.

Unguarded




Guarded



Step 5 – Safety Validation

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The diagram shows a circular process with 'pilz' in the center. A red diamond highlights the 'Safety System Implementation' section.

A structured method for inspecting the safety critical elements of plant and machinery

- ▶ Assessment of implemented design versus safety requirements in standards and legislation
- ▶ Check of sensor and actuator installation and wiring configuration
- ▶ Function test with fault simulation
- ▶ Inspection of guarding and presence sensing devices

“Have we made the machine safe?”



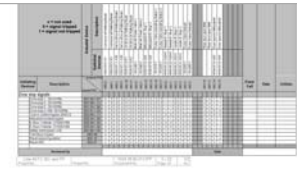


Step 5 – Safety Validation


Validation of safety features on machinery should be performed by a person independent of the design and installation phases.

It should be performed by a competent person with suitable vocational education, practical experience and knowledge of relevant legislation and standards.

The results of the validation should be documented and kept as design records.

Step 5 – Safety Validation

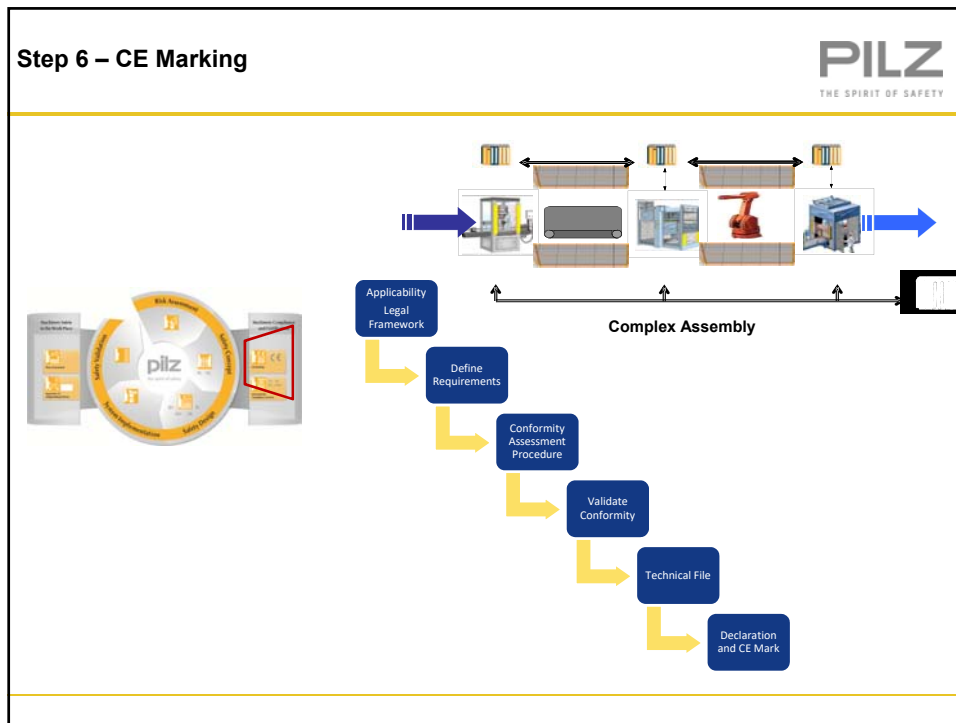


		AV1001.02	AV1001.02	AV1001.02	AV1001.02	AV1001.02	AV1001.02
EMERGENCY STOP							
E-Stop 1	E100.01.02 Drilling machine	OFF	OFF	OFF	OFF	OFF	OFF
E-Stop 2	E100.03.04 Drilling machine	OFF	OFF	OFF	OFF	OFF	OFF
E-Stop 3	E100.05.06 Chaining machine	OFF	OFF	OFF	OFF	OFF	OFF
E-Stop 4	E100.01.02 Chaining machine	OFF	OFF	OFF	OFF	OFF	OFF
RIGHT CURTAIN INPUT							
RIGHT CURTAIN INPUT	E100.01.02 Chaining machine	OFF	OFF				
RIGHT CURTAIN OUTPUT							
Light Curtain Drilling	E100.01.02 Drilling machine	OFF		OFF			

		AV1001.02	AV1001.02	AV1001.02	AV1001.02	AV1001.02	AV1001.02
EMERGENCY STOP							
E-Stop 1	E100.01.02 Drilling machine	OFF	OFF	OFF	OFF	OFF	OFF
E-Stop 2	E100.03.04 Drilling machine	OFF	OFF	OFF	OFF	OFF	OFF
E-Stop 3	E100.05.06 Chaining machine	OFF	OFF	OFF	OFF	OFF	OFF
E-Stop 4	E100.01.02 Chaining machine	OFF	OFF	OFF	OFF	OFF	OFF
RIGHT CURTAIN INPUT							
RIGHT CURTAIN INPUT	E100.01.02 Chaining machine	OFF	OFF				
RIGHT CURTAIN OUTPUT							
Light Curtain Drilling	E100.01.02 Drilling machine	OFF		OFF			

Specification Matrix

Validation Matrix



Step 6 – CE Marking – Significant Change


Where changes are made to the design, function or safety of machinery (or an assembly of machines), you must assess the extent of the changes made or to be made.

If they are very substantial (e.g. significant new hazards and risks are introduced or new methods of control of the machine replace those previously provided, such as computer control of a previous manual machine) it may amount to being considered a "new" machine (or new assembly), for which you must undertake conformity assessment and meet all relevant requirements of any relevant European product supply directives, including the Machinery Directive.

www.hse.gov.uk

Step 7 – Inspection of safeguarding devices – ESPE Testing

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The user should ensure that only competent persons carry out the periodic inspections and tests.


Such persons could be independent inspecting engineering surveyors, machinery suppliers, ESPE suppliers, or from within the user's organisation.

The recommended maximum period between each periodic inspection and test is 6 months for type 4 ESPE and 12 months for type 2 ESPE, but this will depend on the equipment it is fitted to and the risk as a whole.

HSG 180: Application of electro-sensitive protective equipment using light curtains and light beam devices to machinery

The Machinery Safety Life Cycle

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Simple steps to help you to **manage your Risk Profile** and achieve your **Safety and Business Objectives**

