



To investigate the effectiveness of functional safety planning, verification, validation and competence throughout the entire process safety lifecycle.

Case Study: Tata steel, Port Talbot works

MSc Property and Facilities Management

Masters Dissertation (ACFA7003)

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Agenda

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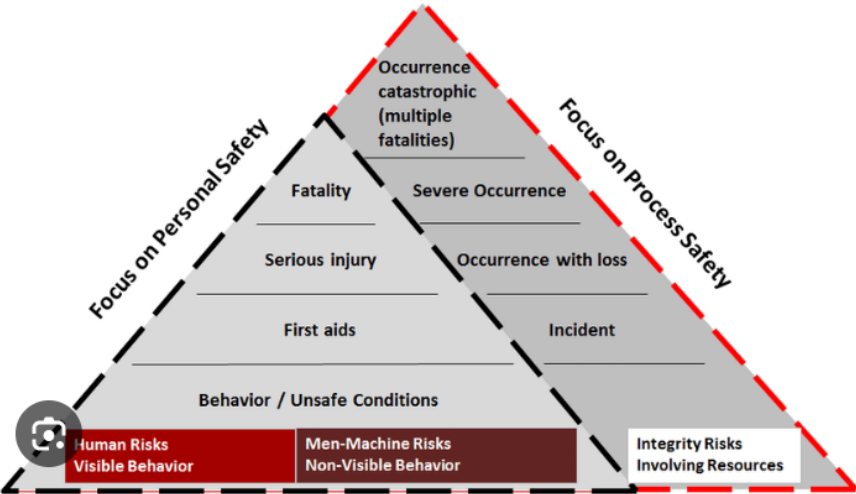
Questions



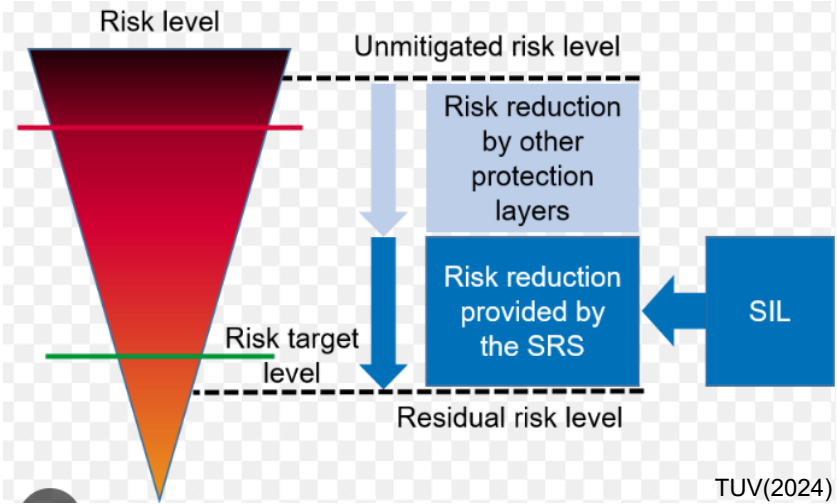
Introduction

What is process safety ?

Where does functional safety sit within process safety ?

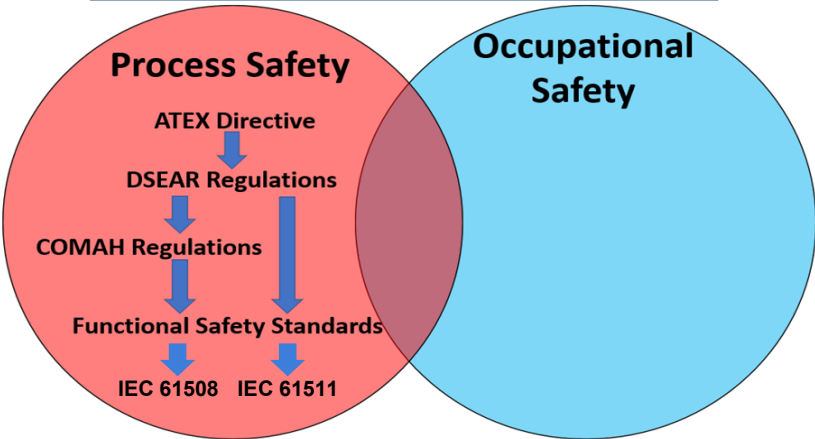


Souza (2024)



TUV(2024)

Health and Safety at Work Act



Introduction

Why adopt functional safety standards ?



Piper Alpha, 6/7/1988, 167 Fatalities

Turner (2013)



Chernobyl 28/4/1986 unknown

Collins (2022)

Date	Location	Incident
1 Jun 1974	Flixborough, UK	Caprolactam production plant, gas release
19 Nov 1984	Mexico City, Mexico	LPG storage tank explosion
3 Dec 1984	Bhopal, India	Carbide plant, gas release
28 Apr 1986	Chernobyl, Ukraine	Nuclear power plant radioactive leak
6 Jul 1988	Piper Alpha, North Sea	Oil production platform explosion
23 Oct 1989	Phillips, Pasadena, Texas	Polyethylene reactor gas release
1 Feb 2003	Columbia, Texas	Space shuttle explosion
23 Mar 2005	BP Texas City, USA	Oil refinery explosion
11 Dec 2005	Buncefield, UK	Vapour cloud explosion
20 Apr 2010	Macondo, Gulf Of Mexico	Deep water drilling rig explosion
11 Mar 2011	Fukushima, Japan	Nuclear reactor, gas release
7 May 2020	Visakhapatnam, India	Chemical plant leak
4 Aug 2020	Beirut, Lebanon	Warehouse explosion
29 Mar 2021	West Java, Indonesia	Oil refinery

Aims and objectives

To investigate the effectiveness of functional safety planning, verification, validation and competence throughout the entire process safety lifecycle. Case Study: Tata steel, Port Talbot works.

1. To critically evaluate the effectiveness and complexity of current functional safety planning specifically around competence, validation, verification, and the use of checklists.
2. To assess the current knowledge level of functional safety, competency, validation, and verification within Tata steel Port Talbot.
3. To critically evaluate the current functional safety planning system during the implementation of a project.
4. To propose, assess and evaluate a list of items to consider within a functional safety plan and produce a standard checklist that can be applied to any future functional safety plan.
5. Identify future research from this proposal.

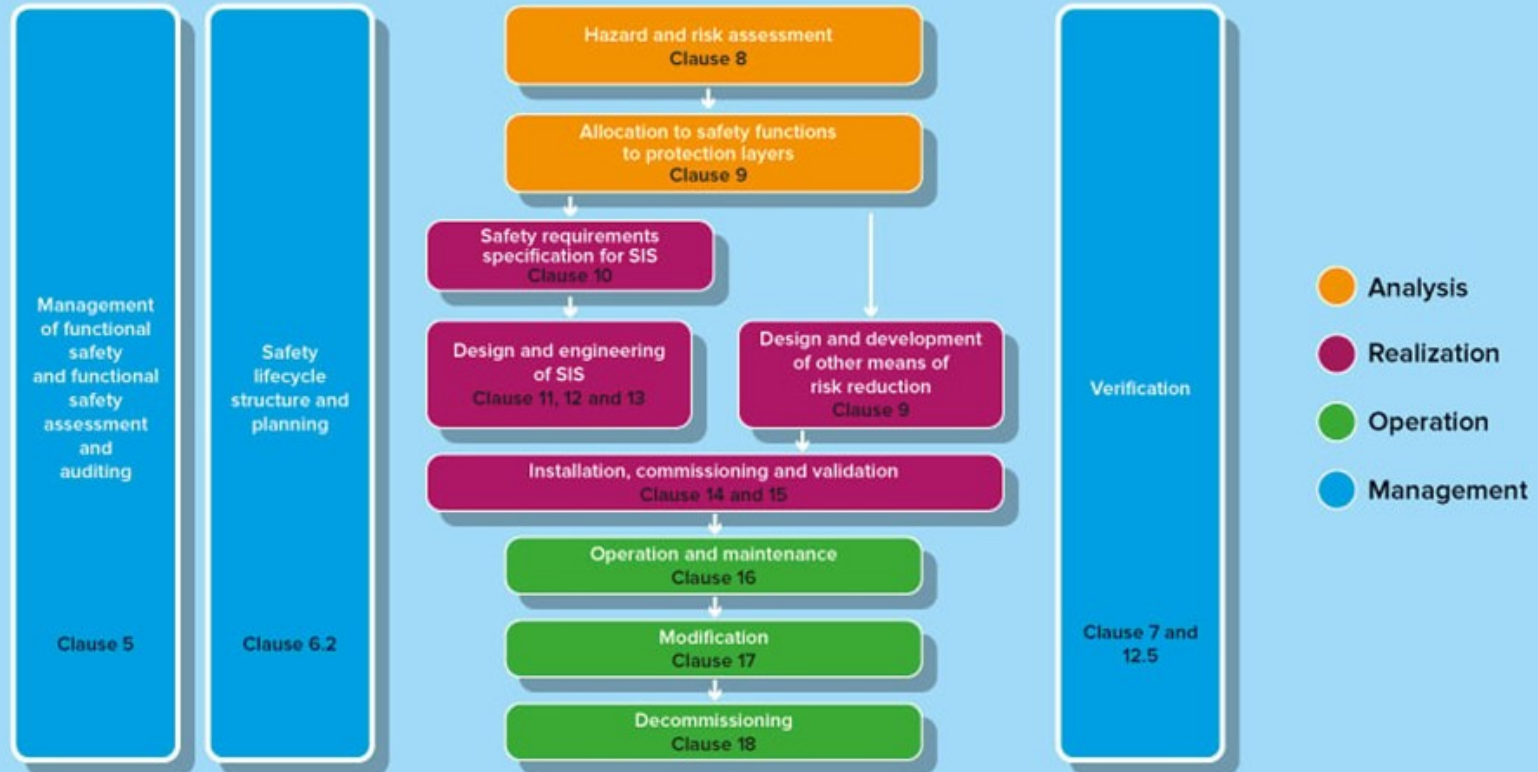
Literature review

The main literature reviewed to meet the overall aim includes:

- Functional safety legislation and safety lifecycle.
- Functional safety planning in industry.
- Demonstrating competence, validation and verification in functional safety.
- Use of checklists as a base for planning in functional safety.



IEC - 61511 Safety Life Cycle



Methodology

To critically evaluate the effectiveness and complexity of current functional safety planning specifically around competence, validation, verification, and the use of checklists.

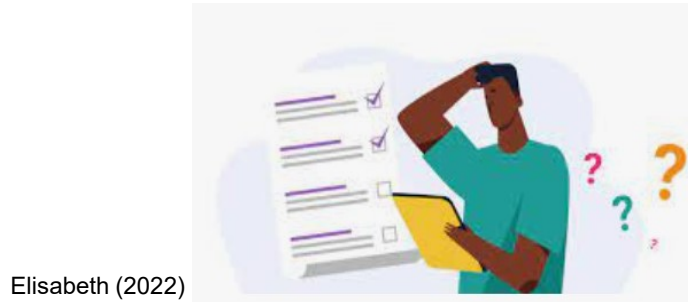


Kramer (2022)

Objective 1 – Literature review

Methodology

To assess the current knowledge level of functional safety, demonstrable competency, validation, and verification within Tata steel Port Talbot.



Elisabeth (2022)



GSB (2023)

Objective 2 – Questionnaire & semi-structured interview

Methodology

To critically evaluate the current functional safety planning system during the implementation of a project.



West (2020)



GSB (2023)

Objective 3 – Work project review & semi-structured Interview

Methodology

To propose, assess and evaluate a list of items to consider within a functional safety plan and produce a standard checklist that can be applied to any future functional safety plan.



GSB (2023)

Objective 4 – Unstructured interview

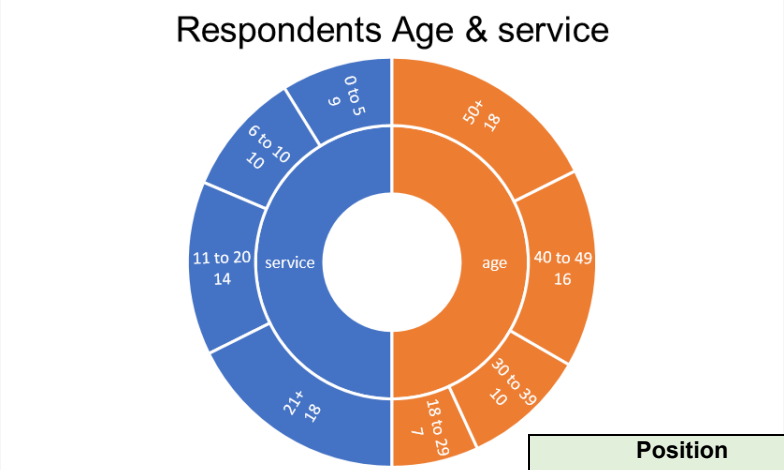
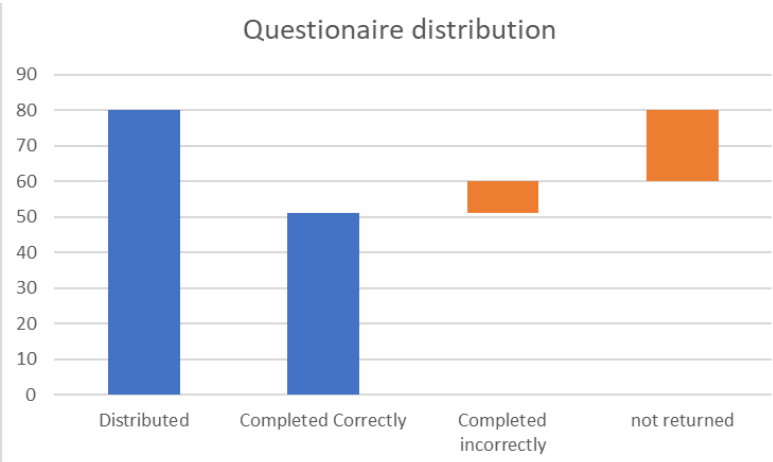
Identify future research from this proposal.



Oakley (2017)

Objective 5 – Lessons learnt

Results



High Level	Distributed area	Declared work area	Respondents
Coke, Sinter & Iron (1)	Coke, Sinter & Iron (1)	Coke Ovens (1)	7
		Sinter Plant (2)	2
		Blast Furnaces (3)	5
		Coke, Sinter & Iron (4)	5
		Harbour (5)	4
Central (2)	Central Safety Department (2)	Process Safety (6)	4
		Central Safety (7)	4
Other manufacturing Areas (3)	Projects department (3)	Projects department (8)	4
	Steel and Slab (4)	BOS Plant (9)	3
	Hot Rolled Products (5)	Hot Rolled Products (10)	3
Central (2)	Central Engineering (7)	Cold Rolled Products (11)	3
		Infrastructure (12)	3
		DSEAR (13)	4

Position	Respondents
Electrical Engineer	15
Departmental Engineer	1
Electrician	7
Shift Engineer	7
Process Safety Engineer	3
Process Safety Graduate	2
Project Engineer	5
PCA Engineer	5
Safety Facilitator	2
Manager	1
Engineering Technician	2
Safety Engineer	1

Results - questionnaire

Low understanding	Clearly understood	Other
Functional safety management planning.	Hazard identification.	Reduction in perceived competence in functional safety.
Functional safety ownership.	Risk assessment.	Need for checklist.
Life cycle stages.	Competence.	
Layer of protection analysis.	Traits of person conducting verification.	
Independence.		

Results, case study review

Training	Competence	Documentation
Project team were not trained.	Single competence assigned to individuals.	Partially completed.
Terminology confused and misused.	Non-competent contractors used.	Inconsistency between documents.
	Project delays.	Documentation errors.
		Document revision numbers used.

Results, semi structured Interview

The interview discussed the following information:

- Process safety training.
- The use of checklists.
- The process safety flow chart.
- The functional safety policy.
- Functional safety responsibility
- FSMP creation.
- Competence requirements.
- Previous functional safety projects.

Produced checklist

SLC Activities	Safety Requirement Specifications	Functional Safety Assessment - Stage 1	Design and Engineering	Functional Safety Assessment - Stage 2	Installation, Commissioning and Validation				
Clauses of BS EN 61511-1	Clause 10	5.2.6.1 of Clause 5	Clause 11, 12 & 13	5.2.6.1 of Clause 5	Clause 14 & 15				
Tasks to be Carried out	Safety Requirement Specifications (SRS)	Functional Safety Assessment (FSA 1)	1. Particular attention will be paid to the following	Functional Safety Assessment (FSA 2)	FAT	Installation	Cold Commissioning including procedure	Proof Test	Hot commissioning & SAT including procedure
Organisations Responsible for activities	System integrator	Designer	System Integrator	System Integrator	System integrator	EC&I Contractor	Tata	System integrator	Tata
Persons Responsible for activities	System integrator Engineer (1)	Tata Process Safety Engineer (1)	System integrator Engineer (1)	System integrator Engineer (1)	System integrator Engineer (1)	Tata projects E,C & I Engineer (1)	Tata projects E,C & I Engineer (1)	System integrator Engineer (1)	Tata projects E,C & I Engineer (1)
Verifier	System integrator Engineer (2)	Tata Process Safety Engineer (2)	System integrator Engineer (2)	System integrator Engineer (2)	System integrator Manager (1)	Tata projects E,C & I Engineer (2)	Tata projects E,C & I Engineer (2)	Tata projects E,C & I Engineer (1)	Tata projects E,C & I Engineer (2)
Independence	Must not have had any involvement with writing the SRS	Must not have been involved in FSA1 assessment	Must not have been involved in the SIS development	Must not have been involved in FSA2 assessment	Not involved in creating FAT procedure	Not involved in the installation process	Not involved in commissioning activities	Not involved in creating procedure	Not involved in creating procedure
Acceptance	Tata Project Manager (1)	Tata Project Manager (1)	Tata Project Manager (1)	Tata Process safety Engineer (1)	Tata Operations (1)	Tata Project Manager (1)	Tata Operations (1)	Tata Operations (1)	Tata Operations (1)
Validator	N/A	N/A	N/A	N/A	Tata Project Lead Engineer (1)	N/A	N/A	N/A	Tata Project Lead Engineer (1)
Verifier (of the validation task)	N/A	N/A	N/A	N/A	Tata Project Manager (1)	N/A	N/A	N/A	Tata Project Manager (1)
Verifier Independence	N/A	N/A	N/A	N/A	Not involved in FAT procedure	N/A	N/A	N/A	Not involved in SAT procedure

Produced checklist

		SLC Activities	Functional Safety Assessment - Stage 2		
Resource Requirements		Clauses of BS EN 61511-1	5.2.6.1 of Clause 5		
		Activity Purpose/Objectives	To investigate the evidences through the independent cross-check and arrive at a judgement on the functional safety achieved by the SIS, it assess that: - no safety requirements are missed out, - all SIFs are functional correctly by SIS, and - all documentation review and FAT activities have been effectively and correctively performed.		
Tata					
Tata Process Safety Engineer	2	Tasks to be Carried out	Functional Safety Assessment (FSA 2)		
Tata Project Manager	1	Organisations Responsible for activities	System Integrator		
Tata Project Lead Engineer	1	Persons Responsible for activities	System Integrator Engineer	Insert name Here	
Tata projects E,C & I Engineer	2	Competence	Formal Training	TUV 61508 / 61511 Functional Safety	
			Experience	Minimum 3 years experience in Functional Safety Assesments	
			Demonstration of Knowledge	Minimum 1 FSA2 Document peer reviewed in last 5 years	
Tata Operations	1	Inputs/Documentation		DMS Ref:	Rev No.
			SIS Document	Insert Document number Here	Insert Revision number Here
			Functional Design Specification	Insert Document number Here	Insert Revision number Here
			Loop Diagrams	Insert Document number Here	Insert Revision number Here
			Electrical Schematics	Insert Document number Here	Insert Revision number Here
Contractor		Outputs/Evidence	FSA 2 Report	Insert Document number Here	Insert Revision number Here
System integrator Engineer	1	Verifier	System Intgrator Engineer	Insert name Here	
System integrator Manager	1	Competence	Formal Training	TUV 61508 / 61511 Functional Safety	
			Experience	Minimum 3 years experience in Functional Safety Assesments	
			Demonstration of Knowledge	Minimum 1 FSA2 Document peer reviewed in last 5 years	
		Independence	Must not have been involved in FSA2 assessment		
		Acceptance	Tata Process safety Engineer	Insert name Here	

Results, unstructured interview on proposed checklist

Advantages	Disadvantages
Explicit requirements for each stage.	Overall resource not highlighted.
Required competence is clear.	Commissioning plans and activities should be combined.
Required documentation is descriptive.	Hot and cold commissioning activities should be combined.
Validation and verification is clear.	Reliance on checklists.

The checklist will be adopted into next Tata document cycle review.

Conclusion

A lack of knowledge is apparent around functional safety, despite this population having been trained. A review process is required to ensure the training provided has landed with the individuals.

The lifecycle stage to create FSMP differs to literature. However, this is irrelevant when the documentation is incorrect, not completed or completed by non-competent persons.

Tata lack demonstrable evidence and continuous assessment for functional safety, in contradiction to how they manage competence elsewhere.

The questionnaire and case study confirms validation and verification are misunderstood and misused.

The case study confirms knowledge gaps in functional safety planning, competency, verification and validation.

A detailed checklist was identified as required in the questionnaire, interview and case study.

The proposed checklist closes the identified gaps within a single document.

Contribution to literature

The produced checklist highlights the required competence and documentation for every stage of the functional safety lifecycle.

These elements are not explicit in any of the literature, legislation or standards reviewed and left to the end user to define.

The proposed checklist covers all the gaps identified from an actual case study within a single document.

The checklist can be used throughout the world by contracting companies; project managers; process safety and functional safety professionals.

Limitations and future research

Limitations

- Research only looks at a steel industry.
- The research is only a snapshot in time.
- Mechanical and production population were not involved within the research.

Future research

- Has the functional safety checklist and learnings, been embedded within Tata steel?
- How is functional safety managed within other organisations?
- Can industries learn from events without detailed legislation?

Lessons learnt and reflections

- Create a data collection plan.
- Consider using applications such as Microsoft forms for questionnaires.
- Plan to complete research ahead of the submission date.
- Expect the unexpected and stay ahead of the plan.
- Training programmes need to be followed up to ensure the training has landed with the intended population in the correct manner.

References

Collins, M (2022) Radioactive survival lessons from Chernobyl nuclear disaster. Available at: [Radioactive Survival Lessons from the Chernobyl Nuclear Disaster \(mirasafety.com\)](#). Accessed 28/03/2024.

Elisabeth (2022) Customer Surveys. Available at: [Survey v Questionnaire v Poll | How do you know which one to use \(customerthermometer.com\)](#) Accessed 23/02/2024.

GSB (2023) How to pass a job interview. Available at [gsb.hse.ru](#) Accessed 22/02/2024.

IEC 61511 (2017) Functional safety standard. Available at: [compass \(astm.org\)](#) Accessed 22/05/2023.

ISTOCK (2024) Interview image. Available at: [Agenda for meeting list - iStock \(istockphoto.com\)](#) Accessed 19/01/2023.

Kramer, L (2022) How to write a stellar literature review. Available at: [How to Write a Stellar Literature Review | Grammarly Blog](#) Accessed 22/05/2023.

Oakley, B (2017) 5 ways to keep learning till 90. Available at: [Tips to keep your mind active till 90 \(indiatimes.com\)](#) Accessed 22/01/2024.

Souza, B (2024) Personal and Process safety pyramid. Available at: [-Personal and Process Safety Pyramid | Download Scientific Diagram \(researchgate.net\)](#) Accessed 25/02/2024.

Turner, J (2013) Legacy of Piper Alpha. Available at: [Sea change: offshore safety and the legacy of Piper Alpha - Offshore Technology \(offshore-technology.com\)](#) Accessed 17/01/2024.

Tuv (2024) Risk reduction by safety related systems. Available at: [An introduction to functional safety assurance - Risktec \(tuv.com\)](#) Accessed 28/03/2024.

West, K (2020) Case Study: Inspiring students with online discussion. Available at: [Case Study: Inspiring Students with Online Discussion – Packback](#) Accessed 03/03/2024.



Questions