Ugo Di Camillo

7

Multi-dimensional Risk Assessment

KEYWORDS: RISK ASSESSMENT, UNDERLYING CAUSE, ATTENTION FACTORS, SAFE SYSTEM OF WORK, PERMIT TO WORK

The International Labour Organisation has a systemic and overall approach to safe and health on workplace topics. "*5 key elements*", "*SMART outputs*", "*5 steps Risk Assessment*", are some of basic approaches suggested by this Institution. European Union has adopted this concepts to define some important procedures: "*Safe System of Work (SSW)*", "*People-Equipment-Material-Enviroment (PEME)*" and "*Permit To Work (PTW)*".
A careful analysis of accidents must be based on direct factors (primary causes) and indirect factors (secondary causes). Consequently, even a careful risk assessment must analyze and evaluate both factors, adopting a multi-dimensional approach.
The first part of the research, focused on the analysis of some indirect factors, such as ageing workers, newly hired workers, etc, introducing the concept of attention factors. In fact, these factors are not yet governed by the current national regulations within the risk assessment.
Following a systemic approach of SSW, the second part of the research is applied to a case study (construction site for a new aerospace building in Milan). Re-entering among the purposes of systematic, cyclicality and continual improvement of the measures to be taken to eliminate or reduce risks, a specific procedure has been drawn up to be associated with the scheduling and management of the site activities. Therefore, the analysis of indirect factors is performed by associating the work phase to be carried out with the employees that have these factors.
The result of the research carried out has highlighted a concept of the attention factor, which if previously assessed, can involve the activation of special worker protection procedures (e.g. Permit To Work).

INTRODUCTION

Despite the significant reduction in the number of accidents and the progress made in the field of prevention and health and safety at work, the consequences for workers are still very relevant in terms of mortality and disease. Injuries at work In Italy have caused about 11 million days of disability with costs supported by INAIL. On average 85 days for injuries that caused impairment and about 21 days in the absence of impairment. In the first five months of 2018, the fatal cases reported were 389, 14 more than in the same period of 2017.

Starting from this unrelenting perspective, the starting point of this research is based on the analysis of international regulations concerning the health and safety in the workplace, to identify areas of development and procedures that have not yet been adopted by the national one.

In fact after 25 years the adoption by Italy of the first European regulations in the field of prevention and protection of workers, many sectors have improved over time (e.g.: information and training of workers, equipment for work at height, etc.), while others have remained practically the same (e.g.: PPE, risk assessment methodology, etc.) and others never started (e.g.: procedures, organisation, health and safety management system, etc.).

The purpose of this research was to verify that some of the sectors not yet developed can effectively and substantially complete the approach to the concept of safety, ensuring greater control of the risks present. The verification was carried out by applying the tools indicated in the paragraphs following a case study of a construction site in Milan.

INTERNATIONAL AND NATIONAL REGULATORY FRAMEWORK ON HEALTH AND SAFETY AT WORK

International Labour Organisation (ILO)

The International Labour Organization (ILO) is the United Nations agency that promotes decent and productive work in conditions of freedom, equality, safety and human dignity for men and women. The main role of the ILO is to formulate the minimum international standards of working conditions and fundamental rights of the worker. Below are just some of the many and rich concepts that can be drawn from a careful reading of the documents issued by the ILO.

Concept of primary importance is contained in the ILO Guidelines on Occupational Safety and Health Management Systems - ILO OSH 2001, following a structure that use the following five key elements, adopting the structure of Deming cycle (see Figure 1):

1. Policy (PLAN);
2. Organisation (PLAN);
3. Planning and implementation (DO);
4. Evaluation (CHECK);
5. Action to improvement (ACT).

Through these indications we can deduce the concept of system, cyclicality and continual improvement of the measures to be taken to eliminate or reduce risks in the workplace effectively. Moreover ILO C155 and ILO R164 making explicit legal requirements in regard to system of working to ensure that hazards are all identified and safe method of working are to be used, that eliminate or minimise those hazards.

Similar concepts are also found in the *5 STEPS of Risk Assessment* highlighted on ILO OSH Management System:

- STEP 1: Identify the hazards;
- STEP 2: Decide who might be harmed and how;
- STEP 3: Evaluate the risks and decide on precautions;
- STEP 4: Record your findings and implement them;
- STEP 5: Review your assessment and update if necessary.

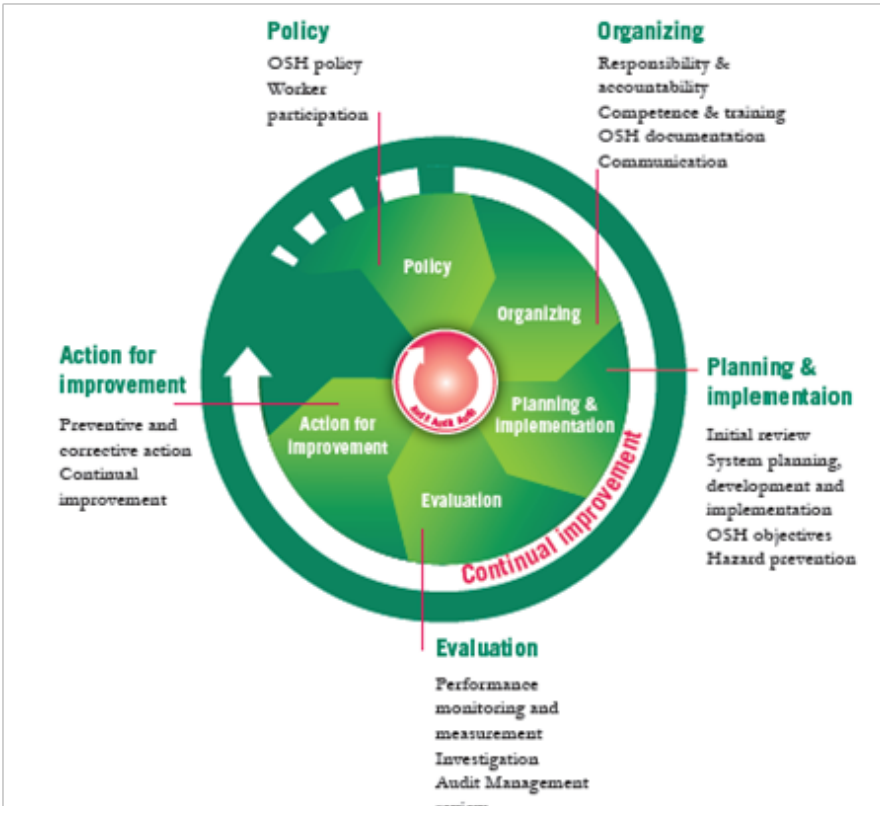

Figure 1: The continual improvement cycle (source: ILO Guidelines on OSHMS)

It is important to highlight that, unlike national regulations, STEPS 2-4-5 assume an indispensable value for a complete risk assessment.
Consequentially to STEPS 4-5 the R164 - Occupational Safety and Health Recommendation, 1981 (No. 164), is focused on the importance and relevance of written procedures. Contrary to what happens in most risk assessment documents, it does not mean that written procedures have to be complicated or difficult. As we can check in the following part (see Table 1), one of the most effective are those that are clear, and easily understood. The importance of creating written procedures is that they serve as a clear standard of works, including how the risks of the work are to be fought.

It is important that procedures express how the work is done, not just how it should be done in theory. If there is a poor match between the procedure and that can be done in practice it will devalue the procedure and others and it will cause dangerous. If a good match is achieved, in a manner that is clear to workers and supervisors, there is a higher chance that it will be complied with and the supervisors will be more able to enforce it.

"*It is important that outputs be written in an effective way. The SMART model is in line with Results-based Management (RBM) and provides a structured approach for thinking more deeply and methodically about what needs to be achieved. A SMART output is one which describes to you and anyone else what products and services you are expected to deliver within a performance cycle*". (ILO Guide to writing SMART outputs).

To achieve what is indicated in the precedent STEP 3, it is necessary to have an analytical and complete approach to the possible causes of the risk, proceeding an analysis of the injuries that have occurred in the same conditions deeper and more detailed, observing not only the direct causes but also the indirect ones. Regarding this issue the ILO Code of Practice for Recording and Notification of Occupational Accidents and Diseases 10.2 requires the Employer to, as reasonable as possible:

1. Establish what happened;
2. Determine the causes of what happened;
3. Identify measures to prevent a recurrence.

OUTPUTS SHOULD BE	
Specific	State clearly and precisely what is to be delivered
Measurable	Define quality (how good), quantity (how many), time (how long), resources (how much)
Achievable	Be within resources, skills and competencies, joimtly determined, challenging
Relevant	Be linked to the unit workplan and be within your job role
Time bound	Have specific deadlines, start and finish dates

W.H. Heinrich' (1931) Domino Theory states that "*accidents result from a chain of sequential events, metaphorically like a line of dominoes falling over..*" Since the actions releted to determine the causes of an accident are often the result of many underlying or root causal failures hazards. Generally they depend by management system failures. Viceversa the immediate causes are linked to unsafe acts and-or unsafe substandard conditions. These are

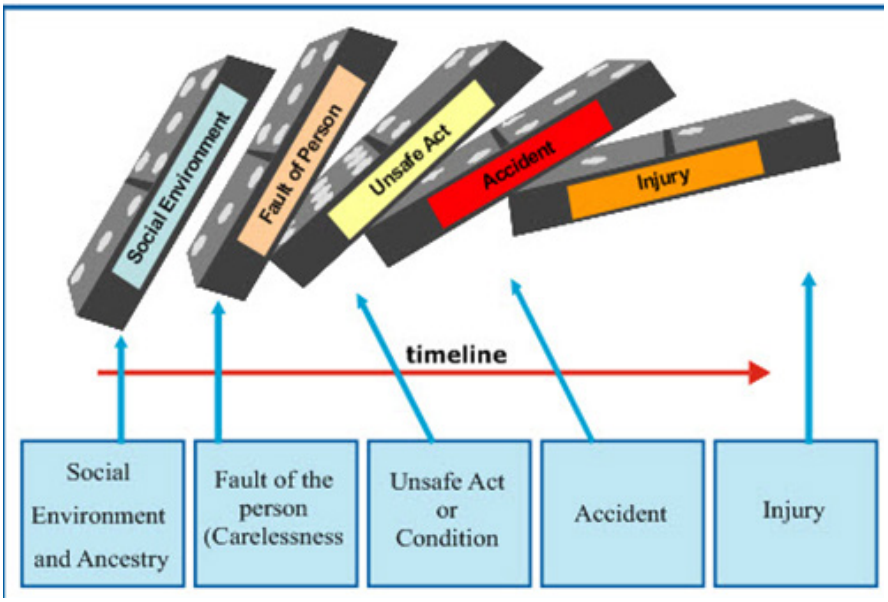

Table 1: The requirements for safety outputs (source: ILO OSH)
Figure 2: The Heinrich's Domino Model of Accident domino (source: DMI)

physical symptoms wich can be seen or sensed. Whilst these symptoms can not be ignored, only the direct preventive action at this level will not, by itself, ensure that recurrence is prevented.

European Union (OSHA)

One of the most effective ways to tackle occupational safety problems is to disseminate appropriate information to workers and employers. The European Union has therefore decided to promote this process and to create in 1996 an agency dedicated to this purpose, EU-OSHA.

EU-OSHA also pursues the very important role of identifying and anticipating possible new and emerging risks through the European Risk Observatory. In the last few years the main topics involved in the research and information work were as follows.

Aging workers.
Increasing levels of employment and prolonging working lives are important objectives of European and national policies since the end of the 1990s. The EU-28 employment rate for people aged 55-64 increased from 39.9% in 2003 to 50.1% in 2013. years in 2010 and trends in the following years are still growing faster. Work experience and skills accumulate with age. However, some functional abilities, mainly physical and sensory, decrease due to the natural aging process. Changes in functional capabilities due to age are not uniform as there are individual differences in terms of lifestyle, nutrition, fitness, etc. In some studies, the Work Ability Index parameter began to be evaluated, linked to the ability to support working conditions that can cause physical and psychological stress in workers aged between 50 and 70 years. Risks related to aging workers include in particular:

- heavy physical work;
- hazards related to shift work;
- work in noisy environments or in low or high temperature conditions.

Young workers and newly hired
Statistics show that people aged 18 to 24 are more likely than other adults to suffer a serious injury at work. They may be exposed to poor working conditions that result in the development of occupational diseases when they are still young or later. Being unfamiliar with the workplace, young people do not have experience and are often still immature, both physically and psychologically, as well as not taking the risks they face seriously enough. In an emergency situation they do not have adequate knowledge to effectively deal with the present danger.

Safe System of Work (SSW)
Several European national regulations have acquired from the Guidelines ILO the concepts of "*safe person + safe place + safe system = Safe System of Work*" (e.g. "*clean up after you do work*"). Those are working methods resulting from an assessment of the risks inherent in a task, and identification of the precaution that are needed to do that task in a safe and a healthy manner. It is very important to highlight that a Safe System of Work is an integration of: People, Equipment, Materials in the correct Environment to ensure health and safety (PEME).

"*A system of work is a set of procedures according to which work must be carried out. Safe systems of work are required where hazards cannot be eliminated and some risk still exists. When developing your safe systems of work, consider how the work is carried out and the difficulties that might arise and expose you or your workers to risk. Then develop a set of procedures detailing how the work must be carried out to minimise or reduce the risk of accident or injury.*" (Ireland Health and Safety Authority).

Italian legislation (D. Lgs. 81/08)

The first reference in Italy regarding the legislation on safety at work is the Legislative Decree 81/08, for all often simply called the "*Testo Unico sulla Sicurezza*" (TUS), that has been elaborated in compliance with the philosophy of the community directives focused on the planning and participation of all the subjects involved in the work.

Recently some innovative elements introduced by TUS have concerned the obligation for the employer, to assess among the risks also those related to work-related stress, to pregnant workers, to differences in gender, age of workers and their origin from other countries. With regard to the management systems, these regulations recall the national ones: SGSL 28/09/2001, European: BS-OHSAS 18001/2007, or international (UNI EN ISO 9000:2001). It should be noted that their application in the construction field sector is still rather limited.

RISK ASSESSMENT: DIRECT AND INDIRECT CAUSES

Two-dimensional risk assessment

the number of risks taken into consideration may also vary substantially depending on the field of application, the nature of the work, the complexity of the work, etc. However, in general it is possible to identify and classify risks related according to the following categories of hazards (regardless of the interferential ones):

- Workplace hazards;
- Work equipment hazards;
- Electricity at work;
- Chemical and biological health hazards;
- Fire and explosive substances;
- Physical and psychological health hazards;
- Muscoloskeletal hazards.

In construction site field, the risk analysis is normally focused on mainly on the main most frequent causes of accidents, in particular:

- Working at height (hazards: workplace – equipment);

- Falling materials (hazards: workplace – equipment);
- Collisions with vehicles (hazards: workplace – mobile work equipment);
- Mechanical and machinery contacts (hazards: machinery – equipment – engine tools);
- Electrocution (hazards: mobile work equipment – equipment – plant - electrical tools).

Risk assessment, according to a traditional approach, results in a two-dimensional type: frequency and entity (see Table 2). Consequently, the preventive and protective measures necessary to eliminate and reduce the assessed risks are concentrated towards the higher level risks (prioritization of risk).

The analysis of possible causes adheres to direct and immediate factors, therefore the proposed solution will belong to protective nature and will mainly be technical-engineering (e.g.: risk of falling from high = protective measure = inserting the guardrail), consistent with the analysis of the direct causes connected to an eventual accident (risk falling from high = direct cause of lack of guardrail).

Multi-dimensional risk assessment

As indicated by ILO-OSHA, the multi-dimensional risk analysis must deal with the concept of systematicity of the approach and therefore extend its horizons to factors that are not adequately taken into consideration, such as:

- identification of the people at risk, who might be harmed and how (e.g.: vulnerable people, young workers, aging workers, etc.);
- work organisation (e.g.: lone workers, night shift, weather conditions, etc.);

moreover those that belong to traditional risk assessment:

- job or task factor (e.g.: technical equipments, PPE, etc.).

This concept is closely correlated with analysis of underlying causes of accidents/ incidents. Identifying the underlying root causes will explain why the substandard act happened or the conditions arose. They are not always easy to identify. Generally indirect causes fall into three major categories:

- personal factors (e.g.: attitude, physical capability, skill, etc.);
- organisational factors (e.g.: procedures, communication, etc.);
- job factors (e.g.: design of equipment and layout, environment, etc.).

In this situation risk control measures must appeal to technical-engineering part (e.g.; falls from high = protective measure = to install guardrail), both organisation-procedural part (e.g.: falls from high = preventive measure = work off with snow and ice on path), and lastly to individual-behavioural part (e.g.: falls from high = preventive measure = allowed only expert and healthy workers).

In this research as a first step, a document is designed that could analyze risk factors that derive from underlying causes to enable a choice of the most effective security measures. The criteria with which it was conceived, however, followed the outputs provided by the PEME concepts.
It was deemed appropriate not to quantify such risks, since there was no adequate case study to measure their frequency and severity and also it would not be possible to determine the weight to be attributed to the different categories. It was therefore decided to address these risks by carrying out an analysis and possibly verifying their presence in the planning phase of the workings. For this reason they have been identified with the term "attention factors", as their possible presence must contribute to increase the attention

			PROBABILITA'				
			Sicuro	Probabile	Possibile	Remota	Improbabile
			5	4	3	2	1
EFFETTO	Mortale	5	25	20	15	10	5
	Grave	4	20	16	12	8	4
	Media	3	15	12	9	6	3
	Bassa	2	10	8	6	4	2
	Minima	1	5	4	3	2	1

Classificazione rischio: **Basso**	**1 - 8**	**verde**
Classificazione rischio: **Medio**	**9 - 15**	**arancione**
Classificazione rischio: **Alto**	**16 - 25**	**rosso**

Table 2: A typical two-dimensional risk assessment (source: THEMA)

towards the choice of additional and complementary organizational and individual measures to those already identified for processing.

Therefore from this scenario, a check list (see Table 3) has emerged that summarizes some of these attention factors, associated with each individual process, conforming to EU-OSHA, such as:

- night job;
- pregnant workers;
- elderly workers (over 55 years);
- newly hired workers;
- workers with linguistic difficulties;
- lone workers

Their possible presence must induce the site's managers to take appropriate supplementary measures, such as the adoption of the Permit To Work procedure. In the case study, this procedure will be further investigated.

APPLICATION OF SSW PROCEDURE: STUDY CASE

The case study is based on the realization of an industrial expansion site in Milan. The Private Client deals with the production and implementation of equipment and tools for the aerospace sector. In particular, the Client had set the goal of concluding the works after only 6 months from the beginning of the construction site, as he had to have the next satellite assembled inside the new expansion denominated “clean room”.

This deadline for the mandatory and imminent work involved an extremely detailed and precise planning and a careful and constant project management, especially with regard to the progress of the work. In this context, the aspects related to the health and safety of the workers of the construction site, depending of the adjacent offices of the Client and the intersections between the traffic of the construction site and the neighboring Via Gallarate, were

ELABORATO	1005	00	00	ES	FDA	5	rev	pag	01	di 1	T.H.E.MA. PROGETTAZIONE E SERVIZI D'INGEGNERIA

Via Melozzo da Forlì 21 – 40133 BOLOGNA – phone +39(0)51.5878411 - www.thema96.it

FATTORI DI ATTENZIONE (FDA) N. (1) DELL'IMPRESA(2) :

Settimana n. dal al

(1) Il presente documento è redatto ai sensi dell'art. 95 comma 1 lett. f) e g) del D. Lgs. 81/08 e s.m.i. ed ai sensi delle Raccomandazioni e Convenzioni dell'Organizzazione Internazionale del Lavoro (ILO)
(2): il nominativo dell'impresa può risultare quello dell'impresa affidataria dei lavori o in subordine dell'impresa che ha il subappalto diretto

Parte di compilazione riservata al Responsabile dell'Impresa ESE

Responsabile Impresa ESE (nome) (cognome) (ruolo)

Il responsabile dell'impresa ESE, per le lavorazione presente in PTA, analizza se i seguenti rischi trasversali possono verificarsi.
Se **SI**, barrare la casella SI, specificare per quale/i lavorazione/i e indicare in tabella il tipo di rischio trasversale.
Se **NO**, barrare la casella NO.

SI ☐ NO ☐

Rischi Trasversali: Lavorazione notturna; Lavoratrici in gravidanza; Lavoratori inserità avanzata (over 55); Lavoratori con informazioni; Lavoratori neoassunti; Lavoratori con difficoltà linguistiche; Lavoratore isolato; Lavorazione con polvere silicotica; Altro:

N.	Titolo lavorazione:
a	
b	
c	
d	
e	
f	

Parte di compilazione riservata al CSE

CSE (nome) (cognome)

Il CSE, visti i risultati dell'analisi dei FDA sulle lavorazioni, richiede il ricorso alla procedura PTW?
Se **SI** quale modello PTW (da PTW 0 a 6) ed indicare l'oggetto del PTW.

☐ PTW n° ... oggetto: ... a
☐ PTW n° ... oggetto: ... b
☐ PTW n° ... oggetto: ... c
☐ PTW n° ... oggetto: ... d
☐ PTW n° ... oggetto: ... e
☐ PTW n° ... oggetto: ... f

Principali misure di coordinamento e di aggiornamento del PSC ai sensi dei 2.3.3 e 2.3.5 dell'allegato XV del D.Lgs. 81/2008 e s.m.i.:
- *Al fine di evitare interferenze con le altre imprese esecutrici si richiede di rispettare le sequenze concordate nel VCS n. ..... del .....;*
- *Il presente documento deve essere sempre compilato contestualmente al documento Programma Spaziale della Attività (PSA) e al documento Programma Temporale delle Attività (PTA).*
- *Altro:*

Firme per presa visione ed accettazione

L'impresa ESE(3)	L'impresa AFF:	Il CSE:

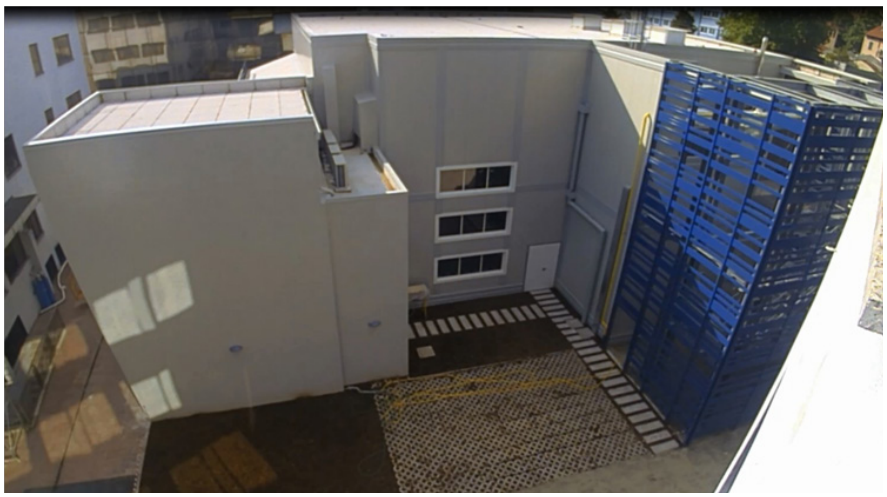

Table 3: Attention factors check list (source: THEMA)
Figure 3: Rendering of the new building (source: THEMA)

among the key factors to be managed to avoid dangerous repercussions on the expected result.

Therefore it is not surprising that the Client has shared with the designers the opportunity to use additional security procedures compared to those established by current regulations, to protect both workers and the achievement of the temporal objective.

Description of the intervention

The intervention that has been carried out has the following characteristics:

- Location: *Milano Via Gallarate, Via Bressanone e Viale del Ghisallo*;
- Client: *OHB Italia SpA - Milano*;
- Design, project management, HSE consultant: *THEMA srl – Bologna*;
- Type of intervention: *new building intended for the production and implementation of equipment and tools for the aerospace sector*;
- Dimension of intervention: *circa 1.000 m²;*
- Cost of intervention: *circa € 3 million;*
- Duration of construction site: *6 months.*

Development of a Safe System of Work (SSW)

The second step of the research has concerned the development of SSW mainly followed the principles and guidelines found in the initial chapter, adapting them to national regulatory requirements. The criteria with which it was conceived, however, followed the outputs provided by the Deming cycle concepts.

Therefore, the development of the SSW has gone through a systematic, cyclic and dynamic approach that involves the direct managers involved in the workings, according to the following main steps (see Figure 4):

1. Before the Construction site starts (PLAN): the Safety and Coordination Plan (SCP) contract document indicates the procedures to be

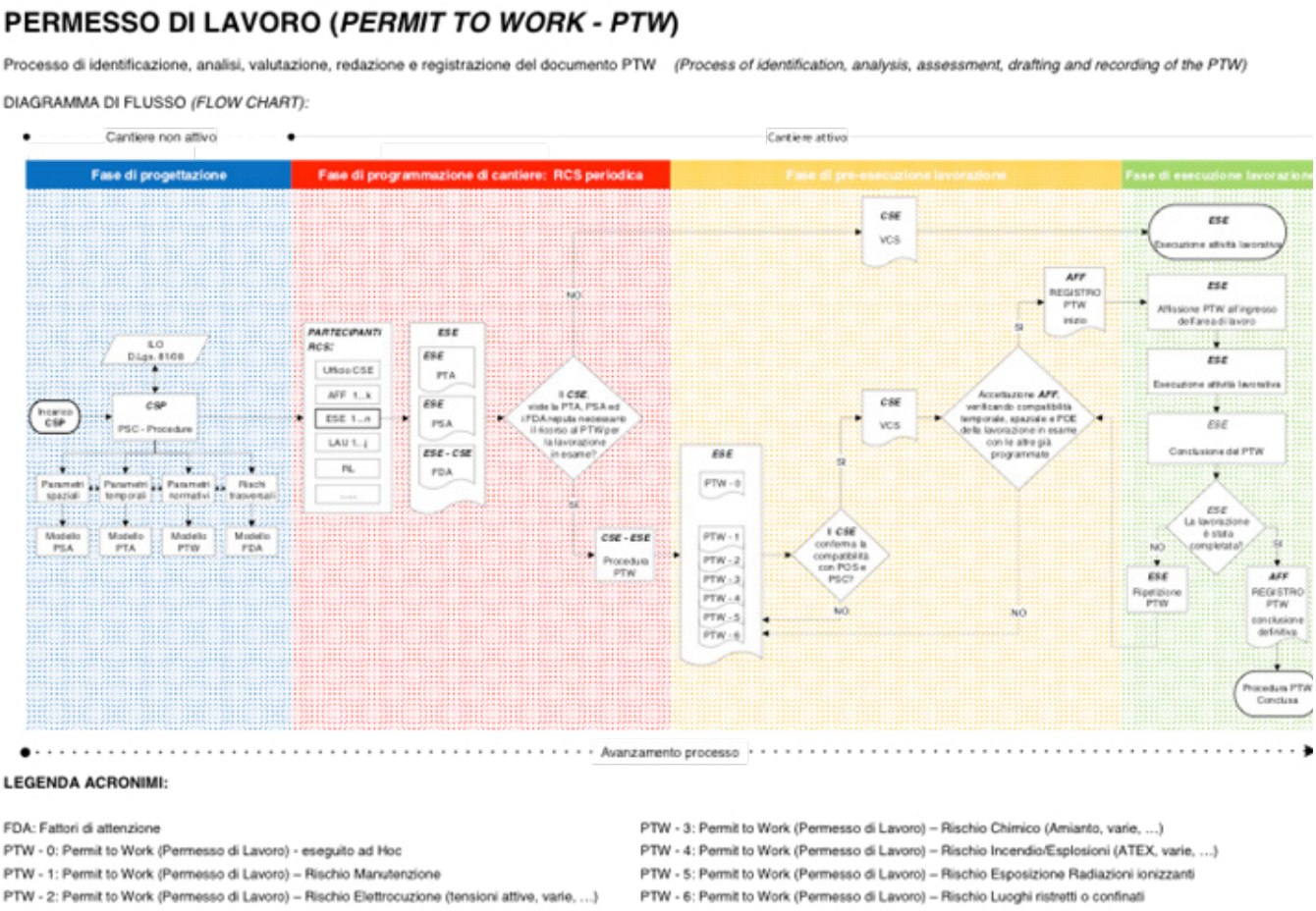

Figure 4: Flow chart of SSW for the remarkable risks on construction site and PTW procedure (source: THEMA)

followed for the analysis, evaluation and adoption of preventive and protective measures relating to all the risks envisaged in the construction site;

2. After the Construction site started:
   a. Planning phase of construction site work (DO): following the procedures indicated in the SCP, the site managers perform the spatial and temporal planning of the activities analyzing, evaluating and adopting the preventive and protective measures relating to all the risks foreseen in the construction site;
   b. Pre-execution phase of work on construction site (CHECK): on the basis of the assessments carried out, a Permit To Work (PTW) procedure is eventually activated;
   c. Phase of execution of workings (ACT): the agreed and envisaged procedures in the SCP are adopted and applied to eliminate and / or reduce the foreseen risks. Any anomalies and / or repetitions of the procedure are analyzed.

The main features of this SSW have been designed with the aim of fulfilling the fundamental principles of sequential, cyclic and dynamic steps.

Permit To Work procedure (PTW)

The third step of research concerned the activation of the SSW in the SCP that was foreseen in the following possible cases, to be evaluated during the works:

1. Maintenance of plant and-or roof;
2. Work on plant with live electrical power;
3. Use of chemical substances and-or dangerous products (e.g. asbestos);
4. Fire and-or explosives substances;
5. Ionizing radiation;
6. Confined spaces.

while it was mandatory for the following work:

7. Working at height during the assembly of new roof .

In fact, in the SCP one of the most intrinsically dangerous working phases was the one related to the assembly of the roofs of the new building. The main risks were those that can be attributed to the fall from heigh of workers and objects. To prevent them it was vital that SSW should be in place.

Coherently with the considerations previously made, as an integrative tool that was considered to be included in the project phases, the use of the procedure called Permit To Work (PTW) was envisaged. This procedure, already widely used in industrial areas (eg chemical industry, oil industry, etc.), is rarely applied in the construction site world. On September 29th 2017 it was then included in the tender documents within the SCP document, just to point out the cogency in terms of security and mandatory nature for the general contractor and the sub contractors involved.

Generally the PTW is a written document that authorizes some workers to carry out specific work, in a specific period of time in a specific work place and through the activation of appropriate preventive safety measures. The PTW adopted in the this construction site was a unique tool in the numerous documents on the site, in fact some of its features have distinguished it completely from the rest of the others. The criteria with which it was conceived, however, followed the outputs provided by the SMART concepts:

- It needs to fill in different parts of the template to respond to the following questions (Smart: Specific outputs):
  - WHO are the responsible?
  - WHAT do actions need to be taken?
  - WHEN shall the actions be executed?
  - HOW shall the responsible act?
- It needs to compare it with others important documents (e.g.: SCP) and to check the quality and quantity of safety arrangements specified (sMart: Measurable);
- The outputs challenging are within the competences and skills of "actors" included in the list. If not, it is predictable a specific Induction Training. The time frame proposed can be delivered. (smArt: Achievable);
- All the responsible shall sign in the template. The document has a relevant value inside the SCP and SSW procedures. The PTW shall exposed outside the workplace (smaRt: Relevant);
- Outputs shall have a specific time frame and deadline. If it needs an extra time deadline they are defined the key steps to reviewing the procedure (smarT: Time bound).

What is highlighted during the meeting with the direct responsible of works is that a PTW is not simply permission to carry out a dangerous job. It is an essential part of a system which determines how that job shall be carried out safely. The permit should not be regarded as a statement that all hazards and risks have been eliminated from the work area. The issue of a permit does not, by itself, make a job safe. The PTW system should ensure that only authorised and properly trained people have thought about foreseeable risks and that these are avoided by using suitable precautions. Those carrying out the job should think about and understand what they are doing and how their work may interface with that of others. They must also take the necessary precautions which they have been trained to take and for which they have been made responsible.

It was considered important to reiterate that for the actual operation of the PTW it is necessary that this instrument be used only for particularly critical conditions. If applied widely and for standard conditions it is likely that:

- it is not regularly applied, because it unjustifiably slows down the work involved;
- be underestimated by the workers

PERMESSO DI LAVORO *(Permit To Work - PTW)* N. 004

Cantiere: ARCOBALENO & CO - Ampliamento PAD. 203 — Impresa AFF: FLAVIO VERDI e FIGLI S.a.s.

Oggetto PTW: LAVORAZIONE IN QUOTA: POSA IN OPERA DI LAMIERA GRECATA

ai sensi del D. Lgs. 09 aprile 2008 n. 81 (e s.m.i.)
ai sensi delle Raccomandazioni e Convenzioni dell'Organizzazione Internazionale del Lavoro (ILO)

Tutti i 9 punti della fase di pre-esecuzione della lavorazione devono essere compilati per intero, prima che l'attività lavorativa abbia inizio.

Fase di pre-esecuzione lavorazione

1. RESPONSABILE DELL' IMPRESA ESE

Impresa ESE:	(nome)	(cognome)
	PIERO	LAME
	(ruolo)	(telefono)
MARTINELLI LAMIERE S.r.l.	PREPOSTO	310 000 0000
	(firma)	
	Piero Lame	

2. VALIDITA'SPAZIALE E TEMPORALE PTW

Descrizione dei lavori (dove, cosa, come): *Fornitura e posa in opera di lamiera grecata nella copertura del PAD. 203.*

AREA DI LAVORO:

PADIGLIONE 203 - COPERTURA

PTW VALIDO DA: (INIZIO)		PTW VALIDO A: (CONCLUSIONE prevista)	
(data)	(ora)	(data)	(ora)
25 / 11 / 2017	08:00	25 / 11 / 2017	19:00

3. FATTORI AMBIENTALI

Nel caso si presentino i seguenti fattori ambientali è **obbligo non iniziare** o **sospendere** la lavorazione.

	SI	NO
Pioggia / Neve	X	
Piano di lavoro bagnato o umido	X	
Materiali accatastati		X
Illuminazione artificiale	X	
Altri:		

4. IMPIANTI TECNICI

I seguenti impianti tecnici saranno **isolati** e **bloccati** per l'intera durata della lavorazione:

	SI	NO
Rilevatore di fumo / gas	X	
Rilevatore antincendio		X
☐ Serbatoi ☐ Condotti ☐ Valvole		X
☐ Dispositivi ☐ Prese elettriche		X
Altri:		

5. MISURE DI SICUREZZA PREVENTIVE

Le seguenti misure di sicurezza saranno attuate **precedentemente** e **durante** la lavorazione:

	SI	NO
Specifici per la Gestione delle Emergenze (Cfr. PdE)	X	
Segnaletica di pericolo	X	
Parapetti provvisori	X	
Rimozione materiali pericolosi	X	
Rete anticaduta		X
Altri:		

6. ATTREZZATURE E DPI

Le seguenti attrezzature ed i seguenti DPI saranno utilizzate **durante** il corso della lavorazione:

	SI	NO
Specifici per la Gestione delle Emergenze (Cfr. PdE)	X	
Dispositivo UNI EN 353	X	
Dispositivo UNI EN 363	X	
☒ Scala telescopica ☒ Scala a pioli		X
PLE	X	
Scarpe antinfortunistiche	X	
Linea Vita	X	
☒ Funi ☒ Imbracatura	X	
Cascetto con sottogola	X	
Dissipatore di energia	X	
Altri:		

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Table 4: Permit To Work filled in (source: THEMA)

and therefore be followed without due attention.

Also for this reason, a specific PTW Register has been compiled, where all the most relevant PTW data in progress and / or completed are recorded in chronological order.
It is in any event essential that anybody starting work is familiar with the local instructions detailing when and how PTW systems are to be applied at a particular location. A specific information-instruction-training session should be done and registered in appropriate format denominated Induction Training.

The format adopted on the construction site (see Table 4) was designed with the logic of responding to the requirements indicated above, but also to respond to the specific peculiarities of the national legislation. In particular, it was considered indispensable that the PTW involved besides the contractor also:

- Safety Coordinator during Construction phase (SCC): as a subject implementing the SCP and validator of the Method Statement, but also responsible for verifying any interference between workers on site. For these reasons it was considered necessary to assign the PTW validation role to the SCC;
- General Contractor (GC): as a company for the overall management of the site and coordinator of all the work to be done. For these reasons it was considered necessary to assign the role of acceptance of the PTW.

Furthermore, among the peculiarities identified in the use of the PTW it has emerged to avoid dangerous interferences or poor management during the passage of delivery of the work areas between different contractors. This will apply equally when there is a transfer of work and responsibilities from one group to another.
The next step of the research, will be that of being able to proceed to multi-dimensional risk evaluation according to parameters comparable with those of traditional two-dimensional risk analysis. This step would allow a comparison between the different risk classes and thus lead to a more comprehensive and overall view of the risk assessment concept (see Figure 5).

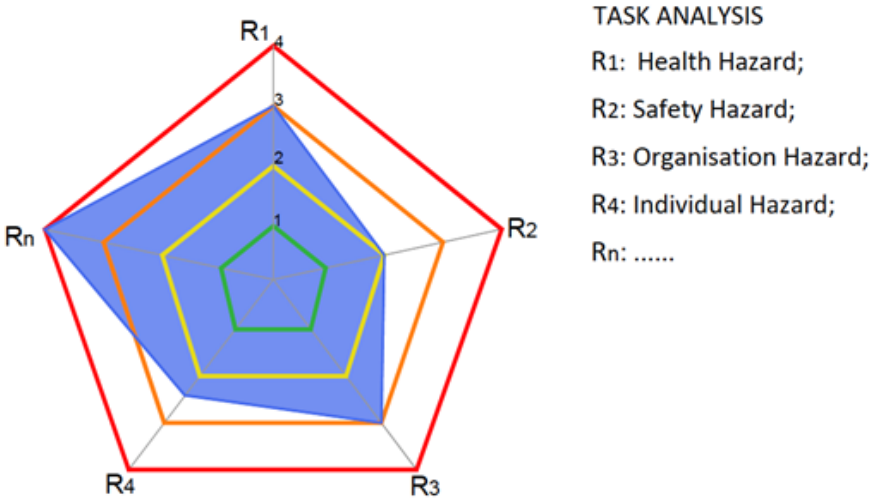

Figure 5: Possible scheme of multi-dimensional risk assessment (source: THEMA)

CONCLUSIONS

The approach used to address the case study has shown the usefulness of adopting procedures referred to by international regulations. In this scenario a multi-dimensional risk assessment could finds out a correct context.

It should be noted that the compilation of the PTW, in the cases envisaged by the SCP, did not encounter major obstacles by the companies involved, since its drafting was generally carried out during the weekly meeting of the construction site and therefore in a well-prepared area for the planning of activities and the assessment of related risks. This aspect also facilitated the collection of signatures of the various managers and the exchange of information with the workers involved.

Minor results were instead made in the application area of the PTW during the work phases involved, as the contractors have not always managed to respect some factors considered indispensable for its application, for example:

- No turnover of designated workers;
- Observance of time scheduling;
- Observance on PPE and signs;
- Delivery of workplaces in safety and proper conditions.

The compilation of attention factors record did not entail great difficulties by the contractor involved. Despite a first attitude of curiosity and surprise towards its compilation (moreover for the identification of worker over 55), this tool became more familiar to the various managers involved.

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