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Design a plan of Best Practices for improving Safety Management System (SMS): Validation Study

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ABSTRACT: This article presents a case study in a Moroccan company. Such a study to identify and analyze the risks related to Health and Safety. It is based on the application of various stages of SOMRA method. The application of such a method has identified the systems and sub-systems with unacceptable risks for the company. This led to the establishment of an action (Best Practices) to improve the safety management system (SMS) of the company.

KEYWORDS: Risks, Health, Safety, SOMRA, OHSAS 18001.

1 INTRODUCTION

In recent decades, companies live in a turbulent environment, competition increasingly increased, the emergence of new forms of requirements and constraints, human resources increasingly demanding ... For this purpose, the company and the men who compose it have no other choice than to work in a complex reality [10]. Modern business is facing unprecedented management issues while remaining in a tradition, in "a world of archaic and modern" as the saying [7]. It must accumulate a large number of constraints and opportunities of different origins, internal or external. It generates, to cope, management tools that can lead to a vertical settling them in practice, such as ISO 9001, ISO 14001, HACCP, ISO 22000, OHSAS 18001, single document, safety management systems, sectoral quality standards ISO 45001 and soon on Management of Health and Safety at Work expected late 2016 or ISO 26000 for management of social, etc.

Considering the new form of requirement for companies '' the newborn ISO 45001 '', taking into account the requirements of this standard will be a major concern for companies even though most of them have adopted the OHSAS 18001 to improve its Safety Management Systems (SMS). As such, for the company to meet the requirements of this standard and be among the pioneers with the certificate ISO 45001, the safety assessment is a crucial year for her to learn risk materializing mechanisms. Indeed, understanding them is a strong way to strengthen the defense, optimize, organize and help guide risk management studies [3],[4].

The rest of this article will focus on three areas. The first is to assess the state of the art on the SMS and risk analysis. The second part is a case study in a Moroccan company. This study aims to identify, analyze and prioritize, by SOMRA method (Organized Systematics Method of Risk Analysis), the different risks occurring at this company. As it will allow to identify and to identify priority areas for an action plan to improve the SMS. In the last part, an action plan will be presented in order to consolidate the priorities for improving health and safety at work.

2 STATE OF ART

2.3 CONCEPT & DEFINITION

According to the AFNOR 06-010-X, security is defined as "the ability of a device to avoid the appearance of critical or catastrophic events" [1].

Security is no danger or conditions that could create an unacceptable risk. It is also the measurement of a level of trust vis-à-vis the acceptability of a risk [9]. Generally in the industry, the term 'security' is used to denote [5]:

- *Security for the product:* this aspect of security is actually a quality component.
- *Industrial Safety and Security Equipment:* relative to major accidents and chronic risks. This security is dominated by the history of dependability and enriched by many theories and developments these last decades.
- *Workplace safety:* this form of security concerning the prevention of occupational accidents and diseases of the employees of the company. It brings together diverse fields as occupational risk prevention, hygiene and health of workers, improving working conditions, workstation ergonomics, space planning, etc.

2.4 PRESENTATION OF THE SAFETY MANAGEMENT SYSTEM (SMS)

The safety management system is "part of the overall management system that facilitates health risk management and / or safety associated with the activities of the organization." This includes organizational structure planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and follow an occupational health and safety policy [11].

Security often makes reference to concepts such as risk, danger, prevention, protection and the responsibility and insurance. Workplace safety is of the order of protection and the prevention of accidents and diseases in the professional world [2].

Health and safety are inseparable and are subject to the same policy. The preservation of health and safety at work is a major public health issue but also a major economic challenge owing to the number of lost days because of work accidents [2].

Consequently an SMS can meet five key objectives [6]:

- Reduction of accidents and working conditions related diseases;
- Organizational;
- Regulatory;
- serenities and image;
- Trust.

2.5 RISK ANALYSIS

Risk analysis is an important step to prevent, correct and have the defense to all kinds of deficiencies that may directly or indirectly influence the health and / or safety [8]. As it represents a mapping allowing the company to better focus its policy and objectives to the places and the most penalizing sites in terms of Workplace Health and Safety (OHS).

Indeed, the risk analysis methods are numerous. They are divided into two main groups: inductive and deductive. In inductive methods, risk or side effect of an element is presumed. This is the reason more specific to the more general and answer questions like "what will happen if ...?". However, in the deductive methods, the final event is assumed and the circumstances that could cause this final event are then sought. This is to reason from the general to the particular, and answer questions like "what is the cause of ...?" [5]

In this study, we use the SOMRA method part of inductive methods group. This method allows to analyze the risks in a progressive manner. It consists of two modules which can be used independently (Fig.1):

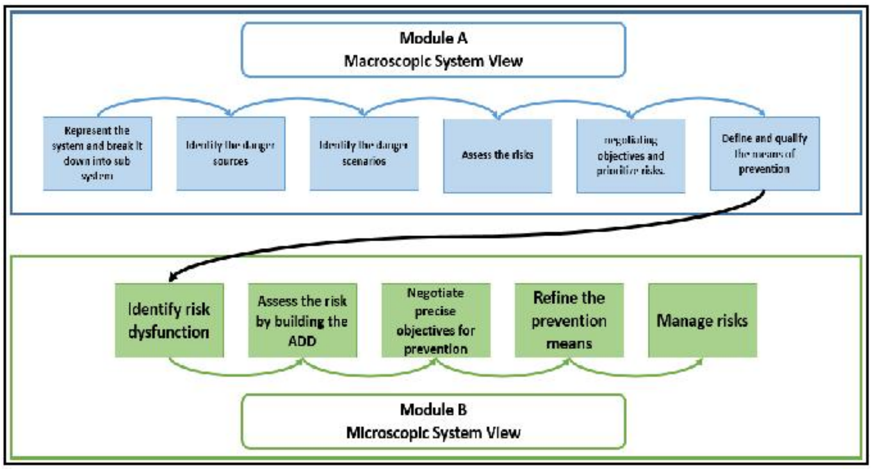

Fig. 1. Modules of the SOMRA method

3 CASE STUDY

3.1 APPLYING THE SOMRA METHOD

The application of the method SOMRA was made in Moroccan company operating in the food industry. This company has two operating services: the Refining Service and the Packaging Service.

Our study focused on refining service. Indeed, such a service is an essential and important step in the manufacture of white sugar. However, it poses risks for staff and can influence the productivity of the company and the quality of the product. Therefore, it is necessary to adopt a very deep risk analysis and updated to avoid the risk of accidents that may weaken the performance or motivation of the company's stakeholders.

3.2 PRESENTATION AND DECOMPOSITION OF THE SITE BY SUB-SYSTEM

Refining service provides operations that allow:

- Remove the outer crystal impurities: refining.
- Remove the inner impurities in raw sugar crystal after melting of refined sugar crystal: clarification.
- Removing dye melting by passing an absorbent.
- Recrystallize sucrose to obtain a pure crystal from the purified solution by previous operations.

So, we deduce the subsystems that make up the Refining Service

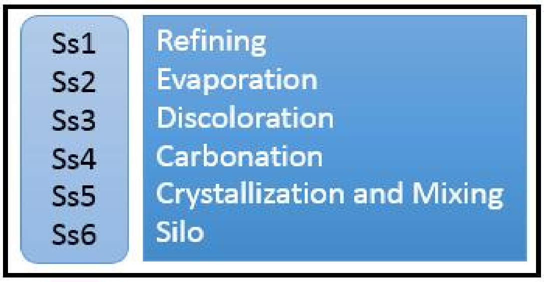

Fig. 2. Refining service decomposition Sub-System

3.3 IDENTIFYING THE SOURCES OF DANGER

This step is to identify dangers and risks associated with each activity. To do this, sources of danger will be examined on the following risk areas:

I. Dangerous substance

N°	Nature of Danger
I.1	Emission gas, dust, waste
I.2	Fire - Explosion
I.3	Contained
I.4	Chemicals
I.5	Organic (Legionella)
I.6	Hygiene
I.7	Asbestos

II. Technical risks

N°	Nature of Danger
II.1	high temperatures
II.2	Rotating Machinery & Cutting Tools
II.3	pressure
II.4	Noise - Vibration
II.5	Electricity - Lightning
II.6	Radiation & Radiation

III. Ergonomics

N°	Nature of Danger
	Display screen
III.1	Lighting
III.2	Slippery & Travel
III.3	Non - Clearing access
III.4	lone Worker
III.5	Climate atmosphere
III.6	Labor organization

IV. Handling / Traffic

N°	Nature of Danger
IV.1	Mechanical handling
IV.2	Collapse - Item Drop
IV.3	Work at height
IV.4	Manual handling
IV.5	Road traffic

V. Other

N°	Nature of Danger
V.1	Specific: Subcontracting, outdoor business
V.2	Sûreté & malice
V.3	Smoking Issues
V.4	Training
V.5	Morsure and sting
V.6	Site-specific

Fig. 3. Risk areas within the Refining Service

Using the figure of the sources of danger (fig 3), we establish, for each subsystem, the list of sources of danger.

Ss1 (Refining)

Nature of Danger	Risk N°	Danger Sources
I.1	R1 R2	dry sugar Transfer Transfer of sugar to refining
I.5	R3	Fomalization melters
II.1	R4	Refining
II.2	R5	Transport of sugar & refining
II.4	R6	Turbine of mass slurred
II.5	R7	Start / Power Off pumps
III.2	R8 R9 R10 R11	Transfer of sugar to refining Cleaning SINEX Refining kettle buckets Exchanger Cleaning
IV.3	R12 R13	Trappe Bypass the SINEX Cleaning melters
IV.4	R14	Closing joints under sifters

Ss2 (Evaporation)

Nature of Danger	Risk N°	Danger Sources
III.1	R21	Lighting
III.2	R22 R23 R24	Condensers Gateway evaporation tray Valves Thermal Transfer
IV.2	R25	Under refining sifters (condensete tank 2400)
IV.3	R26 R27	Grating (5th floor) Circuit VP2
IV.4	R28	Buckets screeners

Ss3 (Discoloration)

Nature of Danger	Risk N°	Danger Sources
I.5	R34 R35 R36 R37	Acid Regeneration (HCl + H2O) Basic Regeneration (NaOH + NaCl + H2O) NaCl preparation Basins Using formalin for disinfection
II.1	R38	Discoloration 110 / M / H
II.2	R39	Discoloration 110 / M / H
II.5	R40	Discoloration 35 m3/h
III.1	R41 R42	Preparation NaCl Nano filtration
III.2	R43 R42'	Filter syrups Nano filtration
IV.3	R44 R45	Nano filtration Bins fading 35 m3 / h
IV.4	R46	Buckets screeners
IV.5	R14	Crossed the road between fading and Nano filtration (circulation)

Ss4 (Carbonation)

Nature of Danger	Risk N°	Sources de Danger
II.1	R50 R51	Filters degassing valve Diastar Blow Moulding
II.3	R52	Cleaning pockets
II.4	R53	Noise on the heating circuit of syrup (BARRIQUAND)
IV.3	R54 R55 R56 R57	Steam circuit DIASTAR Intervention Steam drum Control Filtration Grating

Ss5 (Crystallization / Mixing)

Nature of Danger	Risk N°	Sources de Danger
I.1	R60	Mixing (steam)
I.5	R61	Device DITMAR (chemicals (alcohol))
II.2	R62 R63 R64	Cleaning (Mixing) Cooked drain valves Empty Barriquande STG1
III.3	R65 R66 R67	Air cutlet flap cooler Fans Intervention braids

Ss6 (Silo)

Nature of Danger	Risk N°	Sources de Danger
I.3	R72 R73 R74 R75 R76	Ineffective dust filters Strip TP101 RIA in poor condition (ground floor) RIA (reception silo 2) Materials unsuitable bearings
III.1	R77	Lack of lighting (at the failover)
III.2	R78 R79	Stairs Loading tank
IV.4	R80	changeover valve
V.2	R81 R82	Industrial Safety Equipment Uncontrolled access

Fig. 4. Sources of danger for each sub-System

3.4 IDENTIFICATION OF UN (UNWANTED ENEVEMENTS)

The following table shows the main elements of SFAM model (Systems Failure Analysis Methodology) to specify unwanted events (UN). The first step is to complete the information by identifying with grids made for all subsystems. This gives a list of site hazards. The second step is to identify processes with dangers…

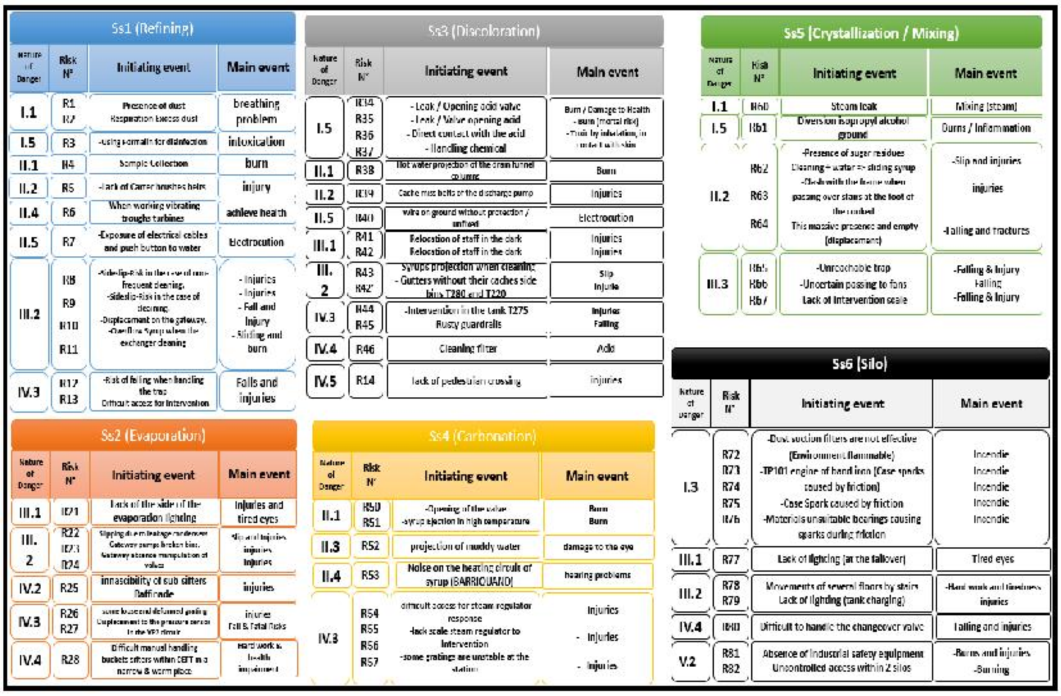

Fig. 5. Danger process for each Sub-systems

3.5 RISK ASSESSMENT

Risk assessment is a step that quantifies the identified risks to make them measurable and comparable.

To perform this task, the criticality assessment of risk (C) is based on their probability of occurrence (P) and gravity (G). The (P) is a function of the sum of the duration of exposure (D) and the level of mastery (M) existing.

<u>*Note*</u>

For what will follow the risk assessment will be based on the criteria required by the process of "hazard identification and risk assessment" established by the company according to the OHSAS 18001 Reference.

Or the formula: ***C = G x P***

3.5.1 QUANTIFICATION OF THE DURATION OF EXPOSURE "D"

This step is to assess the duration of exposure to the hazard of the table following the weighting criteria below

Table 1. Quantification of exposure time

weighting	Exposition	Working time Ratio in %
1	**uncommon**	**Under 5%**
2	**unusual**	**Under 15%**
3	**occasionally**	**Under 30%**
4	**frequent**	**Under 60%**
5	**very frequent**	**Under 90%**
6	**continues**	**More than 90%**

3.5.2 IDENTIFICATION OF PROTECTIONS "M"

This step is to establish the levels of protection implemented according to the table weighting criteria below.

Table 2. Levels of protection implemented

weighting	Description of protection
1	Collective protection
2	Personal protective equipment
3	No protection

3.5.3 PROBABILITY OF OCCURRENCE "P"

This step is to define the probability of risk by making the sum of the duration of exposure "D" and the existing level of protection "M".

Table 3. The probability of occurrence of the risk

Level	Designation	D+M	Description
5	Almost certain	Between 8 and 9	Expected to occur in most circumstances
4	Likely	Between 6 and 7	Likely to occur in most circumstances
3	possible	Between 4 and 5	Can occur a few times
2	unlikely	Between 2 and 3	Could happen sometimes
1	uncommon	2	May occur only in exceptional circumstances

3.5.4 RANKING THE GRAVITY OF DANGER "G

This step is to define the gravity level of danger according to the table below

Table 4. The gravity of the hazard

Level	Designation	Description
5	catastrophic	AT with IPP > 15% or disease which may cause irreversible damage health
4	major	AT with IPP <15% or disease that may cause health effects
3	moderate	AT <10 days
2	minor	Care without work stoppage
1	insignificant	no injuries

3.5.5 RISK RANKING "C"

Criticality of risk is proportional to the combination of severity and likelihood of occurrence.

In order to streamline the method of prioritization, the criticality of a risk is obtained by the product of the combination of "G x P" according to the formula:

C = G x P

3.5.6 CLASSIFICATION OF RISK CRITICALITY

The following figure shows the classification of the criticality of risk for each subsystem

Risk	D	M	P	G	C
Ss1 (Refining)					
R1	3	3	4	4	16
R2	3	3	4	3	12
R3	3	3	4	4	16
R4	5	3	5	5	25
R5	3	3	4	4	16
R6	4	3	4	2	8
R7	6	3	3	5	15
R8	3	3	4	3	12
R9	6	3	5	2	10
R10	3	3	4	3	12
R11	3	3	4	3	12
R12	6	3	5	4	20
R13	2	3	3	5	15
R14	6	3	5	1	5
R15	6	3	5	5	25

Risk	D	M	P	G	C
Ss2 (Evaporation)					
R21	6	3	5	5	25
R22	6	3	5	3	15
R23	6	3	5	4	20
R24	6	3	5	5	25
R25	5	3	5	4	20
R26	5	3	5	4	20
R27	2	3	4	5	20
R28	3	3	4	4	16

Risk	D	M	P	G	C
Ss3 (Discoloration)					
R34	5	3	5	3	14
R35	4	3	4	3	12
R36	4	3	4	4	16
R37	1	3	3	5	15
R38	4	3	4	4	16
R39	4	3	4	4	16
R40	4	3	4	3	12
R41	3	3	4	2	8
R42	3	3	4	2	8
R43	4	3	4	3	12
R44	3	3	4	4	16
R45	3	3	4	3	12
R46	4	3	4	2	8
R47	6	1	4	5	20

Risk	D	M	P	G	C
Ss4 (Carbonation)					
R50	4	3	4	3	12
R51	4	3	4	4	16
R52	6	4	5	3	15
R53	3	2	3	4	12
R54	1	3	3	3	9
R55	1	3	3	3	9
R56	4	3	4	4	16
R57	6	3	5	5	25

Risk	D	M	P	G	C
Ss5 (Crystallization / Mixing)					
R60	4	1	5	3	15
R61	3	3	4	4	16
R62	3	2	3	3	9
R63	4	2	4	4	16
R64	3	2	3	3	9
R65	3	3	4	5	20
R67	4	3	4	4	16

Risk	D	M	P	G	C
Ss6 (Silo)					
R72	4	3	4	2	8
R73	5	3	5	4	20
R74	6	3	5	4	20
R75	6	3	5	4	20
R76	6	3	5	5	25
R77	2	3	3	3	9
R78	2	3	2	4	8
R79	2	3	3	3	9
R80	4	3	4	3	12
R81	3	3	4	3	12
R82	6	3	5	1	5

Fig. 6. Classification of Risk Criticality

3.5.7 RISK MAPPING

A risk is acceptable if the note of criticality is less strictly 16 and G <5 according to procedure. These intervals were determined following a brainstorming session conducted between corporate stakeholders.

G / Frequency	1 Insignifiant	2 Minor	3 Moderate	4 Major	5 Catastrophic
1 Uncommon					
2 Unlikely				R78	
3 Possible			R54; R55; R62; R64; R77; R79	R53	R7; R13; R37
4 likely		R41; R42; R46; R72; R6	R2; R8; R10; R11; R35; R40; R43; R45; R50; R80; R81	R1; R3; R5; R28; R36; R38; R39; R44; R51; R56; R61; R63; R67; R75	R27; R49; R65
5 Almost certain	R14; R82	R9	R22; R34; R52; R60	R12; R23; R26; R73; R74; R83; R25	R4; R15; R22; R24; R57; R76

Fig. 7. Risk mapping

By way of summary, the application of the SOMRA method has identified various sources of hazards 'refining' service. As it allowed also to know the most penalizing subsystems in terms of OSH. This is very interesting to guide the company to take the necessary measures well in these positions in terms of OSH.

3.6 ACTION PLAN

The neutralization of risks is done by the research all preventing barriers at the source system, the main event and induced effects, and protective barriers at the target level systems. These barriers are of two types:

- Technological barriers (TB): whole of technology integral to the system which automatically opposed to the appearance of an adverse event safety and that does not require human intervention;
- The operating barriers or use barriers (UB): actions requiring human intervention based on specific instructions, activated or not an item or technology package.

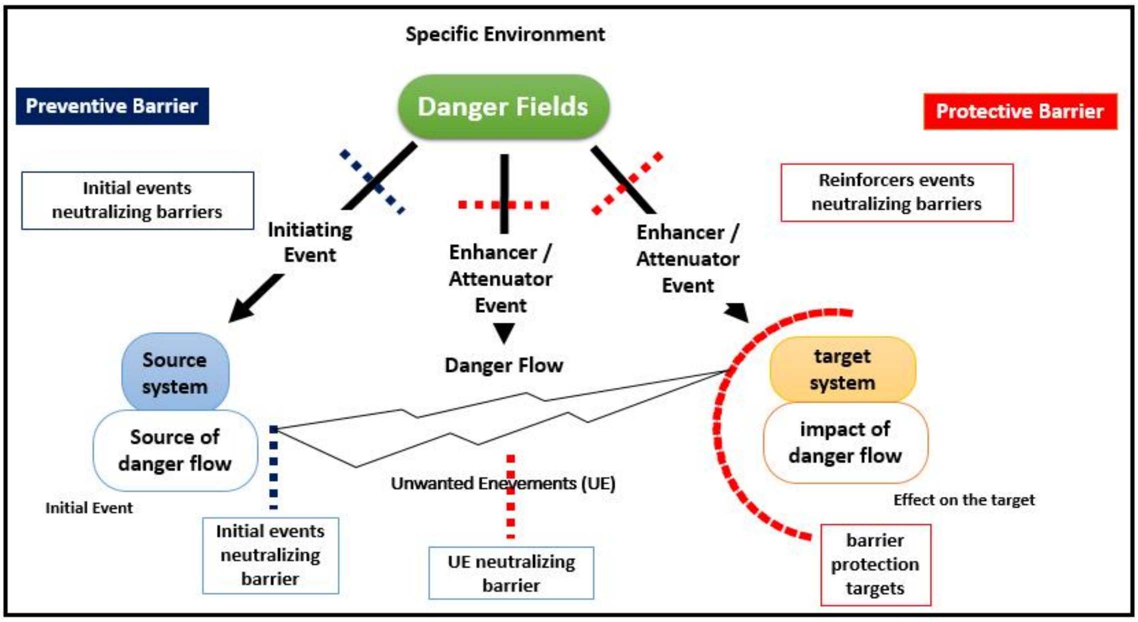

Fig. 8. Risk neutralization barriers

After defining barriers, we must ensure that they have or do not generate risks, and we must qualify in time ie ensure their sustainability.

Thus, we must verify that the proposed barriers do not introduce new risks and must be qualified in time. The table below includes all the barriers that can neutralize qualified unacceptable risks according to the risk assessment carried out before.

Table 5. Neutralizing barriers qualified risk

Risk	Barriers	Design	controls and technical checks	Maintenance
R1	Filtration area increase	Dust collection system in the late band	Frequent cleaning of the filter	Preventive Maintenance
R3	Emerging the circuit in the melters	Correct dimensioning	periodic verification	-
R4, R15, R56	Changing the location of the valves	Easy access (manual & automatic)	-	-
R5, R39	Rehabilitation of crankcases + Sensitization	Robust material & Cover the entire belt	Verification of crankcase 2 times / week	Systematic maintenance
R7	Cover the cables and buttons	Provide plastic covers	-	-
R12	Automatic trap	Pneumatic cylinder & facilitated access	-	Preventive Maintenance
R13, R26, 57	Rehabilitation duckboards or Setup sheet metal instead of duckboards	Good fixation system + robust material	Monthly status check sheet metal and duckboards	Dressage duckboards
R21	Commissioning of the lighting system	Cover lamps + powerful lighting + replacement duckboards	Verification as statements about the state of the lighting system	-
R23, R65, R67	Commissioning the gateway	Correct dimensioning	Long-term audit	Cover gateways
R24	Provide a stepladder	Easy to move and correct sizing	Verification in case of wear of the material	-
R25	Setting up of a monorail	Mechanical block and tackle	-	Preventive Maintenance
R27	Changing the location of the pressure sensor	Easy access	Checking the accessibility when adding hardware or introduction of new technology	-
R36, R44	Commissioning of Gard-corps	Fixing system + adequate sturdy material to the toxic work environment	Visual inspection of the condition of gard-corps	Preventive Maintenance
R37	Centralized formolage station & FDS Sensitization	Availability of ISE + process automation	Conditions and the availability of PPE	-
R38	Funnel cover	Cover is dimensioned and adequate	-	-
R49	Signage to display on the spot	Clear, simple and visible to the machine operator	-	-
R51	Extension vents up	-	-	-
R61	Provide collector or fuel tank bracket isopropyl alcohol	-	-	-
R63	Door to keep it closed	-	-	-
R73	Provide motor ATEX	-	-	Preventive Maintenance
R74, R75	Changing the RIA	-	-	-
R76	Provide ATEX bearings	-	-	Preventive Maintenance

The list of proposed actions is not exhaustive. Other actions have been proposed and are outstanding validation. They are not presented in the present work.

In fact, the implementation of these actions is outstanding and to see the desired improvements, control of resources, compliance verification and monitoring indicators have been set up as a dashboard.

4 CONCLUSION

In this article, we presented initially SMS. We have defined and demonstrated the importance of control of such a system in a company. As we have shown the risk analysis of interest to ensure the proper functioning of the SMS. Subsequently, a case study on the identification and risk analysis was presented.

This study was conducted in a Moroccan company operating in the food industry. To do this, we relied on the SOMRA method to carry out this study. This allowed thereafter, identify, first, the different sources of hazards that occur in each subsystem of the chosen unit and prioritize risks by calculating the corresponding criticality of other. Finally, an action program was proposed to improve sub-systems with unacceptable risks.

REFERENCES

[1] AFNOR, Accès aux machines et installations industrielles, Règles de sécurité. *AFNOR 2002*.
[2] CORREARD I., ANAYA P., BRUN P., Sécurité, Hygiène et risques professionnels. Dunod 2011
[3] DAKKAK B., CHATER Y., GUENNOUN M., TALBI A., Proposition of a method to help the evaluation of safety at work. *International Symposium on Security and Safety of complex systems 2SCS Agadir 25 et 26 may 2012.*
[4] DAKKAK B., CHATER Y., TALBI A., Proposition d'une matrice de criticité intégrant les systèmes qualité, sécurité et environnement pour la fonction maintenance. Journal of Decision System. Vol. 21, No. 4, November 2012.
[5] DAKKAK B., TALBI A., Amélioration de la performance industrielle par le déploiement du SMI: Application aux PME/PMI Marocaines. Presses Académiques Francophones 2014.
[6] GILLET-GOINARD F., Bâtir un système de management intégré Qualité-sécurité-environnement. *Editions d'organisation, 2006.*
[7] LATOUR B., interview donnée au magazine Télérama n° 2941, 2006.
[8] MARGOSSIAN N., Risques et accidents industriels majeurs, Caractéristiques, Réglementation, Prévention. Dunod 2006
[9] MAZOUNI M., Pour une meilleure approche de management des risques. *Thèse de doctorat de l'institut polytechnique de Lorraine*. *2008.*
[10] MICHEL X., CAVAILLE P., et COLL, Management des risques pour un développement durable Qualité Santé Sécurité Environnement. Dunod 2009
[11] OHSAS 18001. Occupational Health and Safety Management Systems – Requirements *OHSAS. 2007.*