Mapping of occupational hazards at Palma Industrial Park, Constantine, Algeria

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Abstract

Methods and tools of risk analysis are used to argue the decisions regarding the issuance of operating permits, the control of urbanization and the development of a contingency plan. Among these tools, we find mapping risk. Mapping is a method of representation and prioritization of an organization's risks. It is an essential component of the risk management process, especially when enacted in an industrial area. Its objective is to have a global inventory of vulnerabilities for all activity fields. The mapping process is important because it raises the general risk evaluation, assessment and prioritization. It offers simple and didactic representations, giving an overview for decision-makers to guide their strategic choices of action especially in the case of an accident. Maps are then used to track the effectiveness of strategies implemented and finally form a very effective tool of communication on the inventory of fixtures. The overall objective of this study to determine the map's risks of a former industrial area "Palma" in extension to help manage risks in situ. To carry out this study a Preliminary Hazard Analysis (APR) approach was used. The latter plays a āecisive role in risks management, meaning cost control, project deadlines related to the achievement of performance objectives for the product or service. In particular, the APR approach must:

- Identify and assess risks;
- Define and quantify the possible scenarios;
- Develop an action plan.

Keywords: analysis, risk mapping, assessment, APR, industrial area.

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1 Introduction

For more than 20 years, risk analysis methods have continued to evolve and their results have now become key decision-makers in the risk management around high-risk settlements. The ever-increasing interest to improve the knowledge of the risks generated by these institutions follows the occurrence of some major industrial accidents that have marked the memories: Flixborough (1974), Seveso (1976), Bhopal (1984), Mexico City (1984) [1], LNG Skikda (2004) [2]. Today, the methods and tools of risk analysis are used to argue decisions regarding the licensing of urbanization and operating, the control of risks and the development of relief [1, 3] and evacuation plans, these tools and methods include risk mapping.

The latter is a mode of representation and prioritization of risks in an entity (organization, industrial area, a district, etc.). This is an essential component of the process of risk management. Its objective is to provide an overview (entity system) overall vulnerability for all fields of activity. The mapping process is important because it raises the overall risk identification, assessment and prioritization. It offers simple and didactic representations, giving an overview for decision makers to guide their strategic choices of action. The cards are then used to monitor the effectiveness of strategies implemented and finally form a very effective tool of communication on the state of the art [4].

2 Problem

Recent disasters, including the LNG refinery in Skikda (Algeria), led to seek enhanced security facilities with better or new technical and/or organization. Following the spate of explosions and fires of any kind, psychosis and panic have insidiously installed among the inhabitants of the city of Skikda which seriously fear a catastrophe [5].

Again, as in most situations, there is no distinction of clear limits between areas reserved for plants and complex high risk and those that remain public. Therefore, thoughtless promiscuity of industrial infrastructure with residential areas represents a potential threat to populations [3]. At the slightest malfunction, a major disaster could occur and thereby cause the country in a very critical situation [6]. If a complex is affected, it might have an immediate impact on the nearest and so complex, with consequences as the outright destruction of the surrounding environment and neighbouring populations [7]. Consequently, the overall objective of the study is the determination of risk mapping of a former industrial area “Palma” in order to help manage risk in situ.

3 Working methodology

The approach is how to develop a risk mapping at the industrial area Palma. To carry out this mapping, we appealed to the APR process (Preliminary Hazard Analysis). This approach is intended to highlight the major problems likely to be encountered in the studied system whose objective is to evaluate the problems to

be solved in terms of risk management. This analysis is generally conducted at the very beginning of the design of the system [4]. It is then updated as the progress of the design, even the life of the system in operation. This can take very different forms in its implementation following the technical area or industrial sector considered [8]. However, because the area has already 40 years, there are three phases and also three objectives, namely:

- Identification of hazards, unwanted events to take into account;
- Evaluation and ranking of associated risks;
- Proposed measures for risk coverage.

The preliminary risk analysis (PRA) is a method of identification and risk assessment whose purpose is to identify, in a functional unit, scenarios leading to a dreaded event in the presence of a hazard or dangerous to deduce the means of action for the control [9] position.

Subsequently, for the development of mapping our area and to facilitate the task of prioritizing all risks in the various businesses, we preferred to use zoning and assigned colour indicators on companies to better identify areas at risk, detect risks that may be unacceptable and identify priority actions to begin.

3.1 Analysis steps

A. The preliminary risk analysis of the system: The result of this analysis is the determination of mapping dangerous situations.
B. Preliminary analysis of risk scenarios: The result is a preliminary analysis to determine the risks mapping and risk of the system.
C. Mastery risk
   - Establish action to reduce initial risk level;
   - Establish a catalogue of security settings.

3.2 Definition of evaluation and decision elements

3.2.1 Scale of severity

The severity of the consequences of an unwanted event is formulated to achieve and degradation of the system, subsystem in a generic 5 point scale. The factors taken into account are:

- The dangerous events having an impact on the safety of personnel;
- The events having an impact on system operation with ceasing of activity and impact in terms of financial loss;
- Events causing degradation of the mission with reduced productivity;
- The events having an impact on the quality of the system organization.

3.2.2 Severity level (SL)

Determine according to generic levels, namely:

- SL1: little damage to health;
- SL2: serious reversible reached;
- SL3: irreversible damage without aggravation;
- SL4: irreversible damage and deterioration;
- SL5: death.

3.2.3 Scale likelihood

The likelihood is also previously defined as a generic scale with three levels. In the absence of adequate figures on the causes of disturbances and balance sheets of accident data, the likelihood was determined using a qualitative scale based on experience and the age of players.

3.2.4 Exposure level (NE)

Is the combination of the occurrence of the hazard, which is the frequency and dose of exposure, three class are distinguished, namely: (F: Low; M: Medium; I: Inevitable).

3.2.5 Exposure frequency (EF) (Occurrence of hazard):

Three class are distinguished, namely (EF1: rare to occasional; EF2: occasional to frequent; EF3: frequent to permanent).

3.3 Acceptability of risk

The risk acceptability is characterized by criticality. The degree of criticality was defined as the product of the probability of occurrence of harm and its severity. The decision repository is built from scales of severity and likelihood (Table 1).

Table 1: Risk rating.

		Severity level				
		SL1	SL2	SL3	SL4	SL5
Exposure Level	F	C1	C1	C1	C2	C3
	M	C1	C2	C2	C3	C3
	I	C1	C2	C2	C3	C3

This grid is used to describe the acceptability of risk and visualize three critical points C1, C2, C3.

4 Study of the industrial zone Palma, Constantine

Our aim is the Palma industrial area. It is located south-west of the city center of Constantine (figure 1), which extended its area as a measure over time, estimated to be 3484m^2. Its biggest problem is thoughtless disposal of various entities (SMEs/SMIs, corporations, institutions, homes, community hall, etc.). There is no rule that is respected for the location and compatibility of their respective activities. These are all facing a high risk of thoughtless promiscuity industrial infrastructure [10]. This represents a potential threat to the environment and the population. We do not distinguish between net areas reserved for plants and complex high risk and those who are public limits. At the slightest malfunction, a major disaster could occur and thereby cause the region to be in a very critical situation.

Figure 1: Palma Industrial Park, Constantine, Algeria.

4.1 Description of systems and subsystems

A listing of the entire work area was made. This enumeration allows us to develop the representation of the industrial area Palma, in lots of activities (figure 2).

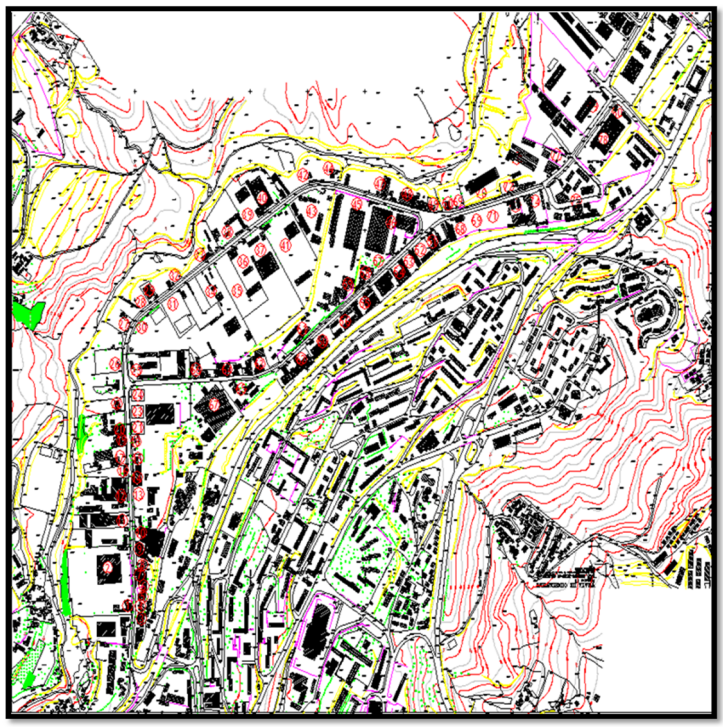

Figure 2: Geographical zoning, enumeration and demarcation of entities [10].

Criticality was determined using the criteria of frequency and severity, as follows.

Frequency:

- Possible ignition source in normal operation;
- Possible ignition source in case of malfunction;
- Possible ignition source in case of a rare malfunction.

Gravity:

- Incident without affecting the holding station or incident may request Benin stop position (care) in the short term but not stop working;
- Accident outside care can lead to work stoppages;
- Injuries with irreversible effects (inability to work) or death/employees of units of work;
- Explosion causing injury with irreversible effects.

Three areas have been identified in accordance with the coding of Table 2.

Table 2: Classification of areas by criticality area.

Area	Criticality
The red area	Risk is present continuously or for long periods or frequently
The yellow area	Risk is not likely to occur in normal operation, however, is only of short duration.
Green area	Corresponds to areas where the risk is identified as weak.

We obtain virtually identical to that of the occupational risk assessment and classification by level of risk (Table 3) matrix.

Table 3: Colour-coded priority areas.

Colour	Level risk	Priority actions to implement
Red	3	A better priority: high-risk situation. Urgent action to implement on short term.
Yellow	2	A better: Correct the measures in place and/or implement new security measures on the medium term.
Green	1	Low risk: Set up additional resources after a thorough study following HTO approach (Human – Technology – Organizational).

4.2 Exploitation of results

Preliminary analysis of the risks identified in this area, while introducing a business table and a level of criticality coefficient table. 26 companies at risk of Priority 1, Priority 2 of 26 companies, 53 companies Priority 3. These results were grouped into five slices of activities with a criticality table 4, 5 and 6, namely: (BTPH) Building and public works and hydraulic; (IND) Industry; (AGR) Agriculture; (SERV) Service; (IPA) Administrative and Public Institution.

Table 4: Companies' coefficient.

Companies' sizes	Coefficient
1–20	1
20–50	2
50–100	3
100–1000	4
more than 1000	5

Table 5: Criticality level.

Criticality	Level
C1	1–5
C2	6–10
C3	11–25

Table 6: Table of criticality of various sectors.

BTPH	5	10	15	20	25
IND	4	8	12	16	20
AGR	3	6	9	12	15
SERV	2	4	6	8	10
IAP	1	2	3	4	5

The study results are summarized in Table 7.

This has allowed us to develop a risk map of the Palma industrial zone (figure 3).

5 Conclusion and recommendations

This study has allowed us to have a global inventory of vulnerabilities for all fields of activity located in the industrial area. A number of critical areas were identified, the first remark is that this area has grown alongside its industrial objective. There is a little all except engineering. There even in homes, cafes, vendors alcoholic drinks, party rooms which is in contradiction with the law. Furthermore, no standard of urbanization was respected and no compatibility

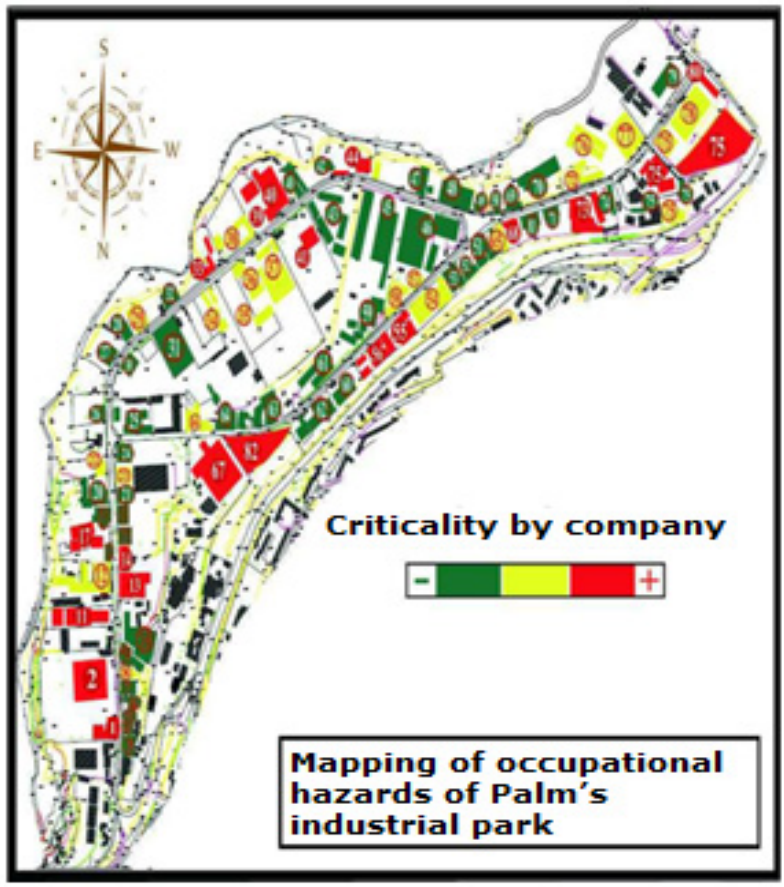

Figure 3: Risk mapping of Palma industrial zone, Constantine.

with the activities described and the majority of their waste discharges is in the valley of Rhumel which represents an imminent danger to the environment. We ask local government to review the nature and arrangement of the various activities within the Palma industrial area and we offer a plan of action on the following areas of development:

- The development of a general development plan, in line with the sustainable development plans of the Palma area;
- The implementation of an integrated waste recycling system for the industrial area;
- The creation of a more stringent procedure for review of existing and future cases.

We believe that the APR proposed methodology must also be applied to other sites in the city; the axes suggested progress was valid for all urban and industrial areas.

Table 7: Criticality of each entity of the Palma area.

N°	Companies	Legal sector	Activity sector	Effective	Coef.SA	Coef.	Criticality
1	Commissariat	PUB	SERV	156	2	4	8
1	SNVI	PUB	SERV	200	2	4	8
2	RESTAURANT	PRIVE	SERV	10	2	1	2
3	TOURNEUR	PRIVE	SERV	7	2	1	2
4	COUTURIER	PRIVE	SERV	5	2	1	2
5	MITSUBISHI	PRIVE	IND	16	4	1	2
6	RESTAURANT	PRIVE	SERV	8	2	1	2
7	IMPRIMERIE	PUB	IND	58	4	3	12
8	DEPOT BOISSON	PRIVE	SERV	47	2	2	4
9	VENTE PNEU	PRIVE	SERV	3	2	1	2
10	ALTRO	PUB	BTPH	600	5	4	20
11	UPC	PRIVE	SERV	89	2	3	6
12	SOREST	PUB	BTPH	457	5	4	20
13	SARL NEOMEDIC	PRI	IND	65	4	3	12
13	SOREST REGIONAL	PUB	BTPH	1110	5	5	25
14	NOVA TOURNEUR	PRIVE	SERV	9	2	1	2
15	SALLE DES FETES PRESTIGE	PRIVE	SERV	23	2	2	4
16	EURL GAMMA MEUBLE	PRIVE	IND	152	4	4	16
.	.....	....	....	.....	....	.....	.....
21	STATION ABONDONNEE	PUB	SERV	0	2	0	0
22	CHANTIER	PRIVE	BTPH	40	5	2	10
23	CHANTIER	PRIVE	BTPH	25	5	2	10
24	DIRECTION DES TRAVEAUX SEACO	PUB	SERV	36	2	2	4
25	LAVAGE	PRIVE	SERV	7	2	1	2
26	SALLE DES FETES RHYMEL	PRIVE	SERV	28	2	2	4
27	DEPOT	PRIVE	SERV	14	2	1	2
28	DEPOT	PRIVE	SERV	8	2	1	2
29	CHANTIER	PRIVE	BTPH	42	5	2	10
30	ASSURANCE	PRIVE	SERV	32	2	2	4

Table 7: Continued.

N°	Companies	Legal sector	Activity sector	Effective	Coef.SA	Coef.	Criticality
31	LAVAGE	PRIVE	SERV	9	2	1	2
32	SARL PHARMAVET	PRI	SERV	12	2	1	2
33	SARL HUP PHARMA	PRI	IND	800	4	4	16
33	CHANTIER	PRIVE	BTPH	40	5	2	10
34	EPTP	PUB	BTPH	947	5	4	20
35	SARL PHARMIDAL NS	PRIVE	SERV	60	2	3	6
36	COTA	PUB	SERV	89	2	3	6
37	ETUSC	PUB	SERV	246	2	4	8
38	DEPOT PEPSI	PRIVE	IND	37	4	2	8
39	ALGERIE TELECOME (polygone)	PUB	SERV	52	2	3	6
40	EURL ENNASR	PUB	SERV	108	2	4	8
40	CHANTIER	PRIVE	BTPH	58	5	3	15
41	MASSINISSA BOISSON GAZEUZE	PRIVE	IND	59	4	3	12
42	MAISON KIA	PRIVE	SERV	40	2	2	4
43	LIND GAZ	PUB	IND	75	4	3	12
44	SOCIETE GENERALE	PRIVE	SERV	40	2	2	4
45	SEROEST	PUB	BTPH	1026	5	5	25
46	DIGROMED	PRIVE	IND	31	4	2	8
46	PHARMIDAL F SAIDAL	PUB	IND	85	4	3	12
.....	.....	.....	....	....	....	....	....
52	DEPOT	PRIVE	SERV	30	2	2	4
53	DIRECTION RESSOURCE EN EAU	PUB	IND	100	4	3	12
53	GICA	PUB	SERV	18	2	1	2
54	CTC EST	PUB	SERV	472	2	4	8
55	GICO	PUB	SERV	0	2	0	0
56	SARL SAFI LAIT	PRIVE	IND	103	4	4	16
57	EX AL	PRIVE	SERV	62	2	3	6
58	SARL EL HADNA	PRIVE	IND	28	4	2	8
59	HABITATION	PRIVE	IAP	7	1	1	1

Table 7: Continued.

N°	Companies	Legal sector	Activity sector	Effective	Coef.SA	Coef.	Criticality
60	BOSH	PRIVE	IND	14	4	1	4
61	PALMA MEUBLE	PRIVE	SERV	14	2	1	2
62	MAISON	PRIVE	IAP	4	1	1	1
62	SARL BIOGALINIC	PRI	SER	20	2	1	2
63	MOSQUE	PRIVE	IAP	57	1	3	3
64	ETC	PUB	SERV	246	2	4	8
...	.....	.....	....	...	....	...	...
65	REVO PHARMA	PRIVE	IND	43	4	2	8
66	ETC PTC	PUB	SERV	164	2	4	8
67	DTP	PUB	BTPH	121	5	4	20
68	EPERTHY	PUB	BTPH	0	5	0	0
68	ITA	PRIVE	IND	30	4	2	8
....	.....	.....	.....	....	.....	....	....
72	SARL SUILAIT	PRIVE	IND	30	4	2	8
73	SARL SUILAIT	PRIVE	IND	350	4	4	16
74	CTC EST	PRIVE	BTPH	421	5	4	20
74	RESTAURANT	PRIVE	SERV	4	2	1	2
75	CIRTA MATLAS	PRIVE	IND	11	4	1	4
75	LPA LABO	PRIVE	SERV	7	2	1	2
75	LTP EST	PUB	SERV	950	4	2	8
75	MAISON	PRIVE	SERV	8	2	1	2
75	SALON D'EXPOSITION	PUB	SERV	50	2	3	6
75	SARL MACO	PRIVE	IND	92	4	2	8
75	SONALGAZ	PRIVE	IND	234	4	4	16
76	CPA	PUB	SERV	156	2	4	8
77	KAHRIF	PUB	SERV	100	2	3	6
78	TVE	PUB	SERV	272	2	4	8
79	SARL CHALENGE AUTO	PRIVE	SERV	42	2	2	4
80	GRANUEST	PUB	IND	220	4	3	12
81	SARL BOMBINO	PRIVE	IND	20	4	1	4
82	SONATIBAT	PUB	BTPH	132	4	4	16

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