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The multicriteria approach assessment human risks: application the Analytical Hierarchy Process and PROMETHEE methods

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Abstract In their competitiveness's research, and facing an uncertain environment, the firms search more and more to attain again objective. For that, it is necessary to minimize risks and unforeseen in their systems give complexes by the assessment risks; this one has been envisaged a long time of the technical point of view, as a first tentative to minimize risks and accidents. Then, the adoption of the analysis on the flat engineering only for the risks elimination endures to run out of him taken in account different demonstrated variability by the human operator.

The human operator as the basic postulate of events appearance of catastrophes and failures; however issuing finders of diverse currents have to apply different methods to minimize risks of human errors, some have used combined methods taking counts him personals factors and engineering, others himself are supported on estimations probabilities to calculate trials of workers.

This paper uses to assessment the risks produced by the human with application of multicriteria method: Promethee methods and AHP (Analytical Hierarchy Process) methods to help the decision for to assessment human errors and to make firm a level of improvement of the long-term security. The applications of the multicriteria approach in the treatment Gas industry in order to visualize his importance level.

Keywords Human risk; Risk assessment; multicriteria approach; methods Promethee, methods AHP

Introduction

The actual systems are more and more complex, because they integrate a variety of technologies. The system need often long period of development. When we take a change on requirements, the objectives are to improve the functionality, the cost or the delay of systems; but unfortunately, this modification can be affect a problem with others requirements those involved with the safety of the system.

The requirements change occurs in two main cases. The first concerns revising/updating existing requirements that led to an actual version of the systems to adapt to new environment.

The second is when new technology is being developed and new requirements are implemented consequently for reasons of cost or feasibility.

Then, the change of requirements has the effect of the change the level of the risk in the system. Those major risks cover well secure accidents to technological character, but more generally everything susceptible events to pledge the timelessness of the co-analyses him technical risks has been a first tentative of answer to those new exigencies, who brings up a system of rules permitting to write down technical problems. Then, this analysis technical risks have procured several scantiness, provided that the human operator would not been bought in account [1]. Indeed, different generated sucking accidents complex systems are mostly the issue of a chain of events of which each link taken isolation appears as minor, and of which some links are human errors.

Then, the proposed paper permits to contribute to improvements of the security with assessment human risk for application a multicriteria approach to help decision of the important and catastrophe risk in the complex system.

2. Human risks

The concept of human error is very elusive. At a closer look, the frequent allocation of accidental causes to human error appears to be subjective and guided by the tool box of the analyst. This is a simple reflection of the nature of causal analysis and the fact that no objective stop rule exists to terminate the causal back tracking in search of a root cause. The search stops when an event is found for which a cure is known to the analyst. Classic human factors evaluation involves task analysis and experimentation to better understand the effect of the task design on human performance. Only recently tools have been developed to support human factors analysis; when the need for automated prediction of human performance prior to system development became apparent. At the heart of human factors analysis resides human reliability. Recent accident statistics show that 80% of failures are attributed to human error [2].

A deeper analysis of accident causation indicates that the observed coincidence of multiple errors cannot be explained by a stochastic coincidence of independent events. Accidents are more likely caused by a systematic migration toward accident by an organization operating in an aggressive, competitive environment. Commercial success depends on exploitation of the benefit from operating at the fringes of the usual, accepted practice [3].

The importance of the human factors contribution to safety has been demonstrated over the past decades by the often-quoted examples of the contribution of human failure to major accidents within the process industry. Given this demonstration, it is surprising that the value of assessing human factors has not yet been comprehensively accepted throughout the industry. So what is a human factor? [4]. A recent definition of human factors as related to the process industry and safety executive:

"Human factors refer to environmental, organizational and job factors and human and individual characteristics which influence behavior at work in a way which can affect health and safety" [5].

The use of functional analysis methods was a first tentative answering of the risk [6], when carrying out a functional analysis; the attention is essentially focused on the technical functions. The operator is not taken in account or just summarily (ergonomics of the handful, colors used in the interface. . .), and he (or she) often inherits functions that the technical system cannot fill.

However, the new regulations concerning work safety require that the conception integrates the fact that the work equipment can be badly used, subject to breakdown, or dangerous for the operator. The instantiation of the European Directives and standards is supposed to suppress a majority of these risks [7]. Safe design in this context also means a design that allows and conditions, as far as feasible, safe use across the whole life cycle of the product, from manufacture, construction, transportation and installation, through use, maintenance, to decommissioning, demolition and disposal. While the case for incorporating safety at the design stage is strong, it is not universally accepted, also not by all suppliers, who may seek to limit their liability by pushing the main decisions about safety over to the user [8].

Then, in specific conditions, these operating modes appear as palliative activities to maintain the performance of the system, sometimes to the detriment of the health and safety of the operators as their primary objective is the optimization of the system. In addition, they are the result of a compromise faced with managing various system constraints and ''operating deviations'' in the process characterizing a migration towards tolerance limit thresholds from the performance and safety points of view [9]. They are constructed and adapted by the organization using the system (evolution of the Human-Task system) and evolve with the environment and with time. They therefore have a dynamic character that, depending on the situation, can tend towards a reduction in uncertainty by increasing the room for man oeuvre of the operators or, they may lead to increase in uncertainty by reducing the room for man oeuvre of the operators. By uncertainty here we mean the possibility of controlling the situation (anticipation, diagnosis, actions, dynamic aspect of the situation) or of losing control of it. Uncertainty evolves in any given situation and is partly linked to the room for man oeuvre of the operators. Indeed, the latter refers to the span of initiative and the span of tolerance that operators actually have to regulate the operation of the Human–Machine system [10]. Room for man oeuvre depends on the rules, the instructions and means given to the operators, their skills, and the effective characteristics of the situation. Analysis of the regulation of the process of social action shows the difference between two possibilities of room for man oeuvre: autonomy and discretion.

3. What is risk assessment?

Risk assessments, whether they pertain to information security or other types of risk, are a means of providing decision makers with information needed to understand factors that can negatively influence operations and outcomes and make informed judgments concerning the extent of actions needed to reduce risk.

A risk assessment is an important step in protecting your workers and your business, as well as complying with the law. It helps you focus on the risks that really matter in your workplace – the ones with the potential to cause real harm. In many instances, straight forward measures can readily control risks [11].

Risk assessment can be qualitative or quantitative. In the presence of known hazards, quantitative assessments can be done. But in many cases, quantitative data will be incomplete or even absent. Types, subtypes, and variants of infectious agents involving different or unusual vectors, the difficulty of assays to measure an agent's amplification potential, and the unique considerations of genetic recombinants are but a few of the challenges to the safe conduct of laboratory work. In the face of such complexity, meaningful quantitative sampling methods are frequently unavailable. Therefore, the process of doing a risk assessment for work with bio hazardous materials cannot depend on a prescribed algorithm.

Many industries conduct risk assessments. Depending on the circumstances, a risk on creative intuition and a careful analysis of potential systemic weaknesses. Assessment can be retrospective or prospective, quantitative or qualitative, or some combination. A quantitative risk assessment, using valid data, can be more objective and more useful over time than a qualitative risk assessment developed from assumptions and random case studies. Retrospective risk assessments have the benefit of drawing on data from past events to help anticipate future problems. Although the past is not always a reliable indicator of the future, consistent patterns can emerge in data and crime data is no exception. Prospective risk assessments attempt to see into the future without the benefit of historical data. The risk assessment process when little or no data is available involves using whatever information is known to anticipate real or potential outcomes. This approach relies primarily on qualitative rather than quantitative indicators. The best risk assessment methodology uses a combination of approaches in order to capture all that is known and as much as possible about what is not known. There are likely to be illicit financing methods being used that have not been detected by financial institutions or law enforcement, and so will not show up in the data gathered from criminal investigations or financial institution currency or transaction reporting. And there may be other illicit financing options that even the criminals have not yet discovered. In the absence of data or case studies identifying these methods, financial institutions and competent authorities must rely [12].

Figure 1: Process risk assessment

4. The process of risk assessment?

In many organizations, the risks are well known and the necessary control measures are easy to apply, the probably already know whether. The process of risk assessment is identified in the five steps:

4.1 Look for the Hazards

Hazard identification this first step in risk assessment consists in collecting data from different sources to determine whether a substance is toxic. It involves gathering and examining data from toxicological and epidemiological studies [13].

Then, the Hazard identification indicates whether exposure to a substance causes a harmful health or environmental effect and the nature of the effect. Hazardous substances are identified by analyzing the wastes that will be fed into the incinerators to determine what kind of air pollutants might be produced during the incineration process, and by collecting emissions information during trial burns.

After to have to collect all indispensable information of hazard, it is to schedule that by major order using the multicriteria approach to helps the decision such as the PROMETHEE method. A multiple criteria decision problem is one that, having a defined set of consequences (alternatives), A, a family of criteria depending on A, designated as C, and a set of preference relations G, intends to find a subset of A containing the best consequences, to assign the alternatives into predefined categories or rank them [14]. Each of these objectives defines a different multiple criteria problem:

a) Selection; (b) classification or sorting; (c) ranking. The PROMETHEE method (preference ranking organization method for enrichment evaluation) is a multicriteria decision-making method developed by Brans [15]. It is a quite simple ranking method in conception and application compared with other methods for multicriteria analysis. It is well adapted to problems where a finite number of alternatives are to be ranked considering several, sometimes conflicting criteria. The implementation of PROMETHEE requires two additional types of information, namely:

• Information on the relative importance of the criteria considered,

•Information on the decision-makers preference function, which he/she uses when comparing the contribution of the alternatives in terms of each separate criterion.

The following steps are required for the implementation of the method:

1- Alternatives are compared in pairs for each criterion. The preference is expressed by a number in the interval [0, 1] (0 for no preference or indifference to, 1 for strict preference). The function relating the difference in performance to preference is called the generalized criterion and it is determined by the decision maker.

2- A multicriteria preference index is formed for each pair of alternatives as a weighted average of the corresponding preferences computed for each criterion. The index Π (a,b) (in the interval [0, 1]) expresses the preference of alternative a over b considering all criteria. The weighting factors express the relative importance of each criterion and are chosen by the decision maker.

3- Alternatives can be ranked according to:

• The sum of indices Π (a, i) indicating the preference of alternative a over all the others. It is termed 'leaving flow' $\emptyset$+(a) and shows how 'good' is alternative a.

• The sum of indices Π (i, a) indicating the preference of all other alternatives compared to a. It is termed 'entering flow' $\emptyset$- (a) and shows how 'inferior' is alternative a.

Then, the method PROMETHEE II extends this classical approach by modeling multicriteria decision the preferences through a preference function $pi(di)$ for the ith criterion, in such way that it reflects the preference level of a over b, from 0 to 1. If $p_i(d_i) = 0$, both alternatives are considered indifferent to each other. If $pi(di) = 1$, a is strictly preferred to b. These functions can have an indifference interval, limited by a threshold ti ,specified by multicriteria decision which allows him to be in different between two alternatives not only when they have the same consequences considering the ith objective function ($d_i = 0$), but also when they are just similar to each other ($0 < d_i < t_i$). Furthermore, these functions can have a smooth transition between indifference and strict preference. Values between 0 and 1 express the preference intensity of the multicriteria decision judgment, in such way that $p_i(d_i) \sim 0$ indicates weak preference and $p_i(d_i) \sim 1$ indicates strong preference. Brans et al [16] proposes four main types of preference functions (it presents two other types that can be derived from these ones), which cover most of the practical situations.

PROMETHEE requests additional information. For each criterion a specific preference function must be defined. This function is used to compute the degree of preference associated to the best action in case of pair wise comparisons [17].

As in PROMETHEE different types of preference functions can be used depending on the nature of the data. Because they are somewhat different from the one used in PROMETHEE they are represented as type A to F. This method includes tools that don't have a very good axiomatic basis but show a pragmatic realistic quality in regards to the decision settings often encountered, many new concepts are found in this method such as decision problematic, discrimination power of a criterion [18]. The criteria and their preference function are represented in Figure 2:

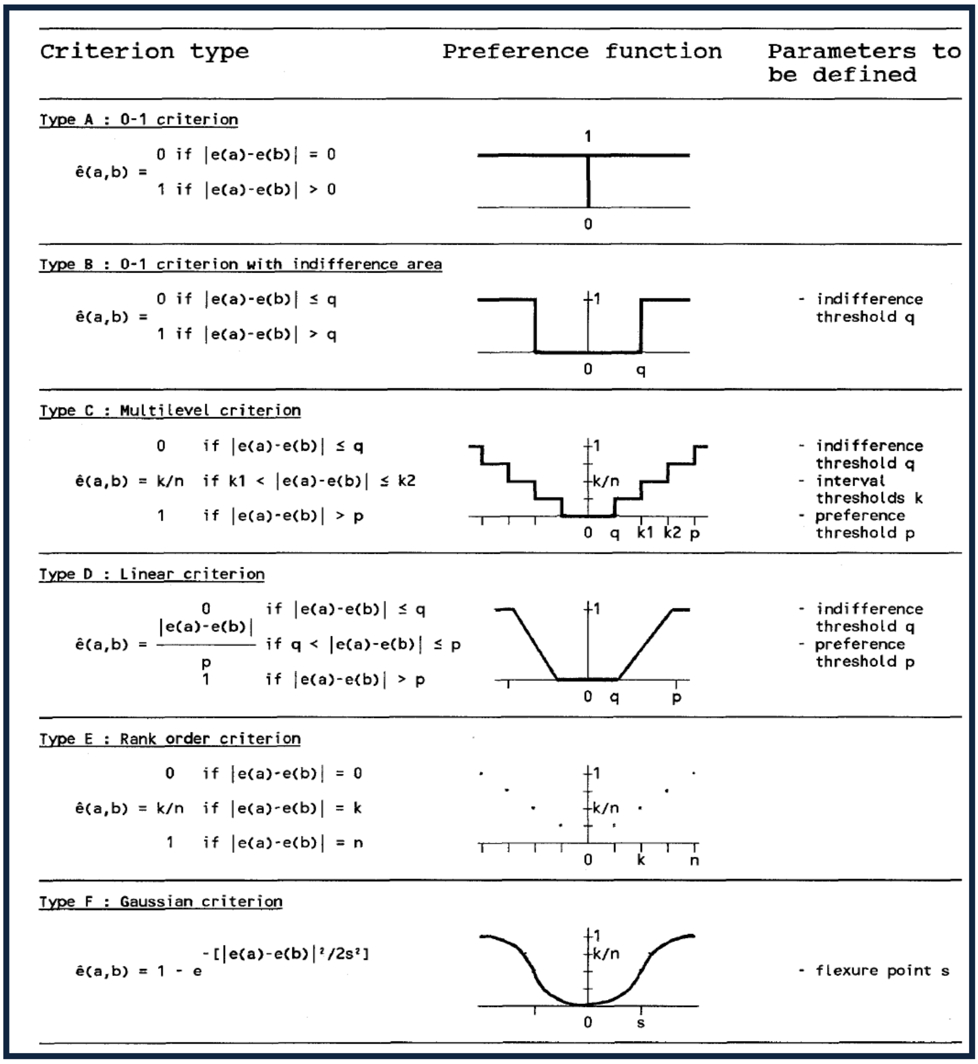

Figure 2: Criteria and their preference function [19]

PROMETHEE methods, is characterized by an infinite discriminating power. Any difference in score implies immediately a total preference or in other words the preference indicator $P\ (a, b)$ will only depend upon the sum of weights of those criteria for which is better than b. The same holds for the second type of preference function, the quasi criterion or U-shaped criterion, but here an indifference threshold q, allowing a margin of error in the evaluation scores, is considered [20].

4.2 Decide who might be harmed

For each hazard establish who might be harmed, it will help to identify the best way to manage the risk. This does not mean listing everyone by name, but rather identifying groups of people; this step consists to identify the relationship hazards / risks is realized by application of Fault Tree Analysis (FTA) of which the objective is to determine causes responsible to the appearance the human risk. Fault Tree Analysis (FTA) is one of the most widely used techniques in this context, it is intuitive for practitioners due to their hierarchical structure and the familiar logical symbols. They allow a variety of qualitative and quantitative analyses. Fault Tree Analysis (FTA) has been used for several decades in the context of mechanical or electrical systems [21].

FTA is a method for analyzing causes of hazards. FTAs use Boolean logic (gates) to describe combinations of individual faults than can create a hazardous event. Each level of the tree lists the lower level events that are necessary to cause the event shown in the level above it.

The tree is written as a Boolean expression to show the specific combination of identified basic events sufficient to cause the undesired top level event. If the individual probabilities for all the basic events are known (not feasible in most abstract cases), the frequency of the top event can be calculated.

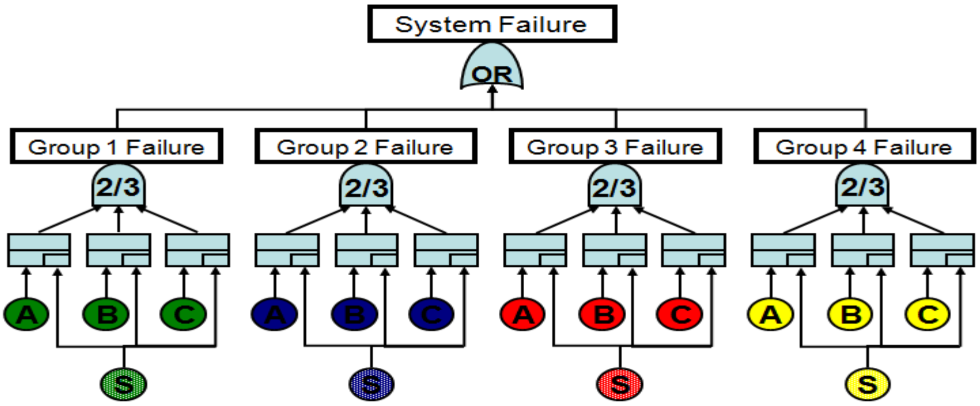

Figure 3: Structure of Fault Tree Analysis

Often the most difficult part of creating a fault tree is the determination of the top level event. The selection of the top event is crucial since hazards in the system will not be comprehensive unless the fault trees are drawn for all significant top level events.

FTA is a status driven analysis where the inputs to a Logic Gate represent the status of a part and/or other factor being included in the analysis. Other factors can include such things as training, tools, safety equipment, supervision etc. The output from a Logic Gate is a logic state that represents a condition that exists in the system. An event occurs when the output of a Gate changes state [22]. FTA is a status driven analysis where the inputs to a Logic Gate represent the status of a part and/or other factor being included in the analysis. Other factors can include such things as training, tools, safety equipment, supervision etc. The output from a Logic Gate is a logic state that represents a condition that exists in the system. An event occurs when the output of a Gate changes state [23].

Fault Tree Analysis (FTA) are a widely accepted model that graphically shows how influence factors (in general component failures) contribute to some given hazard or accident. They provide logical connectives (called gates) that allow decomposing the system-level hazard recursively. The most fundamental gates are the AND gate and the OR gate. Both gates are shown, more gates have been proposed in literature, but some of them have been continuously under discussion, because they cannot be mapped correctly onto pure propositional logic or pose difficulties to some of the used evaluation algorithms [24].

Table 1: Description of FTA Gates

Description	Picture	Truth Table		
		Input A	Input B	Output
AND Gate. The AND gate indicates that the output occurs if and only if all of the input events occur.		T T F F	T F T F	T F F F
		Input A	Input B	Output
OR Gate. The OR gate indicates that the output occurs if and only if at least one of the input events occur.		T T F F	T F T F	T T T F

4.3 Evaluate the risk

If the hazard identification process produces evidence of a hazard, then a hazard evaluation is performed. The purpose of this step is to calculate, if possible, the dose at which a harmful effect will occur.

This step is realized by multicriteria methods “Analytical Hierarchy Process: AHP”. Analytic Hierarchy Process is a powerful and flexible method used for making decisions that help determine the priorities, and leads to making optimal decisions in cases where aspects of quantity and quality are being taken into consideration [25]. Reducing complex decision making to a comparison between alternative pairs, and synthesizing the obtained results, AHP not only helps to make decisions, but leads to the rational decision. The Analytic Hierarchy Process for decision-making is a theory of relative measurement based on paired comparisons used to derive normalized absolute scales of numbers whose elements are then used as priorities [26]. Matrices of pair wise comparisons are formed either by providing judgments to estimate dominance using absolute numbers from the 1 to 9 fundamental scales of the AHP, or by directly constructing the pair wise dominance ratios using actual measurements. The AHP can be applied to both tangible and intangible criteria based on the judgments of knowledgeable and expert people, although how to get measures for intangibles is its main concern. The weighting and adding synthesis process applied in the hierarchical structure of the AHP combines multidimensional scales of measurement into a single “uni- dimensional” scale of priorities. In the end we must fit our entire world experience into our system of priorities if we are going to understand it [27]. Steps of the method AHP are as follows:

- Construction of the hierarchy, it’ s an abstraction of the structure of the used problem to study; the interaction with components of problem and their effect on the final solution, she permits to decompose the problem in a hierarchy of data inter-bound. A top of the hierarchy, one finds the objective, and in inferior level, elements contributing to fetch this objective, the last level are that of actions.

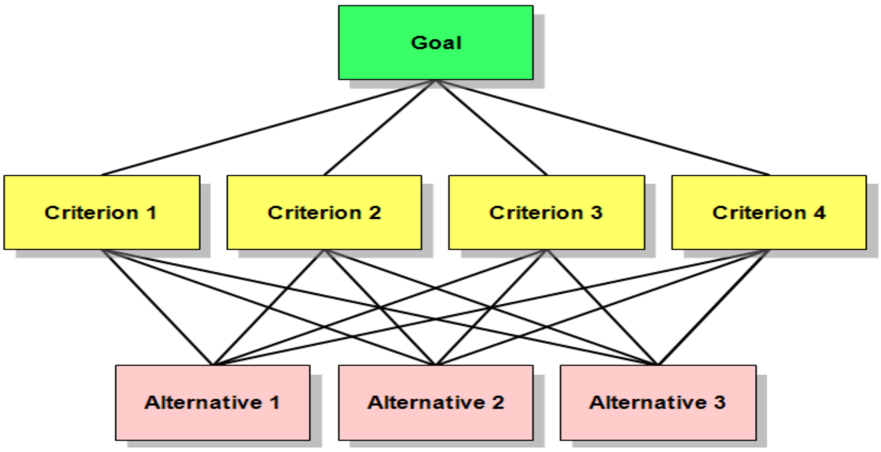

Figure 4: Construction of the Hierarchy

- To proceed to comparisons by elemental pairs of each hierarchic relative level to an element of the hierarchic superior level. This step permits to build matrix of comparisons. Values of that matrix are obtained by the judgments transformation in numerical values is according to the ladder of Saaty (Ladder of binary comparisons), everything respecting the principle of reciprocity:

$$(Ea, Eb) = \frac{1}{Pc(Eb, Ea)}$$

Table 2: Saaty scales

Importance Grade	Define
1	Importance equalizes of both elements.
3	Importance weak person of a relative element to another.
5	Importance strong or determinant of a relative element to other.
7	Importance attested of a relative element to another.
9	importance absolved of a relative element to another
2,4,6,8	Intermediate values with two values neighbor.

- To determine the relative elemental importance calculating primary vectors to correspond of the maximal values of comparisons matrix.
- To verify the judgments coherence. One to calculate at first, the indicator coherence IC

$$IC = \frac{\lambda max - n}{n - 1}$$

Where: λ max is the primary maximal value running in matrix of comparisons by pairs and n: are a large number of comparative elements.
Then; the ratio of coherence (RC) defines by:

$$RC = 100.\frac{IC}{ACI}$$

Where: ACI is the means coherence indicator of obtained generating random matrix of judgment equalizes height. The means of indicator coherence is identified in the following table:

Table 3: Means coherence indicator

Matrix Dimension	Random Coherence ACI
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

A value of RC inferior to 10% is generally acceptable; otherwise, comparisons by pairs must be examined again to reduce the incoherence.
-to settle the relative performance of each action:

$$P_k(e_1^k) = \sum_{J=1}^{nk-1} P_{K-1} \quad (e_i^{k-1})P_k \frac{e_i^k}{e_i^{k-1}}$$

With: $P_k(e_1^k) = 1$
and: $nk - 1$ are a large number of elements of the hierarchic level k-1,
Pk (e_i^k) is the terms priority to the element e^i to the hierarchic level k [28].

4.4 Record your finding

The next step is to put in place the preventive and protective measures. It is important to involve the workers and their representatives in the process. Effective implementation involves the development of a plan specifying:
- The measures to be implemented;
- Who does what and when?
- When it is to be completed.

It is essential that any work to eliminate or prevent risks is prioritized.
The step record your finding combines the information collected during the first three steps and determines the likelihood that humans or animals will experience any of the health effects associated with a substance, or that the environment will be harmed.
Then, the generation possible solutions for detected risks by the brainstorming methods.
Brainstorming is a group creativity technique designed to generate a large number of ideas for the solution to a problem [29].
Although brainstorming has become a popular group technique, researchers have generally failed to find evidence of its effectiveness for enhancing either quantity or quality of ideas generated. Because of such problems as distraction, social loafing, evaluation apprehension, and production blocking, brainstorming groups

are little more effective than other types of groups, and they are actually less effective than individuals working independently [30].

4.5 Review your assessment

All forms of assessment should be reviewed on a regular basis. The frequency of review should be based on the hazards present. Tasks involving significant hazards should be reviewed on a much more frequent basis than lower hazard tasks. Then, Step five of the steps to risk assessment is to review the risk assessment 'from time to time'; in this section the factors prompting a new risk assessment are set out [31].

5. Application the process risk assessment in the industry treatment Gas

Figure 5: *The treatment plant gas*

The Gas decomposes features mixed with air or other substances oxidant and provides areas of flammability. Then, the structure of the natural gas market is very sensitive, provided that this area covers a significant number of accidents per year. The risks in the field Gas Processing occupy a special place in the study of security; they have largely shaped the landscape of risk in the field of security analysis, and are generally caused profound regulatory changes.

5.1. Look for the Hazards

This step permits to identify five hazards proceeding to the Gas industry, these hazards has identified by the figure as following (Table 4):

Table 4: Identification Hazards

Hazards	Description
H1	Instability of the capacitor line connecting the receiver pellet in the area of stabilization capacitor.
H2	Lack of measurement of natural gas.
H3	Catastrophic failure of the receiver chip.
H4	Failure in the tank truck will lead to the loss of containing the tank.
H5	Exposure to sulfur fuel used.

After that to identify the hazards, we classified these hazards by PROMETHEE, it is important to identify the list of criteria in (Table 5):

Table 5: Identification the criteria

Criteria	Description
C1	Reputation of the hazards.
C2	The number of maintenance.
C3	Level of worker protection during exposure to combustible.
C4	Percentage of loss of life.
C5	Response times for breach of Gas.

On base relations of upgrade of the PROMETHEE II methods, the preference follow of the maximum and minimum level of the criteria indicated by the decider in table 6:

Table 6: Level of the criteria

Criteria	C1	C2	C3	C4	C5
min/max	**min**	**max**	**max**	**min**	**max**
H1	34	1	1	55	10
H2	21	5	3	66	22
H3	12	3	5	80	32
H4	15	2	5	70	15
H5	17	5	4	68	60

Obviously the PROMETHEE II ranking is influenced by the weights allocated to the criteria. For the following weight distribution is similar (20, 20, 20, 20 and 20). Then, the ranking of the last five hazards is now completely opposite.

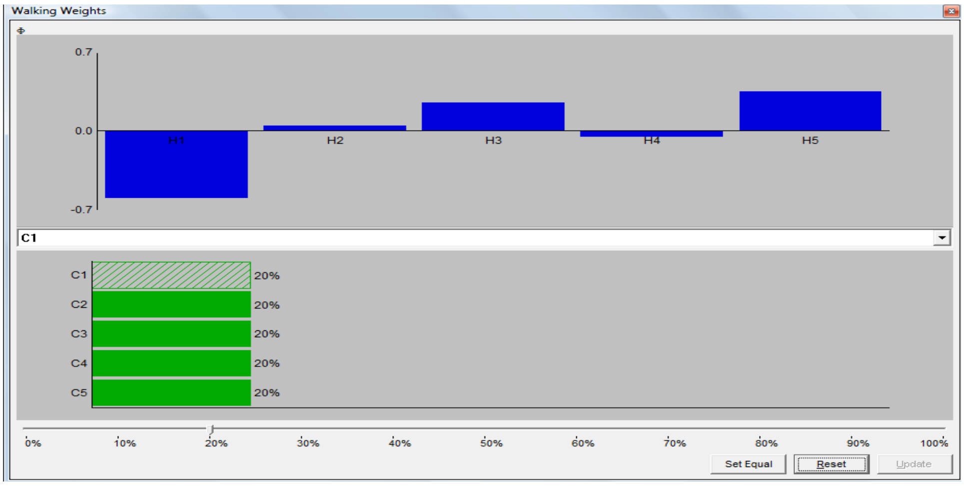

Figure 6: Walking weights

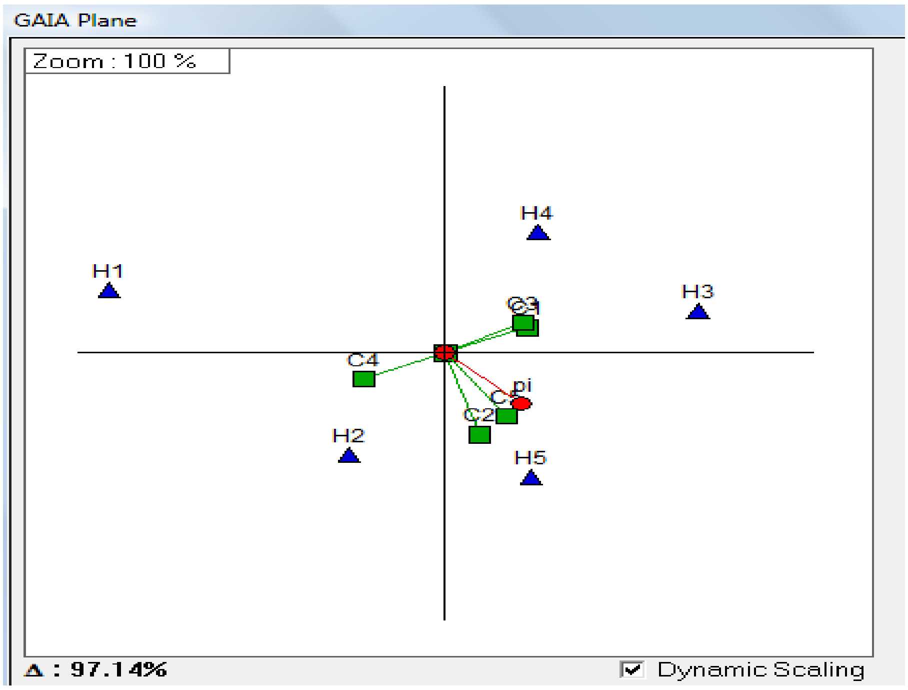

Figure 7: GAIA

The GAIA analysis is obtained by projection of this information such that as few information as possible get lost. Hazards are represented points and, criteria by axes. The conflicting character of the criteria appears clearly (Figure 7): criteria expressing similar preferences on the data are oriented in the same direction; conflicting criteria are pointing in opposite directions. In this case we observe for instance that the criteria C4 (Percentage of loss of life) is in strong conflict with the criteria C3 (Level of worker protection during exposure to combustible). It is also possible to appreciate clearly the quality of the alternatives with respect to the different criteria. H4 (Failure in the tank truck will lead to the loss of containing the tank) and H1 (Instability of the capacitor line connecting the receiver pellet in the area of stabilization capacitor) are particularly good on H3 (Catastrophic failure of the receiver chip) and H5 (Exposure to sulfur fuel used) look good on H2 (Lack of measurement of natural gas).

Then, PROMETHEE II provides a complete ranking represented in the (figure 8). It is based on the balance of the two preference flows. The information looks stronger but some part of it gets lost in the process. Both PROMETHEE II help the decision-maker to finalize the selection of a best compromise. A clear view of the outranking relations between the hazards is obtained following:

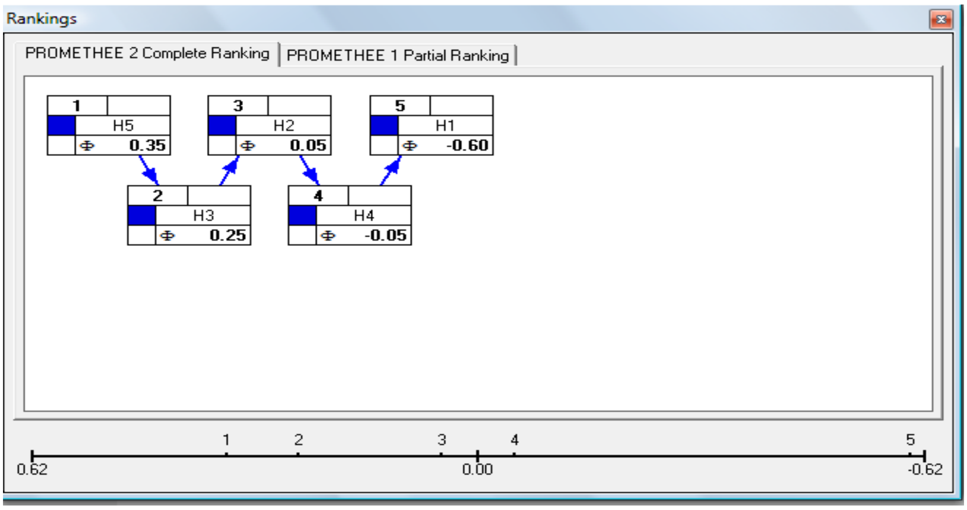

Figure 8: Promethee II ranking

In order to refer of figure 8, the important hazards classified of prior is H5: Exposure to sulfur fuel used.

5.2. Decide who might be harmed

The identification of the relation between the hazards H5: Exposure to sulfur fuel used and the risks procured by this hazard is realized by the Fault Tree Analysis.

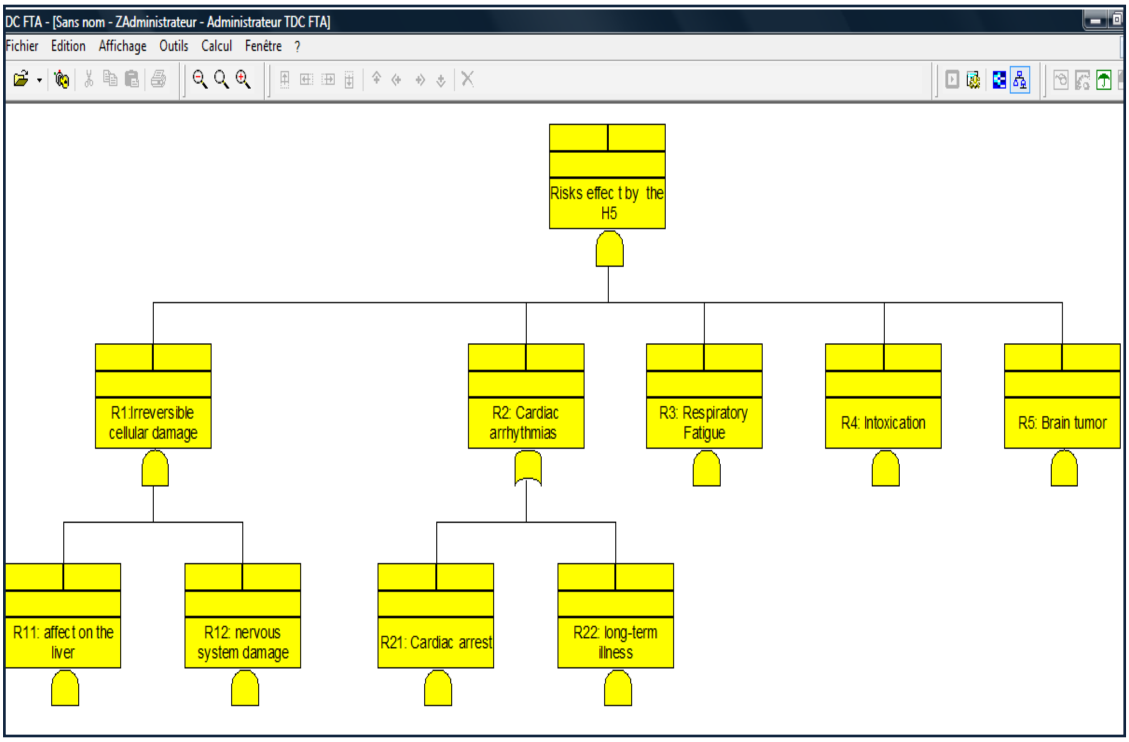

Figure 9: Risks effect by H5

5.3. Evaluate the risk

After identify different risks provide the by the hazards H5, this step consist to assess the weight of gravity of each risk on the worker that referring hierarchy by AHP.

Then, the decomposition of the problem of classifying risks in a hierarchy interrelated elements of the hierarchical structure of the problem is as follows:

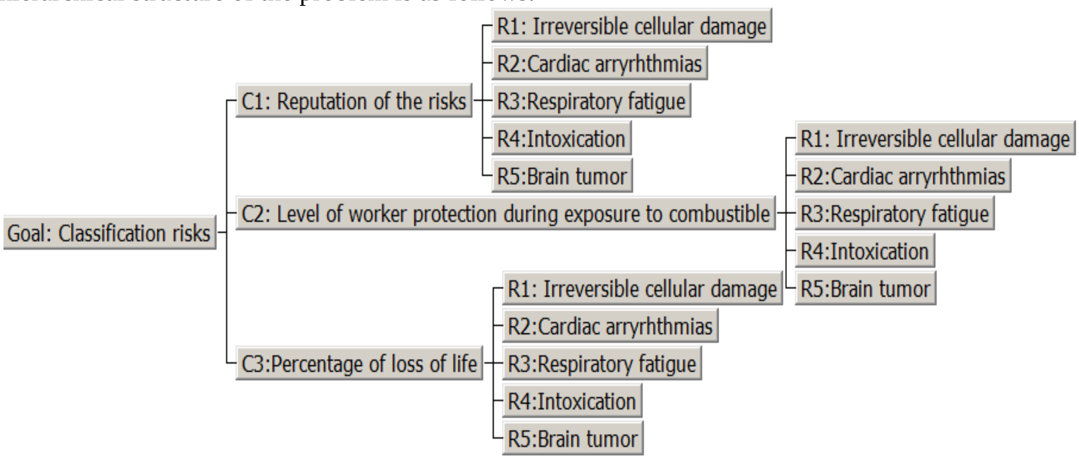

Figure 10: Hierarchical structure of the problem of risk classification

The Pair wise comparison of elements of each hierarchical level relative to an element of higher level is follows:

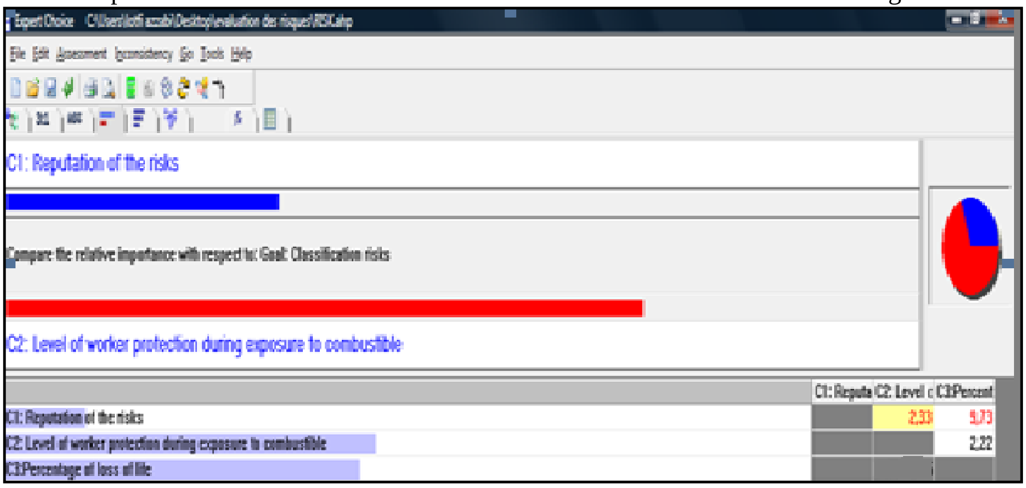

Figure 11: Pair wise comparison of criteria

Then, the determining the relative importance of factors in calculating the vectors own corresponding maximum value matrix comparisons.

-Determination of the vector for criterion C1: Reputation Risk:

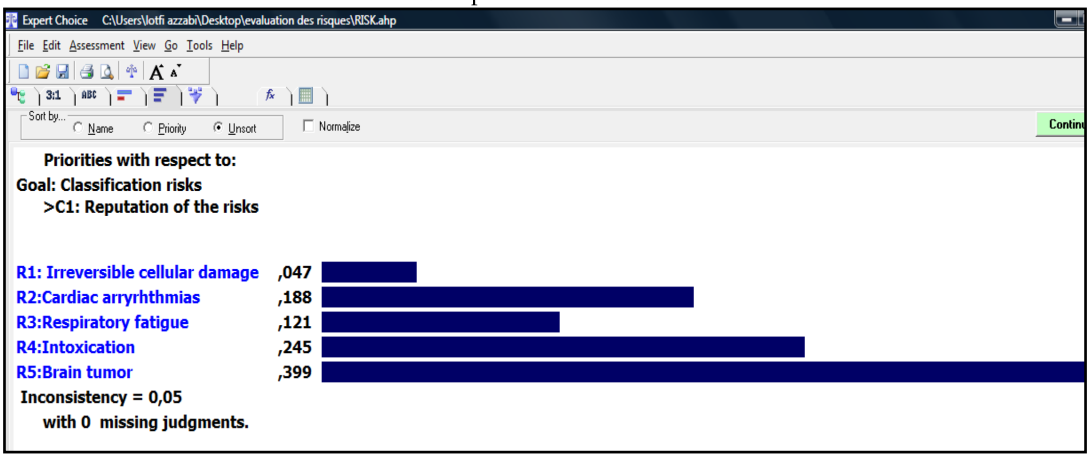

Figure 12: Vector corresponding to the criterion C1 "Reputation Risk"

-Determination of the vector for criterion C2: Level of worker protection during exposure to combustible:

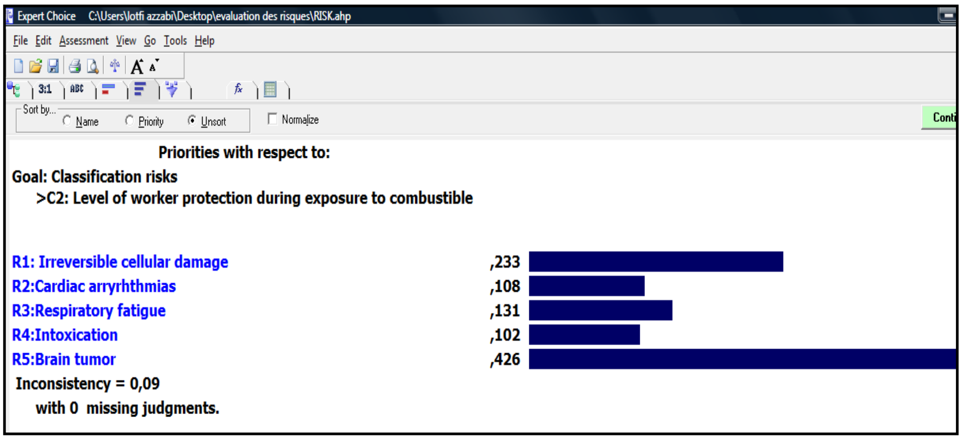

Figure 13: Vector corresponding to the criterion C2 " Level of worker protection during exposure to combustible"

-Determination of the vector for criterion C3: Percentage of loss of life:

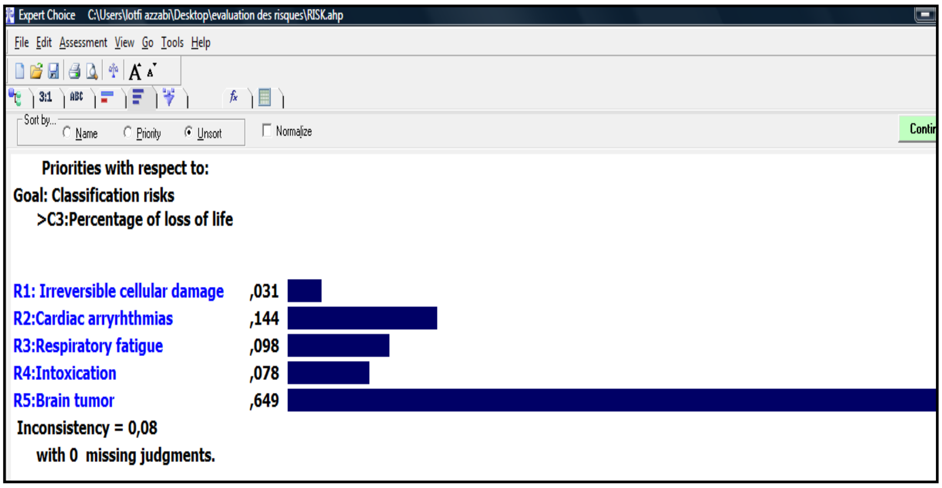

Figure 14: Vector corresponding to the criterion C3 " Percentage of loss of life"

After to identify the vector corresponding of the three criteria, the following step consist to identify the performance (Figure 15):

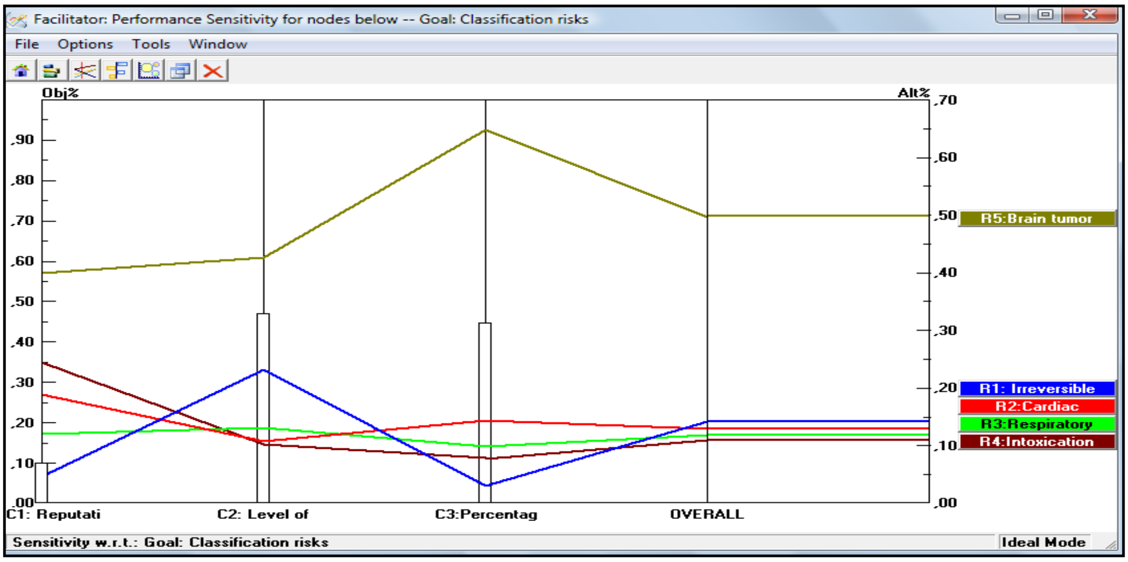

Figure 15: Calculation of performance

The ranking by the AHP method has established a risk classification. From this classification we consider the risk the most important is R5: Brain tumor. The final ranking is as follows:

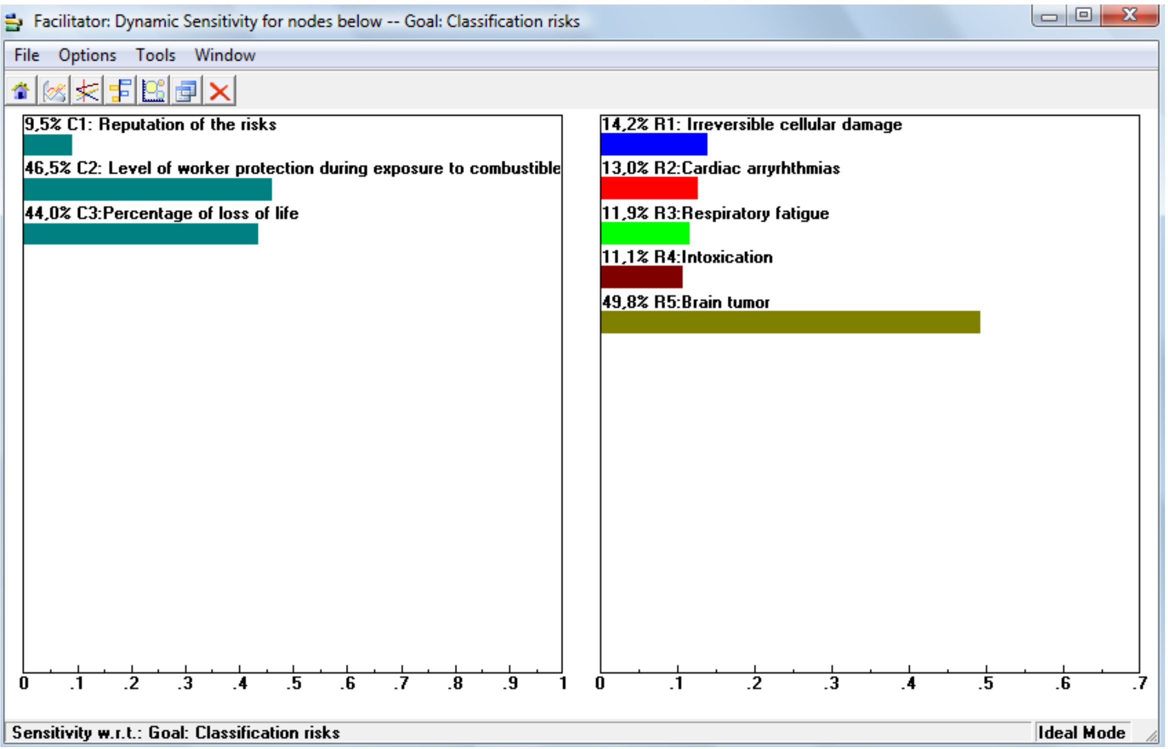

Figure 16: Classification of risks

Then in the following step (Record your finding), we search the solution of the important and priority risks R5.

5.4. Record your finding

The protective measures taken on the basis of statistical taken during the 12 months of work in the plant processing gas are preventive measures to protect everyone in the vicinity of the fuel on a regular or occasional basis.

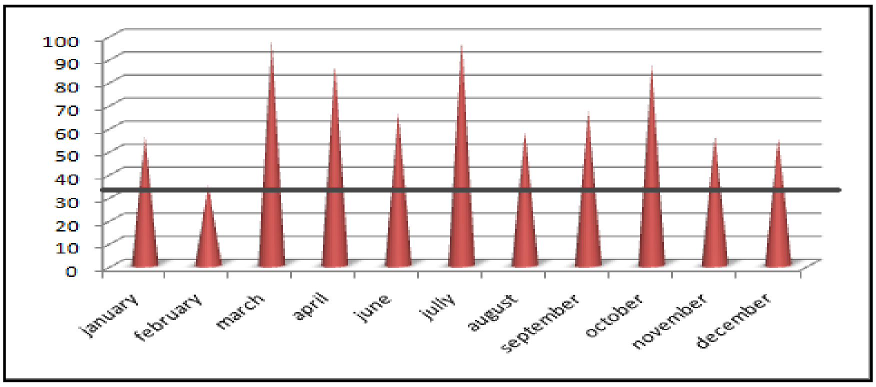

Figure 17: Statistics of risks brain tumor

Statistics risk of tumors that identifies the percentage of occurrence of this risk is very high is above the limits of acceptable risk levels set in the graph at 35%.

Then, the protective measures are:

Table 7: Record the finding

Protective Measures	Descriptions
A closed system	A closed system is a system allowing the maximum containment of substances used. Thus any contact between workers and these products can be avoided. The system can be defined as closed when all process operations in this respect containment: transfer / transport of products, production, purification, cleaning and

	maintenance, sampling, analysis, treatment / disposal, storage ... Concretely, this can result in particular by a mechanical process, transform or automation of certain tasks: transfer of goods by mechanical or pneumatic Sampling mechanized washing tanks without opening ... Be especially watchful for everything concerning the maintenance of such systems.
Capture at source	Capture at source is a measure which is to channel the flow of pollutant emitted to a ventilation and disposal avoiding its release into the atmosphere of the workplace. This aspiration should be to the closest point of emission, in order to maximize system efficiency and minimize the flow required. It must be done using the natural movement of pollutants with air velocities sufficient and well distributed, draft-free and parasite with an air intake compensation.
The crib	The crib is set up physical barriers (walls, sides, cowl ...) that prevent the pollutant in question to spread in the atmosphere. It can be a total enclosure (glove box, fume ...), occasionally with a possible opening for an operation inside the enclosure. It may also be a partial enclosure (single-wall ...) limiting and authorizing the issuance of air velocities lower catchment. The crib is always coupled with a measure of abstraction, it increases efficiency.

5.5. Review your assessment

The review assessment step consist to identify that the improvement proposed in the step record the finding are realized with successful, and it has to permit minimize the damage provide by the risk R5:Brain tumor.

In the graph follows, we consider as the Statistics percentage of risk R5: Brain tumor appears during the 12 months of the year to decline from the level limit of acceptable risk, just for the months of July and October there are still improvements to be redone.

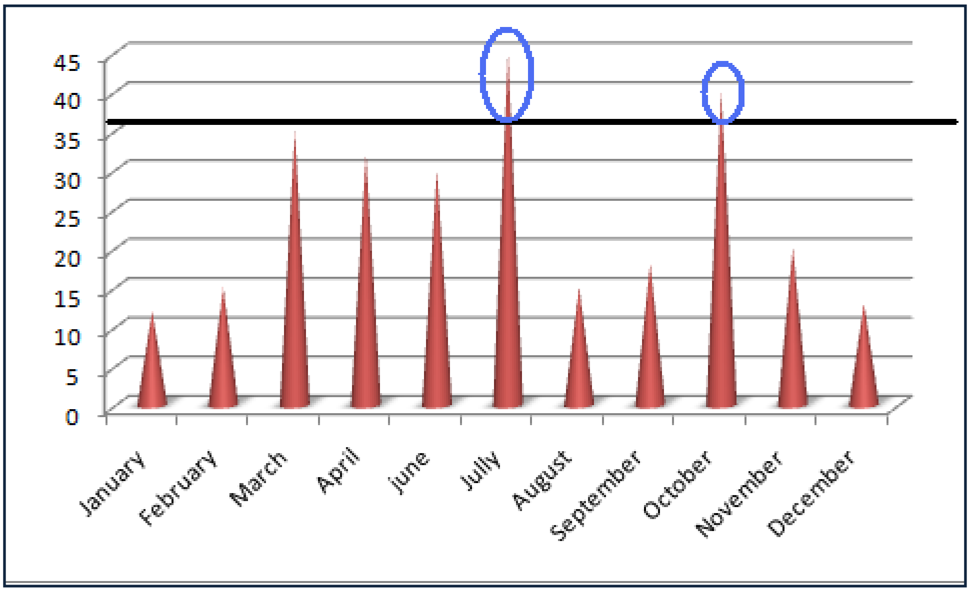

Figure 18: Statistics of risks brain tumor after review

6. Conclusion

The study of the human risk in industry of treatment Gas , having capacities of reconfigure, or else specimens of dependences, comes for the tools utilization and methods very sophisticated in order to write down to the risks maximum and human errors.

The risk assessment must be 'suitable and sufficient' to the proportion of risk, this should include making the premises inherently safe so that the routine and non-routine activities can be adequately assessed and controlled e.g. employees working off site, mobile workers, home workers and non routine operations such unplanned maintenance of equipment. Then, the challenge of risk assessment lies in those cases where complete information on these factors is unavailable. A conservative approach is generally advisable when insufficient information forces subjective judgement. Universal precautions are always advisable.

The advantage of the promethee and AHP method is modelling of the problem decision by hierarchic structure and the utilization of a semantic ladder to express preferences of the settler.

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