Optimizing Industrial Performance: A Managerial Approach Integrating Human and Organizational Factors for Enhanced Productivity and Safety in Algerian Companies

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Abstract:
The importance of Human and Organisational Factors (HOF) in the socio-technical system extends beyond mere ergonomics; it embodies the synthesis of a managerial project aimed at controlling industrial risks. These factors gain unanimous acceptance from all stakeholders involved in designing, constructing, implementing, or dismantling the process. Algerian companies such as COTITEX and SONATRACH face an increasingly uncertain and variable environment. Consequently, decisions cannot be solely based on a predefined process. Thus, the influence of the human decision-maker is unparalleled, as they orchestrate the entire process. Analyzing the processes and activities related to risk management in these organizations allows for decoding the project and elucidating its components.
This paper endeavors to pinpoint the factors contributing to the success, failure, and sustainability of processes instituted by organizations to enhance individual and collective competencies in risk analysis, ultimately improving productivity and security. In pursuit of this goal, we advocate for a quality management system tailored to the human capital (Algerian operator) and its requisites for optimizing workstations. This, in turn, aims to elevate production and diminish the accident rate. The application of this system is demonstrated through two research samples, employing psychometric tests linked to the workstation, with an extension of this approach to the realms of security and productivity.

Keywords
Human and Organisational Factors, Industrial Risk Management, Workstation Optimization, productivity, Industrial Risk Management.

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1. Introduction

Although rare, industrial accidents continue to occur and persist in the future, even as their frequency may change. Human error, issues of use, or maintenance problems are among the significant explanations for these events [1-4], which are often more human-centric than technical. Under the overarching term "human factor(s)," various interpretations of man's role in the security and productivity of complex systems exist. Faced with the expanding concern of "the human factor in security and productivity," researchers such as Baptista et al. (2020) [5] find themselves occasionally perplexed. Indeed, the "human factor" appears to play a pivotal role. Across all industrial sectors, similar conclusions are drawn: the human factor is implicated in 70 to 80% of major accidents [6].

Consequently, human error is often the first 'blame' assigned, especially by the media, in the aftermath of a catastrophe [4]. However, deeper analyses increasingly shed light on factors beyond the operator's error, including decision-making errors by company management, unfavorable environmental conditions, and economic pressures. Investigations into the matter reveal complex situations [3, 7].

The question arises: How do we proceed, and before that, what is implied by the requirement, and what does it involve? Who should consult regarding expertise, and what profiles are necessary for an adequate response? How do we evaluate the relevance of suggested approaches from different perspectives? Numerous urgent questions necessitate well-considered answers [8, 9].

Within this context, the reflection presented in this paper proposes a managerial approach to human reliability in risk management to enhance security and productivity. The objective is not to assign blame but to improve the social-technical system continually, reducing the risks of accidents and opting for better adaptation and enhanced productivity [10, 11].

To address this question, we adopt a practical study of a quality management system conducted on two samples from distinct fields: a traditional company in a highly accident-prone sector and a well-secured modern company. The industrial culture in Algeria, our study field, and the subject matter of our research problem vary depending on whether one focuses on modern industries (e.g., the energy sector), often highly automated like SONATRACH, or more traditional and aged industries relying on numerous but less qualified workforce (e.g., COTITEX Batna). Our approach involves conducting psychometric tests on workstations. We extend this method to the security domain, characterizing the required qualifications for a workstation (cognitive abilities) and assessing the compatibility between the workstation and the person holding it based on psychological abilities. This assessment defines the "determinants of success," ensuring the security level, production quality, and quantity. A tangible outcome of this proposal is illustrated by an increase in production and a decrease in the accident rate in our companies.

2. Methodological Framework of the Model

Our field of observation and analysis relies on the Man-Machine-Environment triptych, serving as a model to describe industrial processes; this is crucial because the human approach to controlling industrial risks necessitates a systemic nature, even though an analytical procedure is also implemented. To achieve this result, we utilized a case study as a research method [12], adapting it to the specific context of Algeria. This methodological choice is justified because a case study is well-suited for understanding complex social systems, encompassing technical aspects that generate situations involving people, behaviors, and organizational, regulatory, and economic constraints.

Furthermore, a case study naturally lends itself to exploratory research, as with the investigated situation, given that the socio-technical system evolves with technological advancements in a specific context (Algeria) and faces changing requirements due to social and economic growth.

We propose an approach that manages human capital within the socio-technical system, aiming for better adaptation and output in more secure work conditions. This approach focuses on the behaviors of operators, deemed the actual source of quality (see Figure 1). We extend this approach to security, characterizing the required qualifications for the workstation (cognitive abilities) and assessing the compatibility between the workstation and the person based on the operator's psychological abilities (see Figures 2 and 4). Such an assessment leads us to define the "determinants of success" to ensure the security and production levels to be reached. This approach integrates actions on various facets of the socio-technical system [13-15]:

- ***Decision or piloting pole:*** This pole establishes objectives based on demands and resources (production rate and quality). It also monitors the expected results through qualifications required by the workstation, such as cognitive abilities;
- ***Organization pole:*** This pole structures demands according to the established objectives and evaluates the alignment between the workstation and the operator based on specified qualifications related to individual behavior and mental processes (intelligence, language, memory, personality features, etc.) or psychological abilities;
- ***Control and events pole:*** This is the field of continuous improvement.

To be effectively implemented, all these stages require the collaboration of various actors. A case study procedure, primarily exploratory, is essential for each selected company. We rely on an adapted methodology with guaranteed results for each stage. It is crucial to specify the companies investigated to enhance the understanding of the presented works. The preparatory phase of the case studies enabled us to make informed choices, acknowledging the limitations of such decisions. We needed to have at our disposal:

- Several traditional companies belonging to an accident-prone sector representing a complex model of a socio-technical system;
- Well-secured modern companies that have embraced complex technologies since their inception.

Indeed, the industrial culture in Algeria varies depending on whether one focuses on modern industries (such as the energy sector), which are well-structured and often automated, or on more traditional and older industries that rely on a larger but less qualified workforce.

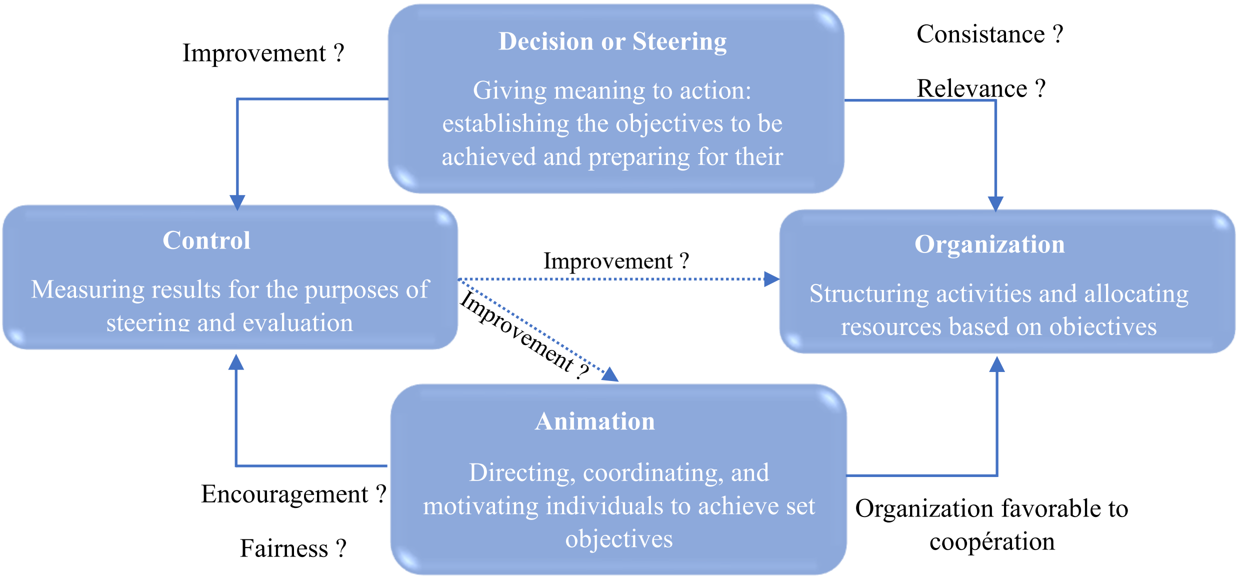

Figure 1: The Human Approach Principle

2.1. Modeling the Socio-Technical System

Manufacturing companies must adopt innovative management approaches to control their systems effectively; this necessitates a thorough understanding of the organization and available resources (capacity, capabilities, competence, etc.) [16] and precise mastery of their dynamics [17, 18]. In today's context, these companies encounter an environment marked by uncertainty and variability. Consequently, decisions cannot be confined to a singular, pre-established process. The influence of the human decision-maker becomes paramount as they orchestrate such processes [19]. Modeling is an essential strategy employed by companies to meet these demands. This discipline furnishes tools and methodologies for gathering information, modeling, analyzing, and aiding in the design (sizing and locating) of components within any socio-technical system [20] (See Fig. 2).

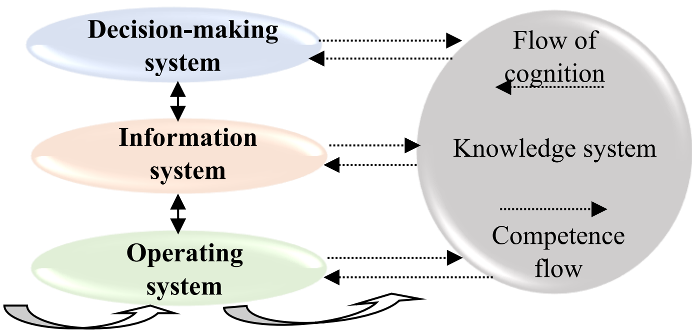

Figure 2: Example of a MADS model for the socio-technical system in its developed systemic or fractal form.

An interesting implication of the systemic model is the following: any system can be decomposed into three sub-systems, as illustrated in Figure 2:

- An Operating Sub-system (OS)
- An Information Sub-system (IS)

- A Decision-Making or Piloting Sub-system (PS)

Our system is organized along three significant axes through horizontal and vertical exchanges: technical, human, and organizational. Additionally, the system is influenced by external constraints, manifested through transactional exchanges with the natural environment contexts and the organization. This modeling approach illuminates the primary issue under analysis, conceptualizing an installation as a system open to its environment.

In Figure 3, a field of complexity is depicted, characterized by the multitude of relationships between material sub-systems (OS, IS, and PS) as they interact with each other and the environment. This complexity is further compounded by the uncertain nature of many relationships, particularly those stemming from living systems (individuals or groups of individuals in interaction) and the Decision-Making Sub-system (PS). The figure proposes an approach that addresses factors involving all flows originating from potential decompositions of the various sub-systems within our installation [11].

To conduct our study, two distinct industrial sectors were chosen:

- **Textile Industry:** Among 35 textile companies located in the southeast region, a subset of 10 companies was selected based on two primary criteria: accessibility and the willingness of management and occupational doctors to cooperate. The selected companies are part of the COTITEX group, an Algerian company operating in the clothing sector. Despite facing the challenges of international competition, all COTITEX companies are experiencing significant expansion. This sector holds substantial weight, constituting 40% of manufacturing industry exports and employing approximately 204,000 individuals across 2,079 companies. It is the most vulnerable sector to the effects of technological transfer, work-related accidents, and occupational diseases due to various risk factors such as noise, dust, physical constraints, repetitive work, and unhealthy postures. The study period spanned from 2014 to 2019, focusing on the installations of the COTITEX Batna and COTITEX Biskra complexes, the sole accessible zones in the Eastern region of Algeria.

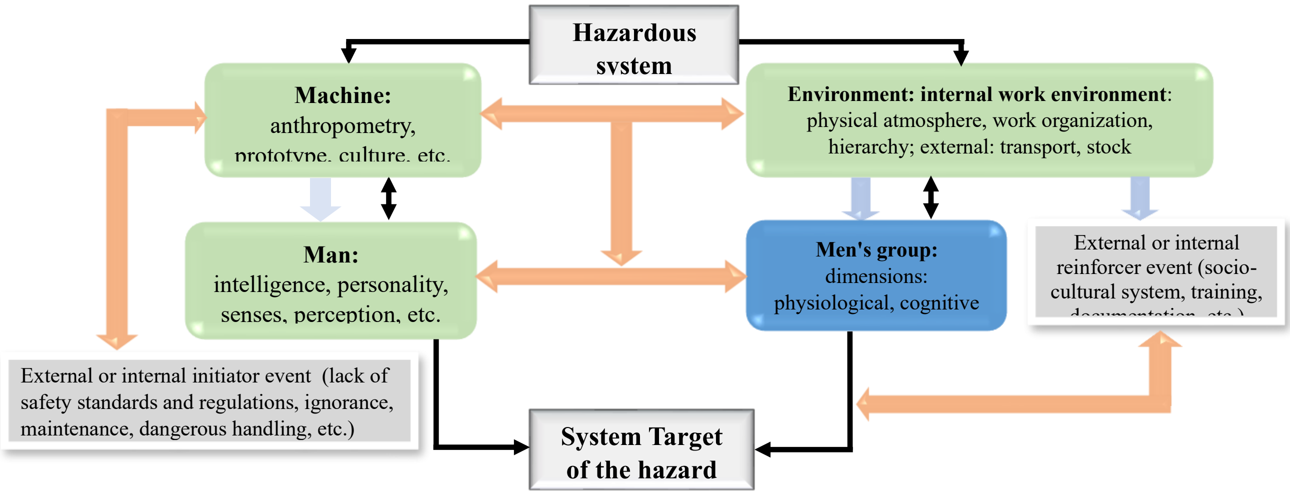

Figure 3: Systemic representation of the socio-technical process, where the human operator is the primary target problem

- **Oil Industry:** Collaboration with the study involved the SONATRACH oil group, with its subsidiary NAFTAL providing the case study centered on the installation of HassiR'mel. This company represents an environment where the technical system is intricately linked with a high level of modern technology.

2.2. Practical implementation of the Human Factor approach

Implemented on a sample of operators (30 individuals) by an industrial psychologist, the assessment of the situation was conducted in two stages and depended on estimating two classes of criteria [21-26] (See Fig. 4):

- The capacity criteria are based on knowledge (intellectual and mental abilities), competence (technical, managerial, and interpersonal), and experience related to the task at hand;
- The behavioral criteria are rooted in style (psychological aspects and temper features), thought preference (influences and considerations), and values (bravery and perseverance).

2.2.1. Stage 1: Assessing Intellectual and Mental Abilities (Psychometric Tests)

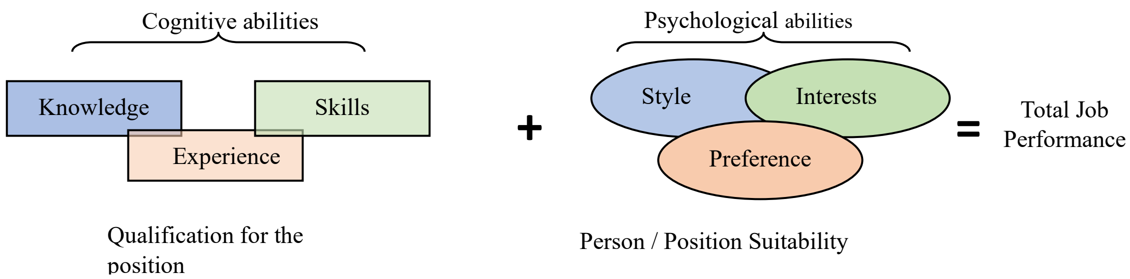

Figure 4: Description of the operator station

The test [22, 27] was proposed to all employees across three companies: COTITEX, SONATRACH, and SONALGAZ. Participants were voluntary subjects with an average physiognomy typical of an Algerian worker (height: 1m 60) and a specific experience in the field (at least five years). Subsequently, assessments and measurements were conveyed to the managing teams of the respective factories.

2.2.2. Stage 2: Assessing Integrated Performances

This stage focuses on measuring alignment with previously established criteria concerning the company's objectives regarding overall performance (security, productivity, and quality) [22]. To achieve this, we, in collaboration with the factory's managing team, determine the "braveries" or "values" to assign to each workstation, as shown in Table 2 above [28-30].

We requested that those associated with each workstation assign security ratings, ranging from 1 (unacceptable) to 5 (excellent), to each predefined criterion in the table. Each personal power linked to ensuring proper function receives a score. The product of personal power matching determines success for the criterion. The sum of these measures provides a total between 0 and 500, corresponding to a score between 0 and 100%. A higher score indicates greater alignment between the workstation and its occupant. Results varied across workstations and their perceived roles within the company.

We then characterize the match between the operator and the workstation, referencing Tables 1 and 3. The match is optimal if the 'capacity' criteria align with the "behaviors" required for the workstation. This management system ensures the sustainability of the security approach if the human resources department ensures follow-up and vigilance. The "Human factor" procedure facilitates a better selection of operators for workstations and individual progress (See Table 1, 2, and 3) [18, 31, 32].

Table 1: Assessment of job values for the position "Industrial Safety Engineer"

Criterion	Weight	Personal Strengths	Average rating out of 5	Value	Score
Awareness	15	Mastery, experience, resolution	3.8	76	
Skills	20	Ability to sensitize, convince, and	4.5	67.5	
Experience	15	Authority, responsibility, sovereignty	3.5	60	
Style	15	Ability to act in dangerous situations	4.0	52.5	
Interests	15	Ability to reach the goal (produce without accidents)	3.0	45	
Psychology	20	authority, personality	3.7	74	
Total	**100**		**Total**	**375**	**75%**

The barriers put in place to ensure this adequacy have a dual objective: to influence the operator's behavior and to build a work environment, i.e., an organization conducive to flexible, responsive, safe, and adaptable work (See Table 2) [33, 34].

Table 2: "Individual-Workstation" match

Job	***Adequacy***	**Person**
Tasks	Compatibility?	Skills
Design	Adapted?	Anthropology, Ethnology
Values	Harmonious?	Interests
Cognitive ability	Appropriate?	Psychological profile

Thanks to better management of the workstations, such a method facilitates setting concrete criteria for managing risks while improving performances (quantity, production quality, emissions) and decreasing the number and frequency of accidents [35].

Table 3: Assessment of the COTITEX company's integrated performance

Criteria	Weight	Performance to be achieved: set by the company	Results obtained	A score between 1 and 5	Value
Tons produced	30	Increase production by 40% (market requirement)	Production increased by 50%	5	150
Quality	25	Reduce rejects by 4%	3% rejection reduction	3.75	93

Productivity	20	Improve productivity by 80% in textile quality	Productivity increased by 50% in textile quality	3.13	62
Application of safety instructions	15	Improve the security level by 10% for the economic status of the company	Safety gain of 8% (reduction in the number of accidents and incidents)	4.0	60
Development staff	10	Improve management by 50% (profitability, security)	The score obtained 8.5/10	4.25	42
Total	**100**			Total	**407/500**
Date: April 2018		Integrated performance evaluation (after application of the "Human Factor" approach)		Score	**81%**
Date: May 2010		Integrated performance evaluation (obtained by calculation)		Score	**77%**

3. **Interpretation of the Human Approach Procedure and its Application to the COTITEX and SONATRACH Companies:**

Considering the companies' nature and the diverse workstation categories, we examined several samples from distinct populations. The samples included volunteering operators and specialists associated with the investigation, and meetings were conducted at the COTITEX Batna unit for convenience. As presented in Table 1, the variables analyzed result from two psychometric tests [36, 37], comprising a Multiple Choice Questionnaire (MCQ) on personality. Within a limited timeframe, operators responded to questions assessing verbal aptitude, digital aptitude, logical reasoning, attention, and memorization. Additionally, they completed an MBTI personality questionnaire: the Myers-Briggs Typology Inventory [38-41].

The relatively small sample size (approximately thirty individuals for five analyzed workstations) was determined by time constraints. The industrial psychologist evaluates the psychometric test results based on the criteria set by the company's significance. These assessments are then utilized to analyze the management system collaboratively with the company's managing team, participants, and advisors from the "Human factor."

This procedure, thus, reinforced the concept of security, managed internal staff mobility, understood specific performances (productivity and security), and explored and enhanced individual professional capacities by identifying each interviewed operator's potential. The approach also facilitated reorienting certain employees with new values [42]. This approach improved human potential, allowing the assessment of benefits in terms of productivity, quality, security, and environmental preservation. This comprehensive evaluation is termed the company's "integrated performance." Data presented in Table 4 quantifies the progress achieved through the implementation of the procedure. Furthermore, this approach supports the efficient application of recommendations from social investigations and experimental analyses, leading to improvements in physical conditions, such as a more effective ventilation system, smoke detectors, earmuffs, silent certified machines, adjustment of footboard height, etc.

3.1. Security and production improvement

3.1.1. Statistics of occupational accidents in COTITEX Batna

Figures 5 and 6 illustrate the benefits obtained in a matter of security for the period 2015-2019 after the implementation of the procedure at the level of the two companies, COTITEX and SONATRACH.

WA-Leave: Work accident with a sick leave WA-PI: Accidents resulting in permanent disability

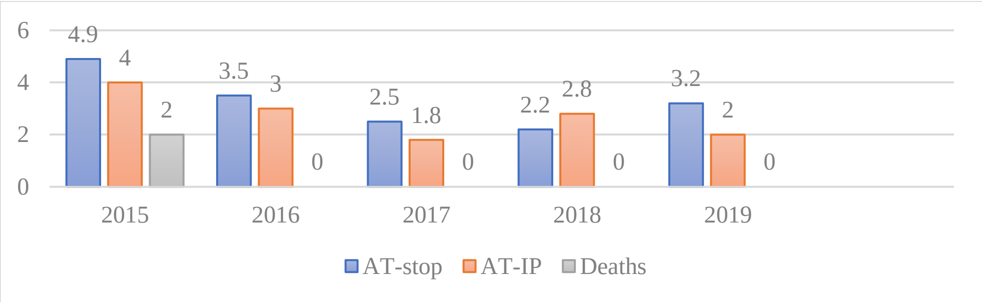

Figure 5: Graphical assessment of the sum of work accidents at COTITEX

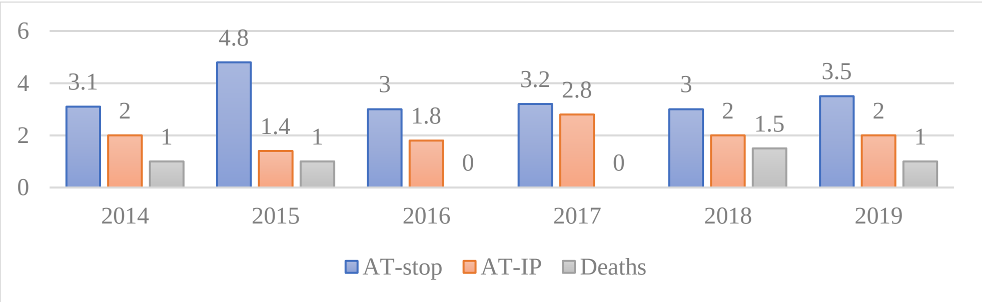

Figure 6: Graphical assessment of the sum of work accidents at SONATRACH (2014-2019)

Table 4 allows us to observe the advancement in workstation control and the enhancement of employee qualifications. Over five years, employees have cultivated cross-sectorial and more integrated knowledge and competence through lifelong education and regular meetings, exemplified by programs like "Skill In." The primary objective of such programs is the continual enhancement of competencies and the employability of workers.

Table 4: Evolution of production (woven products, in meters)

Year	Scheduled production (in m)	Production achieved (in m)	Production achieved in %	Loss in %
2014	1,305,614	569,049	43.58%	56.42
2015	1,196,895	575,802	48.11%	51.89
2016	3,825,650	2400200	62.74	37.26
2017	3,834,927	3,002,320	78.29	21.71
2018	2,695,227	2,265,057	84.04	15.96
2019	3,651,734	3,654,485	100.08	00.00

The initial data spanning from 2014 to 2019 highlight the inadequate functioning of the machinery park, primarily characterized by:

- The high number of machines at a standstill (83 machines out of a total of 203 in the spinning and weaving workshops) due to a lack of spare parts and maintenance issues;
- The poor quality of cotton, not compliant with the functioning of the machines: The quality of the cotton used at COTITEX is significantly below the standard associated with machine operation, leading to both quantity and quality losses of the finished product;
- Traditional hierarchical organizational structures negatively impact communication, management, and collaboration;
- Environmental, social, and economic constraints;
- Non-compliance with security rules.

A substantial loss of 56% was recorded in 2014 before implementing the selected approach. However, with the adoption of this approach, the loss progressively decreased, reaching zero in 2019.

4. **Optimization of the data using the Response Surface Methodology: Box-Behnken**

The experimental designs allowed us to organize the trials that accompanied our scientific research [43, 44]. In this study, the response surface methodology was employed to optimize the potential of safety and productivity (response Y: Pr) by considering capacity and human behavior criteria mentioned in paragraph 2.1, namely, knowledge, competence, experience, style, interests, and psychology (factors). Box-Behnken is among the most widely used experimental designs in the literature. The actual values of the factors were coded as (-1, 0, and 1). Table 5 presents the range of each factor and their levels.

Table 5: The experimental field and the levels of the factors

Factors	Domain and levels		
	-1	**0**	**1**
X_1: Knowledge (Cn)	10	12.5	15
X_2: Skill (Cp)	15	17.5	20
X_3: Experience (E)	10	12.5	15
X4: Style (S)	10	12.5	15
X_5: Interest (I)	10	12.5	15
X_6: Psychology (P)	15	17.5	20

The number of trials of the Box-Behnken plan is calculated using the following formula:

$$N = 2k(k-1) + C_0 \quad (1)$$

Where k is the number of factors, and C_0 is the central point.

In our case, we obtained 51 trials, including 3 points at the center for error estimation. The Box-Behnken plan matrix produced the MINITAB software (18th Version), summarising the experimental and theoretical responses in Table 6.

Table 6: the Box-Behnken plan

Number of trials	CN	CP	E	S	I	P	Experimental Pr	Theoretical Pr
1	10.0000	15.0000	12.5000	10.0000	12.5000	17.5000	41,670	41.583
2	15.0000	15.0000	12.5000	10.0000	12.5000	17.5000	44.290	44.209
3	10.0000	20.0000	12.5000	10.0000	12.5000	17.5000	47.720	47.806
4	15.0000	20.0000	12.5000	10.0000	12.5000	17.5000	48,850	48.931
5	10.0000	15.0000	12.5000	15.0000	12.5000	17.5000	44,690	44.610
6	15.0000	15.0000	12.5000	15.0000	12.5000	17.5000	46.220	46.133
7	10.0000	20.0000	12.5000	15.0000	12.5000	17.5000	47.250	47.333
8	15.0000	20.0000	12.5000	15.0000	12.5000	17.5000	47.270	47.356
9	12.5000	15.0000	10.0000	12.5000	10.0000	17.5000	37.320	37.281
10	12.5000	20.0000	10.0000	12.5000	10.0000	17.5000	45.620	45.495
11	12.5000	15.0000	15.0000	12.5000	10.0000	17.5000	42.960	42.921
12	12.5000	20.0000	15.0000	12.5000	10.0000	17.5000	45.910	45.785
13	12.5000	15.0000	10.0000	12.5000	15.0000	17.5000	43.520	43.396
14	12.5000	20.0000	10.0000	12.5000	15.0000	17.5000	47,690	47.977
15	12.5000	15.0000	15.0000	12.5000	15.0000	17.5000	44.910	44.786
16	12.5000	20.0000	15.0000	12.5000	15.0000	17.5000	43,730	44.017
17	12.5000	17.5000	10.0000	10.0000	12.5000	15.0000	42,590	42,673

18	12.5000	17.5000	15.0000	10.0000	12.5000	15.0000	43.410	43.493
19	12.5000	17.5000	10.0000	15.0000	12.5000	15.0000	43.420	43.504
20	12.5000	17.5000	15.0000	15.0000	12.5000	15.0000	44.380	44.464
21	12.5000	17.5000	10.0000	10.0000	12.5000	20.0000	45.080	44.996
22	12.5000	17.5000	15.0000	10.0000	12.5000	20.0000	45,800	45.716
23	12.5000	17.5000	10.0000	15.0000	12.5000	20.0000	45.560	45.477
24	12.5000	17.5000	15.0000	15.0000	12.5000	20.0000	46.420	46.337
25	10.0000	17.5000	12.5000	10.0000	10.0000	17.5000	41,740	41.659
26	15.0000	17.5000	12.5000	10.0000	10.0000	17.5000	43.970	43.887
27	10.0000	17.5000	12.5000	15.0000	10.0000	17.5000	43.320	43.234
28	15.0000	17.5000	12.5000	15.0000	10.0000	17.5000	44.440	44.359
29	10.0000	17.5000	12.5000	10.0000	15.0000	17.5000	44,400	44.482
30	15.0000	17.5000	12.5000	10.0000	15.0000	17.5000	45.920	46.005
31	10.0000	17.5000	12.5000	15.0000	15.0000	17.5000	45.380	45.462
32	15.0000	17.5000	12.5000	15.0000	15.0000	17.5000	45,800	45.882
33	12.5000	15.0000	12.5000	12.5000	10.0000	15.0000	35.550	35.334
34	12.5000	20.0000	12.5000	12.5000	10.0000	15.0000	40.670	40.880
35	12.5000	15.0000	12.5000	12.5000	15.0000	15.0000	41,620	41.831
36	12.5000	20.0000	12.5000	12.5000	15.0000	15.0000	44.620	43.745

37	12.5000	15.0000	12.5000	12.5000	10.0000	20.0000	39.320	39.946
38	12.5000	20.0000	12.5000	12.5000	10.0000	20.0000	45.440	45.478
39	12.5000	15.0000	12.5000	12.5000	15.0000	20.0000	41,390	41.429
40	12.5000	20.0000	12.5000	12.5000	15.0000	20.0000	43.360	43.327
41	10.0000	17.5000	10.0000	12.5000	12.5000	15.0000	40.070	40.154
42	15.0000	17.5000	10.0000	12.5000	12.5000	15.0000	41,390	41.473
43	10.0000	17.5000	15.0000	12.5000	12.5000	15.0000	41,330	41.414
44	15.0000	17.5000	15.0000	12.5000	12.5000	15.0000	41.910	41.993
45	10.0000	17.5000	10.0000	12.5000	12.5000	20.0000	42.010	41.927
46	15.0000	17.5000	10.0000	12.5000	12.5000	20.0000	44.080	43.996
47	10.0000	17.5000	15.0000	12.5000	12.5000	20.0000	43.170	43.087
48	15.0000	17.5000	15.0000	12.5000	12.5000	20.0000	44,500	44.416
49	12.5000	17.5000	12.5000	12.5000	12.5000	17.5000	43,000	43.110
50	12.5000	17.5000	12.5000	12.5000	12.5000	17.5000	43,000	43.110
51	12.5000	17.5000	12.5000	12.5000	12.5000	17.5000	43.330	43.110

To correlate the selected factors in this study with the studied response, the quadratic equation was developed as follows:

$$Y = \beta_0 + \sum_{i=1}^{k} \beta_i X_i + \sum_{i=1}^{k} \beta_{ii} X_i^2 + \sum_{i=1}^{k}\sum_{j=1}^{k} \beta_{ij} X_i X_j + e_i$$

Where Y is the dependent variable, X_i and X_j are the independent variables, β_0, β_i, β_{ii}, and β_{ij} are respectively the constant, linear, quadratic, and interaction coefficient, and e_i is the error.

4.1. Variance analysis

The obtained results were analyzed using a variance analysis method (ANOVA) to estimate the meaning of the principal and interaction effects. Tables 7 and 8 gather the results of this analysis.

Table 7: The Box-Behnken model coefficients

name	Coefficient	Meaning. %
b0	43.110	< 0.01 ***
b1	0.662	< 0.01 ***
b2	1.861	< 0.01 ***
b3	0.420	< 0.01 ***
b4	0.363	< 0.01 ***
b5	1.087	< 0.01 ***
b6	1.049	< 0.01 ***
b1-1	-0.094	**33.8**
b2-2	0.798	< 0.01 ***
b3-3	0.876	< 0.01 ***
b4-4	2.181	< 0.01 ***
b5-5	-0.826	< 0.01 ***
b6-6	-1.585	< 0.01 ***
b1-2	-0.375	0.100 **
b1-3	-0.185	**7.6**
b2-3	-1.337	< 0.01 ***
b1-4	-0.276	0.0694 ***
b2-4	-0.875	< 0.01 ***
b3-4	0.035	**72.8**
b1-5	-0.176	**9.0**
b2-5	-0.908	< 0.01 ***
b3-5	-1.063	< 0.01 ***
b4-5	-0.149	**14.9**
b1-6	0.188	**7.2**
b2-6	-0.004	**97.0**
b3-6	-0.025	**72.6**
b4-6	-0.088	**38.9**
b5-6	-1.254	< 0.01 ***

Table 7 shows that all the principal effects are very significant, with a p-value that is very weak and inferior to 0.01. In other words, all the selected criteria in this study of capacity and human behavior influence productivity significantly.

Table 8: Variance Analysis

Source of variation	sum of squares	Degrees of freedom	medium square	Report	Meaningful
Regression	322.2403	27	11.9348	150.5136	< 0.01 ***
Residues	1.8238	23	0.0793		
Validity	1.7512	21	0.0834	2.2972	34.7
Error	0.0726	2	0.0363		
Total	324.0641	50			

Moreover, the coefficients with a p-value superior to 0.05 are insignificant. Table 8 indicates that the obtained model is adequate, with a high correlation coefficient of 0.994.

4.1 Response area

We employed three-dimensional graphs of the response area to understand better the influence of the independent variables and interactions with the response. The results are schematized in Figure 7. The figure shows a significant interaction between each criterion and productivity.

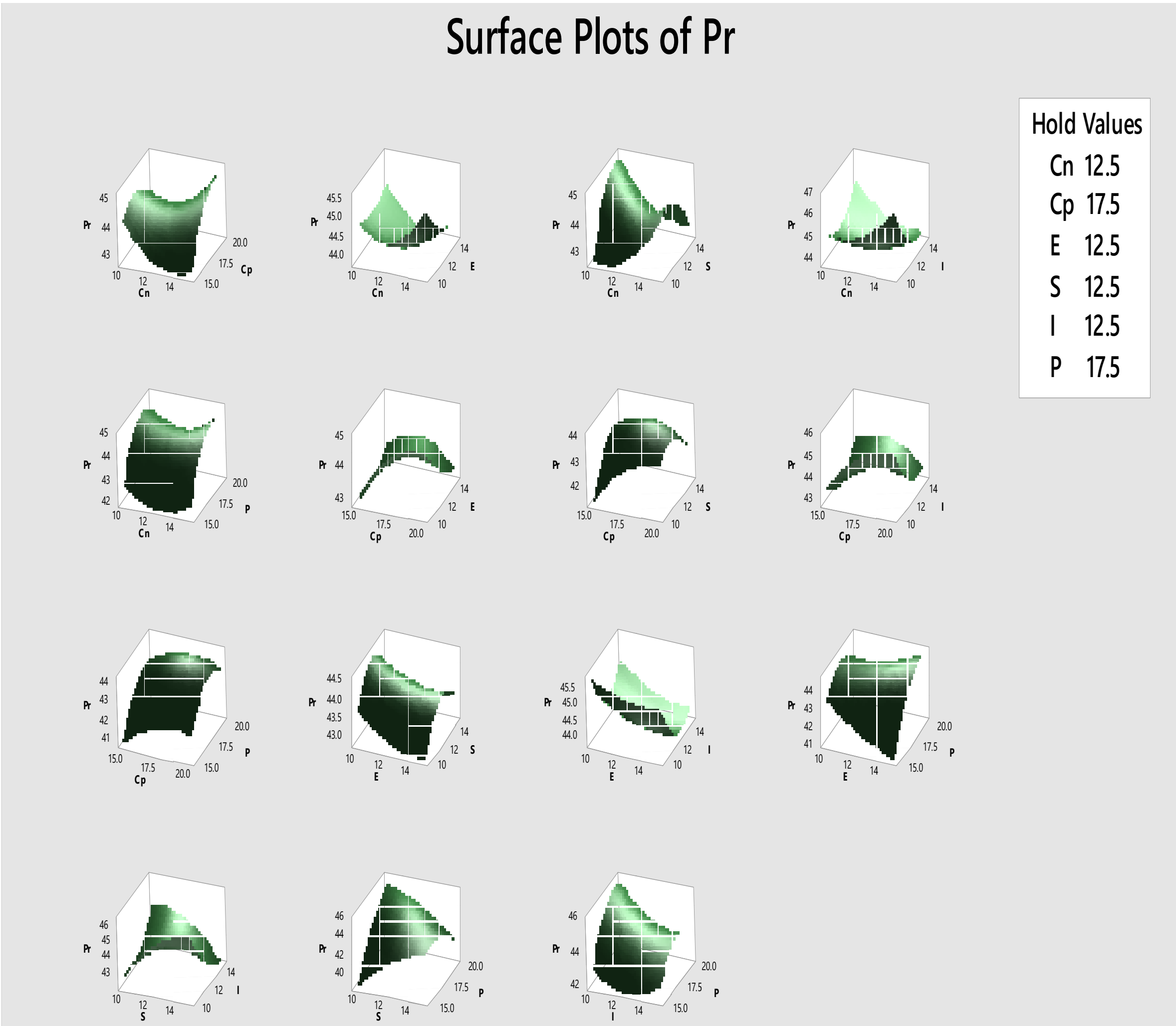

Figure 7. The three-dimensional response surface represents the effect of human capability and behavior criteria on productivity.

5. Discussion of the results

The results of our research on the contribution of the psycho-intellectual capacities of workers have broadened our understanding and led to the development of the concept of human performance. Sonja A. Irlbeck (2002) [45] from the University of Minnesota, who studied the impact of human performance concerning factors such as financial results produced by an individual, their ability to commit to achieving economic goals, and organizational flexibility, defines human efficiency as the ability of an individual or a work unit to take on its share of responsibilities and modulate its action to achieve economic goals by demonstrating adaptability.

For our study, the ability of individuals to commit to achieving goals is facilitated by the quality management's ability to handle rewards with full knowledge of the needs and expectations of each individual (psychotechnical tests).

Our question related to human performance guided our work due to its relevance to the issue, especially with references to the role of safety-productivity management and individual commitment. Thus, the pursued research objective materializes through identifying organizational, cultural, and environmental factors favoring human performance concerning enhancing the safety-productivity concept in our units, COTITEX and SONATRACH.

We have divided the factors influencing safety-productivity into three categories: the Socio-technical System, the individual, the organization, and the environment mentioned in the hypotheses. Among the factors related to the individual, we find the development of skills (Cp) and the development of Style (S).

Regarding the development of skills, it has been carried out according to the needs of the company:

- Development of training modules for managers;
- Training for new employees.

We have proposed investing significantly in continuous training, adapting employees to their workplace, and complying with safety rules to support the rise in employee qualifications. For COTITEX: over the period 2016-2018, only 35% of workers received continuous training, compared to 60% of executives and intermediate professions.

As indicated in Section 2, the skills assessment was carried out through a questionnaire to assess the gap between the personal skills of each employee; this reference then confirms itself as the expected level of mastery for each skill. Based on the results obtained, employees are then offered tailor-made training.

Following the results, we have proposed a program to increase employees' skills and employability continuously. "The Skill In" program involves choosing a series of key positions for the group (applications, methods, maintenance, security) and defining a skills reference that managers must possess for each of these professions.

The proposal of the "Skill In" program confirms its great usefulness for our companies and must be enlightened by their needs. Thus, at its 29th session in March 2016, the International Labour Organization (ILO) Board of Directors selected the issue of skills for better productivity, employment growth, and development as the theme for discussion at the 97th session of the International Labour Conference 2018 [46].

Regarding managing the second behavior criterion based on style, we propose a questionnaire of six questions for employees indicating to what extent they are stressed or satisfied at work. This examination serves as a precursor to the more comprehensive survey for an instant portrait of mental health culture in the organization; the most practical advantage of the compensation-focused approach is that the expression of a relationship between stress and satisfaction provides clear guidance on measures to be taken [47, 48].

However, it seems to us that the social sciences have elements to contribute today at several levels; their contributions are found to be very useful [49]. However, the elements from the literature on accident investigations will be far from useless. They will guide our observations of safety culture and safety management systems.

The elements in the literature on accident research will be instrumental in guiding our observations of culture, security, and security management systems. Our research objective is concretized at the heart of the change strategy within organizations. This change involves the necessary training in human skills (competence and style), aligning with the needs of companies and institutions to enhance their productivity-security levels to navigate international markets and technological changes better.

Productivity-security in our two fields is currently pursued by:

- Stimulating companies to leverage the development of competencies to benefit from emerging opportunities and limit the negative impact of change actors such as technology, etc.;
- Integrating the development of competencies into national and sectoral development strategies;
- Establishing subsidiaries for research and harmonious training that link basic training, professional training, work market access, and lifelong training;
- Adopting an ambitious policy of industrial security.

To this end, we adapted and applied our approach to the sociocultural context of the country. It is an approach that seeks to align individuals with the technological and social environment, focusing on the human factor. The resulting management system is inspired by the concept of quality management (Productivity-Security). This organizational approach ensures more efficient control of human factors, providing more excellent reliability to decisions that affect operators in their industrial activities. The positive results of this approach include:

- There is a close link between the feelings and behaviors of individuals; hence, their work satisfaction influences their productivity.
- The influence of the workgroup on individuals; hence, informal collective norms influence their productive efficiency.

The advantages of the implemented model can be summarized as follows:

- The operators and their supervisors are the key actors in the improvement process, at the center of the intervention;

- The methodology allows them to evaluate all aspects of their work situation that condition their health, well-being, and, consequently, their productivity;
- The procedure leads them to formulate immediate and pertinent solutions and to determine the aspects to deepen as a priority;
- The study allows for assessing the participation atmosphere and, therefore, the social atmosphere at the company. It leads to organizing a dynamic performance and the security required by the regulation concerning well-being at work.

Finally, this procedure, based on questionnaires, psychometric tests, social investigation, and individual interviews, has reinforced the concept of security. It manages the staff's internal mobility vis-à-vis the constraints of the socio-technical system, identifies specific performances (health, security, well-being, and production), and determines and enhances individual professional capacities by identifying the potentials of each interviewed operator.

The approach also allowed the reorientation of particular employees with the new values. Starting from the improvements brought about by such an approach to human potential, we could assess the obtained benefit in terms of productivity, quality, security, and environment preservation. These initial results will be the source of numerous other works that will attempt to demonstrate that employee satisfaction is necessary for their productive efficiency, gathered under the name: "human relations stream."

6. Conclusion

We adapted and applied our approach to the Algerian sociocultural context. It is an approach that seeks to match man with his technological and social environment and, hence, focuses on the human factor. The concept of quality management inspires the resulting management system. This organizational approach ensures more efficient control of human factors, granting more reliability to the decisions affecting operators in their industrial activities.

Our study constitutes an original procedure that highlights the socio-technical system of the Man-Machine-Environment. The adopted approach checks our commitment criterion well. It can solve all problems affecting the actors of our system. It is a model summarising all the aspects to be dealt with to promote rational and progressive management of the "productivity-security" concept. It would be essential to carry on this work, both at the practical level, in terms of validation, and at the conceptual level in light of the suggestions made.

We suggest, hence, some related research tracks:

- To identify the research paths that allow developing concepts and "tools" to establish a new vision of the "productivity-security" concept;
- To foresee a process of organizational and collective learning that allows commitment to new technological paths (by seizing opportunities) combined with a particular coordination model that relies on global control of the latest technologies.
- The public decision-makers ought to be aware of these facts and, therefore, integrate into their programs the following evolutions:

- Training and raising the awareness of the company and the workers of the comprehension and representation models of the production systems and the related risks.
- Dialogue between institutions and companies to jointly define the objectives.
- The close link that exists between the individuals' feelings and behaviors; hence, their satisfaction with their work influences their productive efficiency;
- Influence of the workgroup on the individuals' behavior; hence, informal collective norms influence their productive efficiency;
- There is much more consideration of the human factor by developing and extending the suggested quality management system to the criteria touching upon the most profound requirements of the Algerian operator about their human and socio-professional needs.
- The managers must understand the factors that motivate the individuals and the teams' informal norms if they wish their management to influence their productive efficiency positively.

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