

The impact of human behavior on QHSE management systems (2025)

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Abstract: The objective of this study is to examine the impact of human behavior on QHSE management systems. Various studies have addressed multiple influencing factors, ranging from technology to QHSE culture. Using behavioral theory as a fundamental framework for study, identifying the factors that influence behavior will enable the implementation of a responsible approach that directly contributes to the overall effectiveness and efficiency of the QHSE system. The article begins with a review of the state of the art of various research studies throughout history to focus on the stages that have marked the evolution of QHSE management systems and to extract the factors that impact management systems. The methodology adopted classifies the research into three categories: operational, organizational, and systemic. The result is a matrix of factors summarizing the role and impact of human behavior on an organization's performance and confirming that human beings, through their behavior, are the key factor influencing the overall performance of QHSE systems. This research not only aims to ensure control of management systems, but also provides a standardized approach adapted to the three levels of management: top management, middle management, and operators & MO within the HLS structure of management systems.

Keywords: Behavior, Culture, Environment, Human factors, Model, Organization, Performance, Quality, Safety, System.

1. Introduction

The distribution and evolution of QHSE management systems across the world have shown disparities from one country to another, from one region to another, and even from one continent to another. However, the ultimate goal of QHSE management systems remains the same: to improve corporate performance by ensuring a system that achieves effective and efficient results, delivering compliant products while preserving employees' health and safety and protecting the environment.

In this context, the following document is organized as follows: First, we present a bibliographic study conducted throughout history to assess the milestones that have marked the evolution of QHSE management systems and define the decisive factors in this approach. Second, we introduce a literature analysis on the factors impacting management systems. Third, we conclude by identifying the factors to be adopted in the validation survey. Finally, we present the empirical results of the assessment before providing a conclusion.

2. Literature Review and Hypotheses

2.1. Definition of Human Behavior

Human behavior can be defined as the totality of an individual's actions, reactions, and interactions with their environment, whether physical, social, cultural, or economic. This definition helps us understand the impact of environmental factors on human behavior and vice versa.

“Human behavior” This expression encompasses all aspects of the actions, reactions, and interactions of human beings with their environment. It is often used in scientific research contexts to describe the behavior of individuals in controlled or real-life situations.

2.2. *Fields of Study of Human Behavior*

Human behavior is studied in several disciplines such as psychology, sociology, anthropology, behavioral economics, biology, neurology, etc. Each discipline offers a unique perspective on human behavior. For example, psychology studies mental processes and individual behavior, while sociology focuses on social relationships and power structures that influence human behavior. Anthropology studies culture and social practices, while behavioral economics uses economic models to understand how individuals make decisions.

Understanding human behavior is essential to better understand current social, economic, and environmental issues. In the context of QHSE management systems, it is also crucial to understand how human behavior can affect quality, safety, and the environment. This is because QHSE management systems aim to ensure the quality of products or services and the safety of workers and the environment. Individual behaviors can have a significant impact on these objectives, so it is important to understand how human behavior can influence these systems.

2.2.1. *Psychology*

Psychology is a scientific discipline that studies mental processes and individual behavior. Psychologists study cognition, emotions, perception, motivation, and social behavior. Among the famous authors in this field are:

Freud and Freud [1]: human behavior is the result of unconscious conflicts between instinctive impulses and the demands of society.

Jung [2]: Human behavior is influenced by opposing forces in the psyche, including the conscious and unconscious, the ego and the self.

Skinner [3]: Human behavior is the result of the environment, which reinforces desirable behaviors and punishes undesirable behaviors.

Bringuier and Piaget [4]: Human behavior is the result of a cognitive development process, during which children acquire mental schema to understand the world around them.

Bandura [5]: Human behavior is influenced by social factors, such as observed behavior patterns and social feedback.

2.2.2. *Sociology*

Sociology is a discipline that studies social relationships, power structures, and social norms that influence human behavior. Sociologists examine relationships between individuals and groups, social institutions, social stratification, and culture. Famous authors in this field include

Durkheim, et al. [6]: human behavior is influenced by societal norms and values, as well as by structures of power and social control.

Weber, et al. [7]: human behavior is influenced by individual motivations, such as the desire for power, the pursuit of profit, or belonging to a social group.

Marx [8]: human behavior is influenced by class relations and power struggles between workers and the owners of the means of production.

Foucault, et al. [9]: Human behavior is influenced by the discourses and power regimes that shape social norms and behaviors.

Pierre Bourdieu: Human behavior is influenced by habits, cultural dispositions, and practical skills that are acquired through education and socialization.

2.2.3. *Anthropology*

Anthropology is a discipline that studies culture, social practices, and traditions in different societies. Anthropologists examine cultural diversity, kinship systems, rituals, and religious practices, as well as social and political structures. Some famous authors in this field include:

Boas and Jakobson [10]: Human behavior is influenced by cultures, which are complex systems of knowledge, values, norms, and social practices.

Malinowski and Kubica [11]: Human behavior is influenced by biological needs, such as food, shelter, and safety, which motivate cultural and social behaviors.

Clifford Geertz: Human behavior is influenced by symbols and cultural meanings, which are negotiated in specific social contexts.

Sahlins [12]: Human behavior is influenced by structures of power and social control, as well as by mechanisms of resistance and subversion.

2.2.4. Behavioral Economics

Behavioral economics is a branch of economics that uses economic models to understand how individuals make decisions. Behavioral economists examine cognitive biases, heuristics, and emotions that influence economic choices. Some famous authors in this field include:

Kahneman and Tversky [13]: He received the Nobel Prize in Economics in 2002 for his work on prospect theory, which assumes that individuals' decisions are influenced by cognitive biases.

Thaler [14]: He received the Nobel Prize in Economics in 2017 for his work on behavioral finance, which assumes that individuals' financial decisions are influenced by cognitive and emotional biases.

Tversky and Kahneman [15]: He collaborated with Daniel Kahneman on prospect theory and helped develop the concept of cognitive heuristics, which are mental shortcuts used by individuals to make decisions.

Akerlof [16]: He developed the theory of information asymmetry, which assumes that individuals' decisions are influenced by the quality of the information available to them.

Mullainathan and Spiess [17]: He helped develop the concept of "scarcity," which assumes that individuals' decisions are influenced by the availability of resources.

Sunstein, et al. [18]: He helped develop the concept of "nudging," which assumes that individuals' decisions can be influenced by soft incentives rather than strict regulations.

2.3. Factors That Influence Human Behavior

Human behavior is influenced by a large number of factors, which can be classified into several categories.

2.3.1. Biological Factors

Biological factors include physical and genetic characteristics that influence human behavior, such as gender, age, health and disease, personality traits, and brain function.

Pinker and Jackendoff [19]: According to him, the brain is a product of evolution that has developed cognitive mechanisms to solve the adaptive problems encountered by human ancestors.

Ekman and Friesen [20]: He studied facial expressions and universal emotions around the world and identified six basic emotions: joy, sadness, anger, fear, disgust, and surprise.

Plomin and Daniels [21]: He was interested in the interaction between genes and the environment in the formation of personality traits and mental disorders.

2.3.2. Social Factor

Social factors include interpersonal relationships and social norms that influence human behavior, such as family, friends, social groups, social norms, institutions, and the media

Milgram [22]: He conducted the Milgram experiment, which showed that people are often willing to obey orders from an authority figure even if they go against their conscience or personal ethics.

Solomon Asch: He studied social conformity and showed that people tend to conform to the majority even if it goes against their own judgment.

Sherif [23]: He conducted the Robbers Cave experiment, which showed how inter-group prejudices can be exacerbated when there is competition for limited resources.

2.3.3. Cultural Factors

Cultural factors include values, beliefs, traditions, and practices that influence human behavior in a given society. Researchers such as Thaler [14] have studied these factors in cultural anthropology and cross-cultural psychology.

Hofstede [24]: He identified five cultural dimensions (individualism/collectivism, hierarchical distance, uncertainty avoidance, masculinity/femininity, and long-term/short-term orientation) that can explain differences between cultures in the way they think and behave.

Hall [25]: He proposed the theory of proxemics, which studies how people use space to communicate and interact based on their culture.

Shweder [26]: He studied cultural differences in conceptions of morality and showed that moral judgments can vary depending on cultural norms.

2.3.4. Economic Factors

Economic factors include material resources and financial constraints that influence human behavior, such as income, prices, costs, incentives, and economic opportunities. Researchers such as Thaler [14] have studied these factors in behavioral economics.

Thaler [14]: He studied cognitive biases that can influence economic decision-making, including the endowment effect and loss aversion.

Kahneman and Tversky [13]: He developed prospect theory, which explains how people evaluate risks and potential gains based on their context and emotions.

Akerlof [16]: He studied the effects of information asymmetries on economic markets, showing how sellers can deceive buyers by selling poor-quality products.

In the article “The psychology of intergroup relations: An overview,” published by Malinowski and Kubica [11] in the journal *Psychology Press*, the authors provide an overview of advances in the understanding of intergroup relations.

According to the authors, inter-group relations are complex phenomena involving interactions between different social groups. These interactions can have positive consequences, such as cooperation and integration, but also negative consequences, such as discrimination and conflict.

The authors explore the different theoretical approaches that have been proposed to understand intergroup relations, highlighting the similarities and differences between these approaches. They also discuss the factors that influence intergroup relations, such as stereotypes, prejudices, social identity, trust, and communication.

The authors also address the challenges and opportunities associated with research on intergroup relations, emphasizing the importance of an interdisciplinary approach and collaboration among researchers.

In conclusion, the article “The psychology of intergroup relations: An overview” by Malinowski and Kubica [11] Tausch provides a summary of advances in the understanding of intergroup relations. The authors emphasize the importance of understanding these relations in order to address contemporary social challenges such as cultural diversity, migration, and political polarization.

2.4. QHSE Management Systems: Introduction and Standards

The QHSE management system is an integrated system for managing quality, safety, and the environment within an organization. It is a systematic approach that enables risk management and continuous improvement of the company's performance in terms of quality, safety, and the environment.

The ISO standards related to the QHSE management system are international standards that provide a framework for implementing an effective QSE management system. The ISO 9001:2015 standard concerns quality management, the ISO 14001:2015 standard concerns environmental management, and the ISO 45001:2018 standard concerns occupational health and safety

management.

2.4.1. ISO 9001 standard: Quality management systems

2.4.1.1. Introduction to ISO 9001:2015

ISO 9001:2015 is an international standard that establishes requirements for an effective quality management system. It aims to help organizations provide products and services that meet customer requirements, improve customer satisfaction, and achieve continuous improvement.

2.4.1.2. Objectives and benefits of ISO 9001:2015

The objectives of ISO 9001:2015 are to promote customer satisfaction, improve organizational performance, and enhance stakeholder confidence. By implementing ISO 9001:2015, organizations can improve their operational efficiency, reduce nonconformities, increase their competitiveness, and strengthen customer confidence.

2.4.1.3. Key requirements of ISO 9001:2015

The ISO 9001:2015 standard defines several key requirements for establishing a robust quality management system. These requirements include identifying processes, understanding customer needs and expectations, planning activities, managing resources, delivering products or services, controlling processes and products, and evaluating performance.

2.4.1.4. ISO 9001:2015 Standard Implementation Process

The implementation of ISO 9001:2015 involves several steps, such as management commitment to quality, defining the scope of the quality management system, identifying processes and interactions, establishing documented procedures, training and raising awareness among staff, conducting internal and external audits, and continuous improvement.

Monitoring, auditing, and continuous improvement according to ISO 9001:2015

ISO 9001:2015 requires regular monitoring of performance, including tracking key performance indicators and collecting relevant data. Internal and external audits are conducted to assess the compliance and effectiveness of the quality management system.

2.4.2. ISO 14001 standard: Environmental management

2.4.2.1. Introduction to ISO 14001

ISO 14001 is an international standard that provides a framework for establishing an effective environmental management system within an organization. It aims to help companies identify, manage, and reduce their impact on the environment. ISO 14001 emphasizes pollution prevention, regulatory compliance, and continuous improvement of environmental performance.

2.4.2.2. Objectives and Benefits of the ISO 14001 Standard

The objectives of ISO 14001 are to promote better environmental management, reduce environmental risks, and promote sustainable development. By implementing ISO 14001, organizations can improve their brand image, strengthen their legal compliance, reduce costs related to resource consumption, and meet stakeholder expectations regarding environmental protection.

2.4.2.3. Key Requirements of ISO 14001

The ISO 14001 standard defines several key requirements for implementing an environmental management system. These requirements include identifying significant environmental aspects, establishing environmental objectives and targets, implementing an action plan to reduce negative impacts, training staff, and monitoring environmental performance.

2.4.2.4. ISO 14001 Implementation Process

The implementation of ISO 14001 involves several key steps, such as identifying stakeholders and their expectations, assessing environmental aspects, establishing objectives and targets, defining responsibilities and competencies, implementing documented procedures, conducting internal and external audits, and conducting management reviews to ensure continuous improvement.

2.4.2.5. Monitoring, Auditing, and Continuous Improvement in Accordance with ISO 14001

The ISO 14001 standard encourages regular monitoring of environmental performance, including data collection, analysis of results, and corrective action in the event of non-compliance. Internal and external audits are also necessary to assess the effectiveness of the environmental management system. Continuous improvement is at the heart of ISO 14001, with corrective and preventive actions being implemented to ensure optimal environmental performance.

2.4.3. ISO 45001 Standard: Occupational Health and Safety

2.4.3.1. Introduction to ISO 45001

ISO 45001 is an international standard that establishes requirements for an effective occupational health and safety (OHS) management system. It aims to help organizations prevent workplace accidents, injuries, and occupational illnesses by creating a safe and healthy work environment for employees.

2.4.3.2. Objectives and Benefits of ISO 45001

The objectives of ISO 45001 are to provide a framework for identifying, evaluating, and controlling occupational health and safety risks, to promote a culture of accident and occupational illness prevention, and to continuously improve occupational health and safety performance. By implementing ISO 45001, organizations can reduce safety incidents, improve employee health and well-being, and strengthen their legal compliance.

2.4.3.3. Key Requirements of the ISO 45001 Standard

The ISO 45001 standard defines several key requirements for establishing an effective occupational health and safety management system. These requirements include hazard identification, risk assessment and the establishment of appropriate control measures, employee training and awareness, emergency response, employee health surveillance, internal and external communication, and active worker participation.

2.4.3.4. ISO 45001 Implementation Process

The implementation of ISO 45001 involves several key steps, such as management commitment to occupational health and safety, the creation of a health and safety policy, the establishment of documented procedures, the implementation of a risk management system, employee training on safety procedures, and the conduct of internal audits to assess the compliance and effectiveness of the management system.

2.4.3.5. Monitoring, Auditing, and Continuous Improvement in Accordance with ISO 45001

The ISO 45001 standard requires continuous monitoring of occupational health and safety performance, including the collection and analysis of relevant data. Internal and external audits are conducted to assess compliance with the requirements of the standard and the effectiveness of the occupational health and safety management system. Continuous improvement is encouraged through the implementation of corrective and preventive actions based on the results of monitoring and audits.

3. Materials and Methods

The literature review states that human behavior has an impact on QHSE management systems. To reach this conclusion, research was conducted on several studies throughout history.

The methodology adopted classifies the research into three categories: operational, organizational, and systemic.

The classification adopted is inspired by the progression of management systems throughout history:

- Class A: 18th century, comprising operational actions following the industrial revolution.
- Class B: 20th century, grouping together actions at the organizational level following the industrial era and world wars.
- Class C: 21st century, grouping together actions at the system level following globalization.

A brief overview of the study conducted in each class is provided below :

The 18th century is known as the Age of Enlightenment, spanning from the death of Mulla Nathan and Spies [17] to the revolution in 1789. This European movement sought to impose reason and science, fight against obscurantism, challenge monarchical despotism, and defend freedom of thought and belief. The philosophers of this century took education and tolerance as the basis for their thinking. Voltaire, Rousseau, Diderot, and others were at the origin of this revolution of thought that led to the French Revolution. However, the prosperity enjoyed by France during this period was at the expense of the people, who were subject to heavy taxation. The events of this period gave rise to the Industrial Revolution, which saw the emergence of operational and technical solutions for quality and health and safety at work:

- 1700: Treatise on workers' diseases.
- 1840: Table showing the physical and moral condition of workers.
- 1841: First French law on working conditions prohibits children under the age of 8 from working during the day and children under the age of 12 from working at night.
- 1892-1893: New laws governing work.
- 1906: First international congress on occupational diseases. Image from 1902 showing the Saint-Gothard tunnel, which caused thousands of deaths.

The 20th century was a century marked by accelerated historical change, with demographic shifts, globalization, and wars. The second half of the century saw economic growth and the development of mass consumption, which led to greater emphasis on quality and working conditions for employees and on the environment:

20th century: the industrial era / wars.

1919-1939: Between the two world wars.

- 1919: Creation of the ILO at the end of World War I under the auspices of the Treaty of Versailles, which ended World War I, embodying the conviction that universal and lasting peace could only be built on the basis of social justice.
- 1930: Creation of the ILO Encyclopedia.
- 1939: World War II.
- 1940-1989: During and after World War II.
- 1945: United Nations (UN).
- 1946: Occupational health services become mandatory.
- 1948: World Health Organization (WHO).
- 1950: In 1950, the ILO and WHO organized their first Joint Committee on Occupational Health. The overlap in the responsibilities of the two institutions subsequently led the ILO to withdraw from the purely medical aspects of OSH in order to focus on prevention, combining safety and health issues into a single program.

- 1969: Nobel Peace Prize and is considered the global authority on labor.
- 1980: In the 1980s, after the Chernobyl nuclear disaster, attitudes toward OSH began to evolve toward the development of a “safety culture” focused on risk assessment, prevention, and reduction, taking into account the mental health of workers as well as their physical well-being.
- 1999: OHSAS 18001 (for “Occupational Health and Safety Assessment Series”).
- 1990-2008: Globalization.

The 21st century has seen a shift in reference points with technological, economic and societal transformation: the world has experienced globalization, the collaborative economy, environmental concerns and the emergence of algorithms that have profoundly influenced the world of work. The trend towards prevention and systematization is leading to management systems in three dimensions: quality, occupational health and safety, and the environment.

The 21st century: The world of globalization.

- 1987 Date of first publication of ISO 9001.
- It was first revised in 1994, then in 2000, followed by revisions in 2008 and finally in 2015.
- 1996 Date of first publication of ISO 14001, revised in 2004.
- 2003 The adoption of the ILO's Global Strategy on Safety and Health at Work in 2003 illustrated this change, placing less emphasis on regulation and more on prevention.

Also in 2003, the first annual World Day for Safety and Health at Work was celebrated on April 28, in recognition of the growing public interest in this issue.

- 2012 Publication of the HLS structure and its integration into updates to management system standards.

- 2018 ISO 45001 replaces OHSAS 18001.

Achieving natural and immersive motion and interaction for VR-animated characters in Unreal , ensuring a seamless connection between users and their digital environments.

4. Results

The classification of the articles studied published between 1986 and 2023 shows that research has been conducted systematically, with a peak between 2009 and 2022 (see graphs below):

Numbered lists can be added as follows:

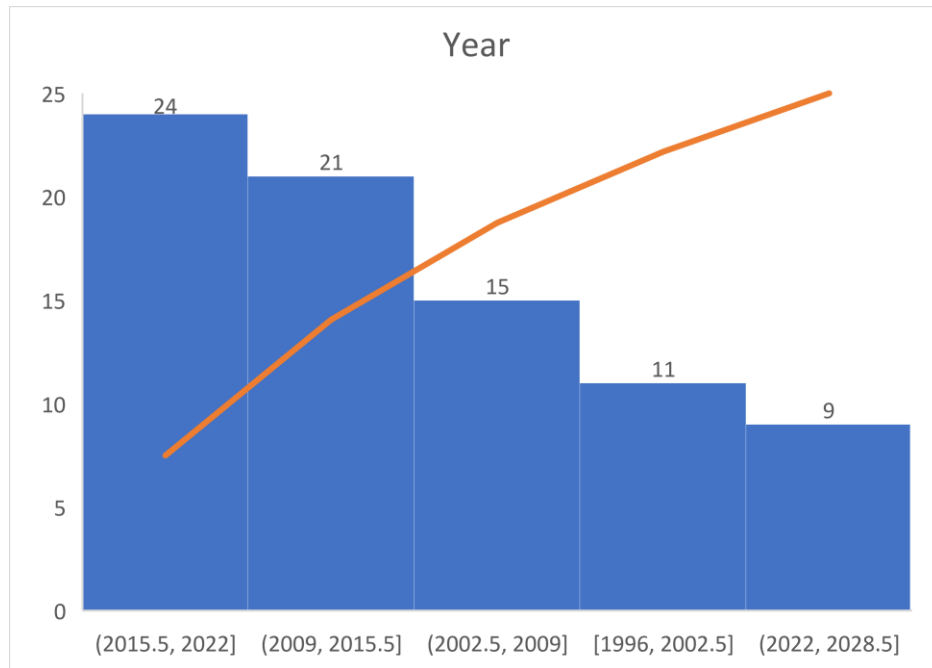


Figure 1.
Distribution of research articles by year, 1996–2023.

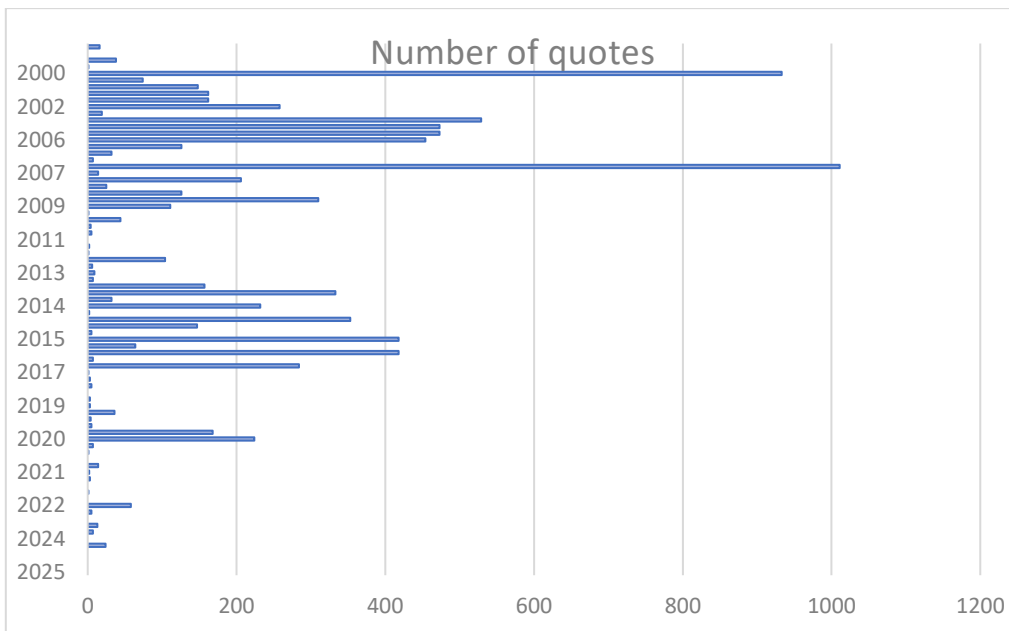


Figure 2.
Distribution of articles according to number of citations.

The trend shows that research continues and there is always a revival of new ideas based on capitalizing on results. The transition from one class to another was a process that took place over many years and led to greater importance being attached to the study of culture.

The definition of safety culture given by a study group on human factors at the ACSNI: Third

Report - Organizing for Safety HSE Books 1993 is as follows: "The safety culture of an organization is the product of individual and collective values, attitudes, perceptions, skills, and behavior patterns that determine the commitment, style, and competence of an organization's health and safety management. Organizations with a safety culture are characterized by communication based on mutual trust, shared perceptions of the importance of safety, and confidence in the effectiveness of preventive measures."

The definition provided and the articles studied explain a set of factors that impact management systems.

In 2001, the article entitled "Behavior-based safety in industry: Realizing the large-scale potential of psychology to promote human welfare" written by E. Scott Geller discusses the BBS (behavior-based safety) approach, a process of observation and feedback based on psychological science through the combination of the DO IT principle ("Define, Observe, Intervene, Test") and the ABC model ("Activator, Behavior, Consequence"), which aims to influence paradigms and increase safety performance. O observe, I intervene, T test," employee engagement styles, and the ABC model ("activator, behavior, consequence"), with the goal of changing paradigms and improving safety performance.

In 2011, we developed the BFDF concept, "Bonne façon de faire" (RWTD, Right Way To Do), by combining engineering science, human resources, and information technology in research conducted from 2005 to 2010 by INERIS. The objective was to create a virtual reality that allows operators to confront the requirements of production and environmental safety and prepare them to act safely.

In 2012, the article "Why don't people just follow the rules? A psychologist's explanation of safety management beyond behavior-based safety" written by Geertz [27] Principal Psychologist at DuPont Sustainable Solutions, provides an overview of the history of safety evolution. At the beginning of the industrial era, we saw an increase in accidents and fatalities, resulting in higher human and commercial costs. To remedy this, attention was focused on technological knowledge to design safe products. Subsequently, managers turned their attention to process development, the provision of defenses, and the establishment of rules, after which they added the provision of safety tools and equipment. Despite the actions taken, something new was needed to promote safety management. In 1970, psychology entered the scene, adding human responses with the advent of psychoanalysis. The theory that marked this era was behaviorism, the principle of operant conditioning developed by psychoanalyst B.F. Skinner, whereby behavior is encouraged by positive or negative reinforcement. This new approach was limited by its long-term effectiveness (BBS plateau), explained by: A) habituation, i.e., the cessation of responding to repetitive and iterative environmental stimuli; B) an approach focused on behaviors directed outside the individual; and C) an emphasis on the behavior of employees and their managers.

These obstacles led to the development of cultural approaches in the 1990s, which target all levels of the organization by developing a variable ratio scheme:

- The principle of cognitive psychology, which states that much of what influences our behavior occurs beneath the surface in our mental processing
- The key attention mechanism: the reticular activating system (RAS), which filters according to three components: a) degree of novelty, b) personal significance, and c) familiar information pattern.

The transtheoretical model of change developed by clinical psychologists James and Carlo, a series of five stages:

1. Pre-contemplation stage: no intention to change
2. Contemplation stage: developing the intention to change in the foreseeable future
3. Preparation stage: the individual prepares to take action
4. Action stage: action, obvious changes
5. Action stage: maintenance, measurement of behavioral maintenance, change.

Finally, the article discusses the holistic approach, which includes all of the above elements and integrates social and cognitive components.

In 2019, the article "Assessing Human Factors Maturity" written by Janette Edmonds and Ken Gray provides an overview of a model to evaluate an organization's maturity based on human factors. This model uses a five-level scale:

- Level 1: Emerging
- Level 2: Transitional
- Level 3: Planned
- Level 4: Proactive
- Level 5: Leading

The evaluation is based on 12 specific human factors elements:

- Human factors in design
- Design and development of procedures
- Managing human failure
- Safety critical communications
- Contractor management
- Fatigue and shift work
- Safety culture and behaviour
- Staffing and workload
- Managing organisational change
- Training and competence
- Human factors in incident investigation
- Managing performance under pressure

In 2020, the article entitled "Computer vision for behavior-based safety in construction : A review and future directions" written by Geertz [27] discusses the BBS (behavior-based safety) approach focused on computer vision and CNN (Convolutional Neural Network) processing, which aims to monitor construction sites in order to automatically capture and identify dangerous behaviors and hazards in real time from two-dimensional (2D) digital data, photos/videos with the aim of providing feedback and influencing individual behavior. The article also suggests integrating deep learning with computer vision to support behavior-based safety (BBS), with the goal of developing a process that will enable behavior to be influenced by following a four-point approach:

- Observe and record dangerous behaviors
- Understand why people engage in dangerous behaviors
- Learn from dangerous behaviors
- Predict dangerous behaviors.

The classification of items and the identification of factors within each class are summarized in the diagram below.

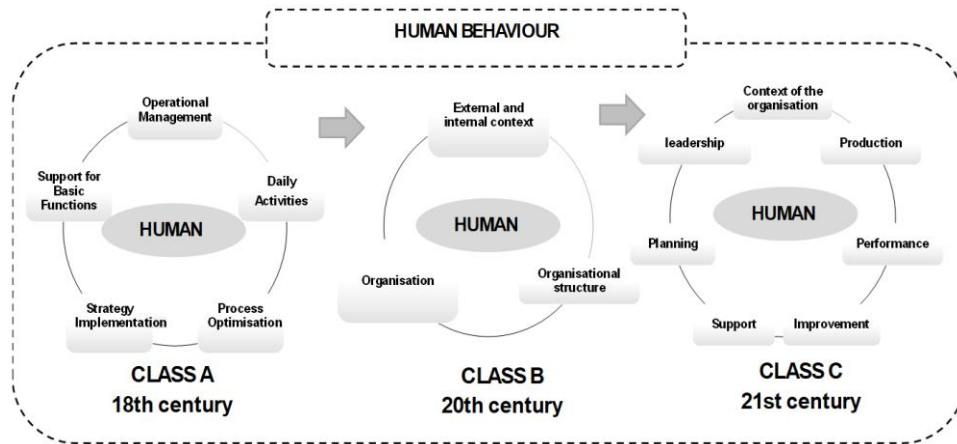


Figure 3.
Distribution of factors impacting management systems throughout history.

4. Results

The graph summarizes the results of the study, with the three classes and a summary of the factors identified:

Class A: summarizes the premises of safety and quality focused on technical actions that affect the operational level.

Class B: summarizes the evolution towards actions at the organizational and system levels.

Class C: summarizes the evolution towards actions at the system level and specifically at the cultural level.

The study of various theories explaining human behavior and the identification of impact factors are summarized in the table below:

Table 1.
Summary of theories and factors impacting human behaviour.

Theories	Year	Impact factors
Classical conditioning theory (Pavlov, Watson)	Late 19th century	BIOLOGICAL/CULTURAL Associations between neutral stimuli and meaningful stimuli
Theory of instinct (William James): First American psychologist Two doctrines Psychology: Functionalism Philosophy: Pragmatism Influenced by Darwin: Natural selection	1842–1910 At the beginning of the 20th century	BIOLOGICAL Innate instincts, biological impulses Functionalism influenced by Darwin
Psychoanalytic Theory (Sigmund Freud)	At the beginning of the 20th century	CULTURAL Unconscious motivations
Behaviourist theory (Watson)	1920s and 1930s	SOCIAL Moving away from the introspective model of analysis based on the unconscious and basing it on behaviour: observable and measurable behaviours rather than internal mental processes.
Behaviourism theory (Skinner)	1920s and 1930s	SOCIAL Consequence-oriented behaviour. Influencing behaviour through a system of rewards and punishments.
Théorie de la pyramide des besoins (Abraham Maslow)	Années 1940 et 1950	BIOLOGIQUES Hiérarchie de besoins, allant des besoins physiologiques de base aux besoins d'accomplissement personnel.
Social cognitive theory (Bandura)	The 1960s and 1970s	CULTURAL Cognitive processes, such as observation, imitation and self-efficacy, in the development of human behaviour.
Social exchange theory (Homans, Blau)	1960s	ECONOMIC Individuals impact the costs and benefits of social interactions and make decisions based on these assessments.
Bounded rationality theory (Simon)	Herbert Simon	CULTURAL Individuals make decisions based on their limited cognitive abilities and the information available to them, rather than in a completely rational manner.
Self-determination theory (Deci, Ryan)	In the 1980s and 1990s	BIOLOGICAL Inspired motivation and the satisfaction of fundamental psychological needs for human behavior.

Theorem: If the three levels of management—Top management, Middle management, and Executors & MO—within the HLS structure of management systems systematically adopt expected behaviors, then the QHSE system will function more effectively, reducing quality non-compliance, occupational health and safety incidents, and environmental impacts.

4.1. Proof of Theorem

Suppose that each non-compliant behavior increases the risk of quality non-compliance, occupational health and safety incidents, and environmental impact.

By acting on the factors that impact human behavior in a methodical and studied manner, these risks are reduced, resulting in measurable improvements that enable the implementation of a sustainable and effective QHSE management system, guaranteeing the achievement of the intended performance.

Thus, identifying the factors that impact behavior makes it possible to implement a responsible approach that directly contributes to the overall effectiveness and efficiency of the QHSE system.

5. Discussion

Following the analysis of the three classes, Figure 3, it can be seen that human beings are the driving force in all three classes and that human behavior is the factor that determines the results obtained. Following this conclusion defining the decisive role of the human factor and human behavior at the level of management systems and their various components.

The table, Figure 4, shows that human behavior is influenced by a large number of factors classified into four categories.

- Biological factors
- Social factors
- Cultural factors
- Economic factors

These four factors are classified into two categories: fixed factors and variable factors. These types of factors are addressed at three levels: Top management, Middle management, and Operators and Workforce within the framework of the HLS (High Level Structure) of management systems.

A more in-depth study will follow, providing further details on the components of fixed and variable factors, with the aim of developing a standardization that enables companies to implement a supporting approach to achieve the objectives of QHSE management systems in terms of performance.

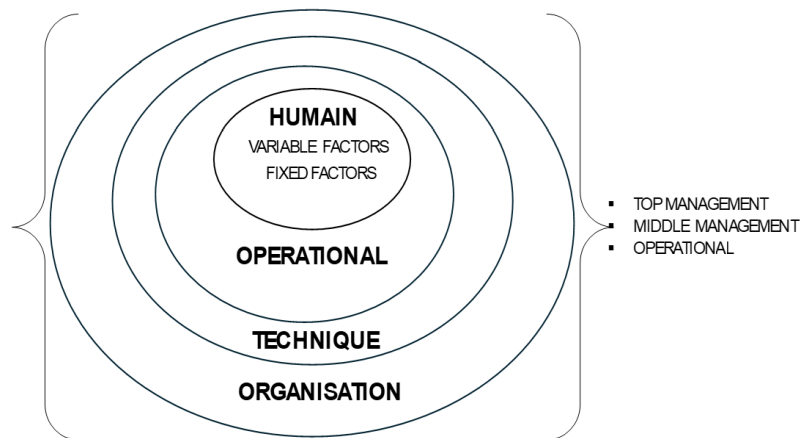


Figure 4.
Impact of fixed and variable factors on different levels of management.

6. Conclusion

This historical analysis has highlighted the crucial importance of human behavior in the effectiveness of QHSE management systems through a historical and systemic study of research conducted since the 18th century.

The gradual evolution of approaches, from simple technical aspects to integrated cultural and systemic dimensions.

The results confirm that human beings, through their behavior, are the key factor influencing the overall performance of QHSE systems. The results of this research will be followed by a survey to establish a standardization process for support practices, aimed at better integrating human components into QHSE management systems. This will not only improve safety, quality, and health at work, but also ensure the sustainability and long-term performance of organizations in a constantly changing global context.

Transparency:

The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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