



Role of HR in Fire Safety and Innovation for Secure and Sustainable Paper Operations

Abstract:

The article explores the critical role of fire safety in the manufacturing of bank note paper, emphasizing the unique risks associated with the industry's specialized processes. These processes—ranging from pulping to watermarking—use highly flammable chemicals, inks, and solvents, which pose significant fire hazards. Key risks include loss of life, destruction of sensitive raw materials, operational disruptions, environmental damage, and economic loss due to fire incidents. The article highlights the pivotal role of Human Resources (HR) in promoting a safety-first culture through policy development, recruitment, training, and continuous learning. HR's involvement ensures compliance with statutory and safety standards, fosters safety awareness, and leads initiatives to prevent accidents. Additionally, the article addresses HR-driven innovations, such as technology-enabled training, behavioural safety programs, and data analytics to enhance fire risk management. It also discusses HR's role in crisis management, post-crisis support, and the integration of fire safety with sustainability and environmental goals. The article concludes with a forward-looking perspective on HR's expanding role in ensuring secure and sustainable operations, advocating for the adoption of predictive technologies and global best practices. Through collaboration and strategic HR involvement, fire safety is positioned as a core organizational priority that aligns with both safety and corporate sustainability objectives.

Keywords: Safety Culture, Crisis Management, Sustainability, Behavioural Safety, Environmental Impact, Safety Leadership, Fire Safety Technology



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Introduction

Bank Note Paper Manufacturing is a highly specialized industry that involves intricate processes such as pulping, chemical treatments, watermarking, and the embedding of security threads to produce currency paper. These activities, while essential to creating secure and durable banknotes, inherently carry significant fire risks due to the flammable nature of the chemicals, inks, solvents, and high-temperature equipment involved. As a result, ensuring fire safety within such environments is not only a matter of operational integrity but also crucial to protecting human life, sensitive raw materials, and the broader economy.

Fire incidents in this industry can lead to severe consequences, including the loss of lives, exposure to toxic fumes, destruction of valuable security materials, long production downtimes, and environmental damage. Such disruptions can compromise both the supply of banknotes and public trust in the financial system. In addition, the environmental impact of fire-related emissions and waste further highlights the need for comprehensive fire safety protocols that go beyond basic regulations [1].

Human Resources Department (HR) plays a pivotal role in ensuring the success of fire safety programs. While technical departments design safety systems and processes, HR is responsible for fostering a culture of safety through recruitment, training, compliance, policy and continuous engagement. By integrating safety into organizational frameworks, HR can drive a proactive, safety-first mindset across all levels of the workforce, ensuring both prevention and effective response in the event of a fire.

Furthermore, HR's role extends to managing compliance [2] with national and international fire safety regulations, supporting employees during fire crisis, and innovating through the use of technology and behavioural safety programs. The growing focus on sustainability and environmental responsibility also places HR at the forefront of integrating fire safety with broader corporate goals such as Environmental, Social, and Governance (ESG) targets [3]. This article aims to shed light on how HR's evolving role in fire safety is crucial for the sustainability, resilience, and success of the Bank Note Paper manufacturing industry.

MATERIALS AND METHODS:

The study draws on a combination of qualitative and quantitative research methodologies to assess the importance of fire safety in manufacturing industry. The role of HR in planning fire safety strategies and importance of policy implementation was studied using Bank Note Paper Mill (BNPM) as case

study. A survey was conducted to understand the current working pattern and involvement of HR in fire safety management in other manufacturing units in study area.

a. Case Studies Method Specific to BNPMIPL:

A case studies of Bank Note Paper Mill, was analysed to evaluate best practices in fire safety management. The case description includes HR planning and successful strategies for implementing fire safety programs, HR-driven initiatives in alignment with regulatory standards. Insights used to understand HR’s role in policy development, crisis management, and the creation of a safety-first culture.

b. Survey on HR strategies in fire safety management:

To understand the role of HR in fire safety a structured survey was conducted to gather empirical insights into how HR professionals perceive their responsibilities, challenges, and contributions in HR policies on fire safety Strategy, Innovation and technology adoption, Sustainability initiatives, Employee engagement and psychological support. Both qualitative and quantitative data was collected to ensure a balanced analysis of HR’s role working in manufacturing sectors. 25 HR executives from various industries were invited; 21 valid responses were received, yielding a response rate of 84%.

A Case Studies Method Specific to BNPMIPL:

Why HR Matters in Fire Safety

Fire safety requires behavioural compliance, continuous learning, awareness and a safety-first culture. While engineers design safety systems and managers implement processes, HR ensures that the workforce is trained, motivated, and engaged in these initiatives [9]. Fire safety is not effective without people’s cooperation and involvement, and that cooperation is orchestrated by HR policies, initiatives and programs.

1. HR’s Strategic Role in Fire Safety

1.1 Policy Development and Implementation

HR plays a pivotal role in implementation of fire safety into organizational policy frameworks. It ensures that fire safety:

- ♦ Is included in induction programs for all new employees
- ♦ Including awareness of contract labours while engage them
- ♦ Is documented in employee handbooks, HR Manual and code of conduct.
- ♦ Aligns with national fire safety regulations, Factories Act provisions [4], ISO 45001[5], and industry-specific security protocols.
- ♦ Is periodically reviewed and updated through joint committees involving safety officers, security managers, and employee representatives.

1.2 Recruitment and Selection of Safety-Sensitive Roles

In high-security industries like bank note paper production, HR ensures that employees hired for critical operations (plant operations, chemical handling, boiler operations, firefighting teams, security) are not only technically qualified but also psychologically fit for crisis response. Recruitment involves technical & skill assessments, background verification, and medical screenings to ensure fitness for safety-critical roles.

1.3 Training and Continuous Learning

Training is the most visible HR contribution to fire safety. Programs include:

- ♦ Fire Drill Simulations: Regular on-site fire safety and emergency evacuation exercises to prepare employees for real emergencies [1].
- ♦ Role-Specific Safety Training: Tailored sessions for chemical handlers, machine operators, material handling, fire detection and alarm systems, Emergency Life Support Apparatus (ELSA), Fire and Safety, Operation of and security personnel.
- ♦ Emergency Leadership Training: Preparing supervisors and managers to take quick decisions during a fire.
- ♦ Certified Fire Fighting: To achieving professional recognition of expertise in fire prevention, protection, and safety. This l certification demonstrates knowledge in managing fire risks and involves meeting educational and experience requirements followed by passing a comprehensive exam organised by Department of Fire & Emergency Services [7].

1.4 Building a Safety Culture [8]

Policies and training will not succeed unless employees adopt a safety-first mindset. HR fosters this by:

- ♦ Establishing “Zero Tolerance for Safety Violations”.
- ♦ Celebrating “Fire Safety Week” with competitions, awareness drives, and rewards.
- ♦ Linking safety compliance to performance appraisals and recognition systems.
- ♦ Encouraging peer-to-peer monitoring and reporting of unsafe practices.
- ♦ Encourage employees and department heads to report near-miss, non-reportable and reportable incident to review unsafe act and unsafe condition.
- ♦ Establishing Safety is one of the important parameters to assess the Performance Link Incentive Scheme.

Involvement of contract labours in safety initiatives, forums and committees.

Table 1: HR’s Role in Fire Safety Strategy Implementation

Aspect	HR's Involvement	Key Actions
Policy Development	Leading or Consulting	Ensures fire safety policies are aligned with national/international regulations.
Recruitment & Selection	Primary Role	Focus on hiring qualified and psychologically fit employees for safety-sensitive roles.
Training Programs	Implementation & Coordination	Regular fire safety drills, role-specific safety training, emergency leadership.
Employee Engagement	Promotes and Encourages	Organizes safety-related competitions, celebrates Fire Safety Week, and incentivizes safe practices.
Sustainability	Integration	Ensures eco-friendly fire safety measures and supports waste management practices.

1.5 Alignment with Statutory & Compliance Requirements

The paper industry, like all manufacturing sectors, operates under strict fire safety regulations. In India, provisions of the Factories Act [4], the Indian Fire Services Act [9], and State Fire Safety Rules govern industrial safety. Internationally, OSHA regulations [10] and ISO standards[5] (such as ISO 45001 for occupational health and safety) provide guidelines. HR ensures that company policies align with these frameworks by:

- ♦ Coordinating with legal and compliance teams to stay updated on changing regulations.
- ♦ Documenting fire safety measures for audits and inspections [11].
- ♦ Obtaining Boiler Operation Licence and its periodical renewal as per the Factories Act 1948 [4] & the Indian Boiler Act 1923.
- ♦ Fire Safety Compliance Certificate from fire prevention, firefighting and evacuation point of view under the Indian Fire Services Act [9], and State Fire Safety Rules govern industrial safety.

- ◆ Petroleum & Explosives Safety Organization (PESO) [6] Licence to Import and Store Petroleum in an Installation under the provisions of the Petroleum Act, 193
- ◆ Coordinate with National Safety Council, Karnataka Chapter, Bangalore for Fire Risk Assessment Audit [12].
- ◆ Coordinate with Regional Labour Institutes (RLI), Directorate General Factory Advice Service and Labour Institutes (DGFASLI), for Comprehensive External Safety Audit [11].
- ◆ Maintaining updated employee training records as evidence of compliance and ISO standards [5].
- ◆ Ensuring contractual workers are equally covered under fire safety rules.

Failure to comply can result in heavy penalties, insurance claim denials, or even plant closures, making HR’s role in compliance critical to organizational survival [2].

Table 2: Fire Safety Compliance and Legal Framework

Legal Requirement & Compliance Area	HR’s Responsibility	Key Actions
Factories Act 1948 [4]	Ensures organizational compliance	Regular audits, training records maintenance, compliance documentation.
Indian Fire Services Act [9] & State Fire Safety Rules	HR ensures alignment with fire safety rules	Obtains necessary licenses, coordinates safety audits, and tracks compliance.
ISO 45001 [5] (Occupational Health & Safety)	Implementation & adherence to international standards	Ensures employee training and documentation meet ISO requirements.
Regulatory Compliance	Ensuring alignment with local and international fire safety standards	Regular updates on regulations, periodic audits, documentation.
Employee Certification	Ensuring all fire safety certifications are up-to-date	Coordination of training and certification renewals for all relevant employees.
Contract Labor Compliance	Ensuring contract labor is covered under fire safety regulations	Integrating fire safety training and compliance measures for contract workers.

2. HR-Driven Innovation in Fire Safety [13]

Innovation in fire safety goes beyond equipment—it is about human behaviour, knowledge, and collaboration. HR drives innovation through the following means:

2.1 Technology-Enabled Innovation

- ◆ Fire Detection Alarm System: Employees are trained to detect the usually smoke detectors, heat detectors, duct detectors, manual pull stations, and sometimes flame detectors in the working area.
- ◆ Automated Sprinkler System: Awareness on Automated Sprinkler System to control fire incidents.
- ◆ CCTV is embedded with FDAS: Employees / Security personnel are trained to monitor the fire incidents which enable to control the fire incident easily.
- ◆ Automated Fire Hydrant System: Fire hydrant system is operated during fire it gives alarm to WTP to give signals and if any pressure drops further, it will automatically start the Main pump to maintain pressure to control fire.

2.2 Behavioural Safety Programs

- ◆ Near-Miss Reporting Systems: Employees are encouraged to report unsafe practices anonymously.
- ◆ Positive Reinforcement: Incentives for teams with zero fire safety violations.
- ◆ Gamification: Introducing fire safety quizzes, drawing, slogan competition, cyclothon and rewards to keep employees engaged.
- ◆ Health Talk: Experts are invited to enrich the awareness on various health related issues such as First Aid, Back Pain, Spine and Neck, Cancer

Awareness & Advancement in Cancer Treatment, Joint Pain, Food and Nutrition, Digital Addiction etc.

2.3 HR Analytics in Safety

Using HR’s data systems, companies can track:

- ◆ Training completion rates.
- ◆ Individual response times during drills.
- ◆ Individual medical treatment and their health condition with respect to working condition.

This data informs future training investments and risk management strategies [14].

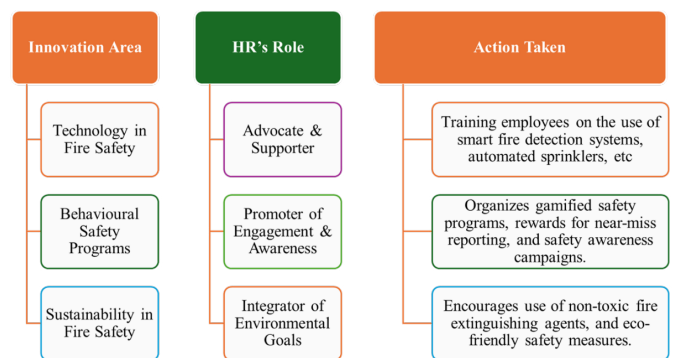


Figure 1: HR’s Contribution to Fire Safety Innovation

Table 3: Employee Engagement and Behavioural Safety Metrics

Metric	Measurement Method	HR’s Involvement
Training Completion Rates	Tracking through Learning Management System (LMS)	HR ensures all employees complete mandatory fire safety training.
Near-Miss Reporting	Number of near-miss incidents reported by employees	HR tracks near-miss reports and incentivizes reporting.
Safety Violations	Monitoring safety violations and corrective actions taken	HR evaluates the effectiveness of fire safety policies through regular assessments.
Employee Satisfaction with Safety Programs	Surveys and feedback after training sessions	HR gathers feedback to continuously improve training programs.

3. Fire Safety and Sustainability

Bank note paper operations cannot ignore the environmental dimension of fire safety. HR ensures that sustainability is integrated into safety practices.

3.1 Eco-Friendly Fire Safety Measures [3]

- ♦ Adoption of non-toxic fire extinguishing agents instead of harmful chemicals.
- ♦ Water recycling systems in hydrant operations.

- ♦ Sustainable building design that uses natural fire-resistant materials.

3.2 Employee Engagement in Sustainable Safety

HR conducts awareness programs on:

- ♦ Safe handling of inks, solvents, and bleaching agents.
- ♦ Waste segregation and disposal after fire incidents.

Reducing dependency on hazardous chemicals in day-to-day operations.

Table 4: Sustainability and Fire Safety Integration

Sustainability Goal	HR's Contribution	Key Actions
Eco-Friendly Fire Extinguishing Agents	Advocating for use of non-toxic, environmentally friendly agents	HR supports the transition to sustainable agents in safety protocols.
Water Recycling in Fire Systems	Integration with the company's sustainability goals	Ensures water recycling systems in fire suppression are in place.
Reducing Hazardous Chemical Use	Promoting safe handling practices and reducing dependency	HR facilitates programs to reduce reliance on hazardous materials.

3.3 Alignment with ESG Goals and SDG Goals

HR's role in fire safety directly contributes to organizational Environmental, Social, and Governance (ESG) [3] performance and advances multiple Sustainable Development Goals (UN SDGs).



Figure 2: Alignment with ESG Goals and SDG Goals

- ♦ Environmental (E): Fire prevention reduces air pollution, greenhouse gas emissions, and material wastage, supporting SDG 12 (Responsible Consumption & Production) and SDG 13 (Climate Action). Adoption of water-efficient firefighting aligns with SDG 6 (Clean Water).
- ♦ Social (S): Employee safety training, fair inclusion of contract workers, and community awareness programs foster safe, inclusive, and resilient workplaces, supporting SDG 3 (Good Health), SDG 8 (Decent Work), and SDG 11 (Sustainable Communities).
- ♦ Governance (G): Transparent compliance, reporting of safety practices, and integration into ESG disclosures strengthen accountability, aligning with SDG 16 (Strong Institutions).

By embedding ESG values and SDGs into fire safety, HR ensures secure, sustainable, and socially responsible paper-making operations.

4. Crisis Management and Psychological Safety

4.1 Immediate Response Role

In a fire incident, HR coordinates with emergency services and local authority, maintains employee accountability (roll calls, attendance systems, manpower count), and supports safe evacuation.

4.2 Post-Crisis Rehabilitation

- ♦ Medical Assistance: HR ensures affected employees receive healthcare coverage.
- ♦ Psychological Counseling: Employees exposed to trauma receive support through Employee Assistance Programs (EAPs).

- ♦ Reintegration Programs: Employees unable to return to previous roles due to health concerns are reskilled and redeployed.

4.3 Communication Management

HR manages internal and external communication to ensure that:

- ♦ Employees receive accurate updates without panic.
- ♦ Communication through public addressing system.
- ♦ Confidential information is not leaked to media or outsiders.

Stakeholders and regulators are kept informed responsibly.

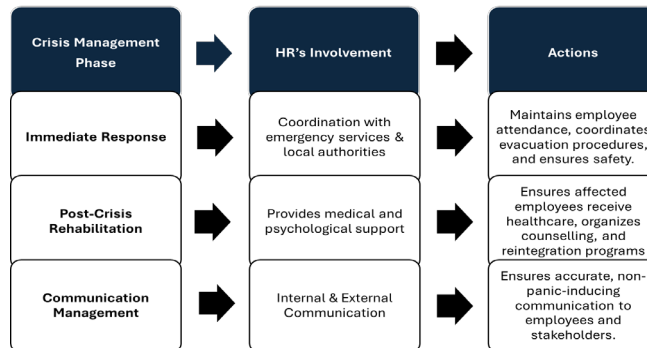


Figure 3: HR's Role in Fire Safety Crisis Management

5. Collaborative Role of HR

HR is the connective tissue linking management, safety officers, security, employees, and external agencies.

- ♦ Facilitates Safety Committees with employee representation.
- ♦ Facilitates Safety Committees with indirect staff / contract labours.
- ♦ Coordinates joint drills with local fire brigades.
- ♦ Organising various events in association with Department of Fire and Disaster Management.
- ♦ Builds partnerships with training institutes for advanced fire safety modules.
- ♦ Building partnerships with Central Industrial Security Force in ensure fire safety.
- ♦ Partnership with parental / neighbouring industries for joint sharing of firemen support and fire brigades

This collaboration ensures that fire safety is not seen as the responsibility of one department but as an organizational priority.

6. Future Directions: HR’s Expanding Role

Looking ahead, HR’s role in fire safety for secure and sustainable bank note paper operations will continue to evolve [14]:

- ◆ Greater use of AI-based predictive analytics to forecast safety risks from employee behaviour.
- ◆ Expansion of remote training platforms to reach every employee consistently.
- ◆ Integration of sustainability certifications with fire safety initiatives.
- ◆ Adoption of global best practices through benchmarking with currency paper mills worldwide.

Survey: Report on the Role of HR in Fire Safety Strategy and Innovation for Secure and Sustainable Manufacturing Industries.

The results of survey undertaken to understand the role of HR in fire safety in manufacturing industries within region is represent Figure-4.

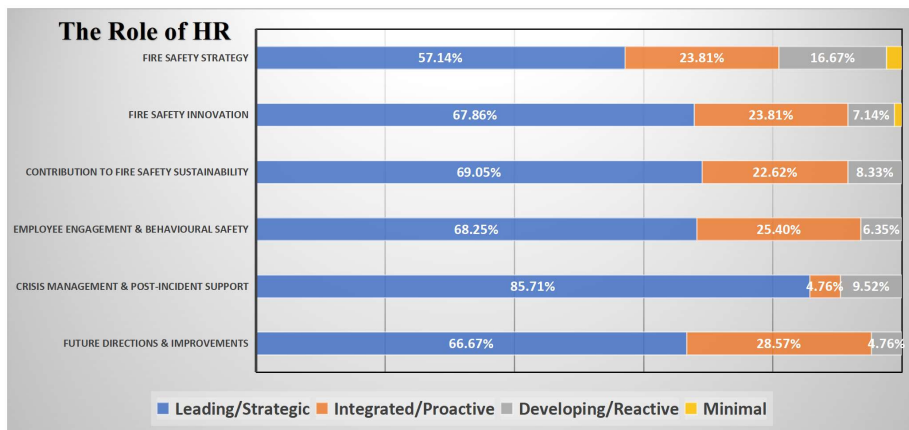


Figure 4: Survey Responses on the Role of HR in Fire Safety Management

The survey conducted findings reveal that 57.14% of respondents recognized HR’s role in fire safety strategy as leading, while a significantly higher 85.71% highlighted HR’s leading role in crisis management and post-incident support. This indicates that HR plays a pivotal role in managing crises and providing post-incident support, making it the strongest area of HR involvement in fire safety.

With respect to the other four parameters—fire safety innovation, sustainability, employee engagement, and future improvements—the responses reflect a consistently strong yet moderately varied perception, with leading role ratings ranging between 66.67% and 69.06%. These results suggest that HR is widely acknowledged as a strategic driver across all dimensions of fire safety, with its most prominent contribution evident during crisis situations, followed by meaningful involvement in innovation, sustainability, and employee engagement.

In light of these findings, it is recommended that the role of HR in fire safety be further strengthened, particularly in the area of fire safety strategy. Enhanced focus and involvement in this domain will ensure the effective implementation and holistic management of fire safety practices, thereby contributing to a more secure and sustainable manufacturing environment.

Conclusion

BNPM’s HR strategies encompass well-structured policies, continuous training, culture-building initiatives, and innovation-oriented programs that emphasize both prevention and preparedness. The HR approaches fire safety as shared responsibility, human-centered includes awareness campaigns, simulations, and employee engagement platforms. Moreover, the integration of fire safety with BNPM’s sustainability agenda ensures that practices are not only secure but also aligned with national security, employee well-being and environmental responsibility, reinforcing the organization’s commitment to green operations. The HR plays a transformative role—not as a support function but as a strategic partner by embedding fire safety into the organizational DNA, HR safeguards not only the physical assets of the plant but also the trust, credibility, and stability of the nation’s currency system.

The survey shows that the HR from manufacturing units involved mainly during crisis management and post-incident support, lacks the preparedness or preventive strategies. Hence it is imperative that the HR from the manufacturing units should strengthen involvement in fire safety strategy enabling enhanced organizational resilience and contribute to the creation of a secure, sustainable, and employee-centric manufacturing environment. In today’s era of rapid change and heightened security concerns, HR’s role in fire safety is no longer optional—it stands as a pillar of resilience, sustainability, and national responsibility in the secure world of bank note paper operations.

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References:

- 1.Jones, M., & McDonald, R. The Impact of Fire Safety Drills on Employee Performance: Case Study in Manufacturing Plants. *International Journal of Occupational Health and Safety*, 43(1), 88-102. (2019).
- 2.Thomas, J., & Hamilton, P. Human Resource Management and Fire Safety Compliance: Best Practices in High-Risk Industries. *Journal of Safety Management*, 49(2), 129-138. (2018).
- 3.Smith, R., & Ferguson, B. Sustainability in Fire Safety: Integrating Environmental Considerations into Workplace Safety Programs. *Environmental Safety and Health*, 45(4), 205-213. (2021).
- 4.Factories Act, 1948 – Government of India. Provisions and Regulations Related to Safety in Manufacturing Industries. Ministry of Labour and Employment, Government of India.
- 5.ISO 45001:2018 – Occupational Health and Safety Management Systems — Requirements with Guidance for Use. International Organization for Standardization.
- 6.PESO (Petroleum and Explosives Safety Organization) Act, 1984 – Government of India. Guidelines for Safety in the Handling and Storage of Petroleum. Ministry of Petroleum and Natural Gas, Government of India.
- 7.Department of Fire & Emergency Services – Fire Safety and Certification Programs. National Fire Protection Association (NFPA) Standards
- 8.Arendt, L. & Larkin, D. Building a Safety Culture: The Role of Human Resources in Fire Safety Management. *Journal of Safety Research*, 72(3), 165-172. (2020)
- 9.Indian Fire Services Act, 1986 – Government of India. Regulations for Fire Safety in Industrial Environments. Ministry of Home Affairs, Government of India.
- 10.OSHA 29 CFR 1910 – Occupational Safety and Health Standards. U.S. Department of Labor. Occupational Safety and Health Administration.
- 11.Regional Labour Institute (RLI)–Fire Safety and Health Audit Recommendations for Manufacturing Units. Directorate General of Factory Advice Service and Labour Institutes (DGFASLI).
- 12.National Safety Council (NSC), Karnataka Chapter, Bangalore – Fire Risk Assessment Audit Guidelines and Reports.
- 13.Fire Protection Research Foundation (FPRF). Innovations in Fire Detection Systems and Employee Training for Manufacturing Industries. *Fire Protection Engineering*, 36(3), 55-62. (2020).
- 14.Harrington, T., & Clarke, S. Behavioral Safety and Human Resource Interventions: Reducing Risk in High-Risk Manufacturing. *Safety Science Review*, 60(5), 190-199. (2022).