Effective Communication for Enhancing Occupational Health, Safety, and Risk Management in the Mining Industries in Papua New Guinea: A Case Study of Porgera Gold Mining in the Enga Province

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Abstract

Effective communication is the pillar in enhancing health, safety, and risk management by enabling information sharing, promoting awareness, and facilitating timely responses to potential hazards. This study's focus on effective communication aims to ensure the clear dissemination of safety protocols and standards, foster a positive safety culture, reduce workplace accidents and injuries, and contribute to achieving zero incidents while enhancing the overall safety management system. The study utilizes Porgera gold mining in the Enga Province as a case study to demonstrate how effective communication can enhance safety culture in the mining industry and similar high-risk extractive industries in Papua New Guinea. While the study is grounded in general qualitative and quantitative research methods, it employs specific techniques, including document reviews, questionnaires, and interview schedules, to collect data and information. The MILLES and HUBERMAN (1994) interactive model of data analysis is used to prepare and analyze the data. The results reveal that many local employees do not understand safety language and rules due to inadequate training and low educational backgrounds. It is concluded that effective communication can enhance workplace safety and risk management, emphasizing the importance of clear communication from sender to receiver. When effectively employed in the workplace, communication provides clarity, brevity, promotes a positive safety culture, and facilitates zero injuries or accidents among workers and properties, ultimately enhancing Barrick Gold Mining's safety management system.

Key words: Effective Communication, Occupational Health, Safety, Risk Management

Introduction

The mining industry is a cornerstone of Papua New Guinea's economic landscape, promising prosperity and development. However, this promising sector is accompanied by inherent challenges, chief among them being the necessity to ensure the well-being of the workforce and the mitigation of risks. This research delves into the pivotal role of effective communication in enhancing occupational health, safety, and risk management within the mining industry, specifically focusing on the Porgera Gold Mining operation in the country's Enga Province. This case study serves as a microcosm, enlightening the broader landscape of communication challenges and opportunities in Papua New Guinea's mining sector.

Papua New Guinea's mining industry is featured by its unique blend of geological richness and complex risk factors. Hence, occupational health, safety, and risk management have become ethical necessities important to the industry's sustainable growth. The Porgera Gold Mining operation, owned by Porgera Joint Venture (PJV) and operated by Barrick Niugini Limited (BNL), is an illustrative example of this sector's challenges and opportunities. The significance of this research lies in its potential to uncover how effective communication can be harnessed to fortify safety practices and risk management within the dynamic and high-risk environment of mining operations.

Effective communication is the core of safety and risk management within mining organizations. It transcends mere information exchange; it is the cornerstone that ensures the dissemination of safety protocols, regulatory compliance, and the nurturing a robust safety culture. Communication is the conduit through which policies and procedures are transformed into lived experiences that safeguard the health and well-being of miners and the sustainability of mining operations.

Our methodological approach combines qualitative and quantitative research methods, including document analysis, structured interviews, and surveys, to comprehensively understand communication practices within the mining environment. These insights will undergo rigorous analysis, enabling us to draw meaningful conclusions and offer practical recommendations.

Within the mining industry in Papua New Guinea, challenges such as language barriers, inadequate training, and the intricate nature of geological and environmental risks persistently loom. These challenges highlight the urgent need for effective communication strategies to bridge knowledge gaps, mitigate risks, and nurture a culture of safety.

This study revolves around a core set of critical inquiries, all aligned with our overarching aim of uncovering the effects and potential of effective communication within the mining industry. Our primary objectives include investigating how PJV's practices in occupational health, safety, and risk management impact worker productivity, assessing PJV employees' comprehension of and adherence to general health and safety protocols across different work areas within the mine and elucidating the mechanisms through which effective communication can bolster the safety and risk management system at Porgera Gold Mine.

Consequently, the specific research questions we aim to address in this study are as

follows:

(a) What are the PJV's occupational health, safety, and risk management practices' effect/ issues on worker's productivity?
(b) Do PJV employees demonstrate a thorough understanding of and adherence to general health and safety protocols in various work areas within the mine?
(c) How can effective communication enhance the safety and risk management system in Porgera Gold Mine?

We provide detailed responses to these questions in the subsequent discussions.

Background

Effective communication is the cornerstone of conveying thoughts, ideas, knowledge, and data from the sender to the recipient through various channels in a clear, concise, and meaningful manner. It involves articulating messages and ensuring their comprehension and accurate interpretation by the intended audience. As highlighted by the School of Meaningful Experiences in 2022, effective communication demands active engagement from both employers and employees, necessitating attentive listening, mutual understanding, and timely responses. Additionally, effective communication extends beyond mere words, encompassing non-verbal cues such as body language and facial expressions, which play a crucial role in conveying information. In the context of this research, effective communication is explored as a pivotal factor in enhancing occupational health, safety, and risk management within the mining industry in Papua New Guinea, with a particular focus on Porgera Gold Mining in the Enga Province.

Communication takes various forms, including verbal and non-verbal, written, visual, and auditory, and can occur through diverse mediums such as face-to-face interactions, phone calls, written correspondence, and digital platforms like forums, social media, and websites.

For "communication to be effective, messages must show completeness, empathy, specificity, and clarity, ensuring that they are comprehensively understood by the recipients" (Tyson and York 2000:4). However, as noted in a Coursera publication by Ng and Koller in 2023, effective communication is a multifaceted process that involves a synergy of these diverse elements.

Effective communication in the workplace plays a pivotal role in fostering occupational health, safety, and risk management. It establishes a foundation for a productive, safe, and healthy work environment by facilitating a clear understanding of roles, responsibilities, instructions, and safety procedures. Effective communication is essential for conveying warnings, discouraging risky behaviors, promoting rapid responses during emergencies, and identifying and addressing workplace issues and hazards. When organizations fail to communicate safety procedures effectively or provide access to vital health and safety information, they expose themselves to unnecessary risks. Consequently, this research

focuses on Porgera Gold Mining in the Enga Province as a case study to emphasize the crucial role of effective communication in advancing employee well-being and safety within the mining industry.

Employers bear moral and legal responsibilities to safeguard the well-being of their employees and, in doing so, protect the interests of their organizations. According to CLAUS (2009), employers are obligated to ensure a safe and secure working environment, and this duty aligns with the concept of shared responsibility between employers and employees in achieving the organization's safety and health objectives (BURTON 2010). Occupational Health and Safety (OHS) has evolved into a critical discipline in recent years, with the potential to significantly reduce workplace illnesses and accidents (ALLI 2008). The Occupational Safety and Health Administration (2016) emphasizes that, with adequate planning and resource allocation, OHS can establish a workplace characterized by health, safety, security, and the absence of accidents. In this context, OHS assumes a pivotal role within organizations, contributing directly to their long-term vision, mission, and strategic directions (MANUELE 2011).

A crucial aspect of OHS is risk management, which involves identifying, assessing, and controlling potential threats that may lead to incidents, accidents, and losses within an organization (Safe Work Australia, 2011). OHS and risk management are intricately linked, and this research investigates both concepts in conjunction with effective communication. Effective communication acts as the glue holding the entire organization and its diverse components together, enabling the development and implementation of robust OHS and risk management plans (VECCHIO-SADUS 2007). Thus, this study examines how effective communication can augment OHS and risk management within the workplace, focusing on the mining industry in Papua New Guinea, using Porgera Gold Mining in the Enga Province as a case study.

The management of occupational health and safety at Porgera Gold Mining is integral to the overall operation of the mine. A comparative analysis by KANAPARO (2008) highlights safety management practices at Porgera Gold Mining compared to Lihir and Misima gold mining operations. The study underscores the significance of Barrick's OHS policies and regulations in setting standards for employee and contractor safety. SOKALSKY (2014:2) emphasizes Barrick's commitment to fostering a safety culture founded on teamwork and leadership, guided by the vision of "Every person going home safe and healthy every day." While Barrick's safety and health management system aligns with its respect for people and the business objective of safe production, its effectiveness is contingent on the commitment and dedication of individuals in leadership positions.

Notably, Barrick's safety management system is designed to deliver specific outcomes. Still, the effectiveness of safety systems may diminish when management does not closely monitor and review health and safety programs' input structures and process performances. Executive management is pivotal in ensuring effective communication with line management, overseeing the appropriate execution of health and safety programs by safety committees, and enforcing compliance with safety rules and procedures. This encompasses employee involvement, hazard identification and control, education and training, and

accident investigation, all of which can be enhanced through effective communication (TYSON and YORK 2000). Effective communication is central to a health and safety management system, as it facilitates safety risk assessments, enhances hazard awareness, and integrates legal obligations into the organization, ultimately fostering an efficient safety culture. While Barrick implements safety standards and compliance with safety protocols in Porgera mining, integrating effective communication into OHS management systems is vital to preventing workplace accidents.

Workplace safety is of paramount importance in high-risk industries where workers face potential injury, illness, or even fatality. Beyond the direct exposure of workers to risks, the neglect of safety can have adverse repercussions, including equipment damage and substantial financial costs, which can hinder social and economic development (KANAPARO 2008). Multinational companies in the mining industry have adopted OHS codes of practice to protect human capital, recognizing that this safeguards corporate value in the context of production-related risks. Workplace health and safety (WHS) is a multidisciplinary field concerned with preserving individuals' safety, health, and well-being within the private and public sectors. The primary objective of occupational health and safety programs is to uphold worker well-being by promoting safe work practices.

Occupational health, safety, and risk management (OHSRM) assume critical importance in the context of hazardous mining workplaces in Papua New Guinea. Incidents within these environments often result in material and financial losses for companies, necessitating insurance payments and compensation for injuries and damages. The Porgera mine, in particular, has faced numerous accidents that have tarnished the company's reputation and affected productivity. An article in "The National" from 2019 (1) highlights the significant financial burden posed by illegal miners, illustrating the social crises arising from their unrestricted access to stockpiles and open pit areas, thereby endangering the lives of both employees and themselves. These activities frequently lead to loss of life and injuries for employees and illegal miners alike.

According to PJV's Monthly Injury Frequency Rate from September 23, 2018, the month of July 2018 alone witnessed three major injuries and nine first-aid injuries. The Mine Manager's Annual report presentation from December 25, 2018, highlights a range of issues affecting the Porgera mine, including an increase in patients at the mine medical center, armed confrontations within the site, trespassing by employees and contractors, rising incidents of vandalism and theft, involvement of armed juveniles in criminal activities, and employee fatigue—all of which have contributed to production losses. Despite robust safety and health practices and policies at Porgera Mine aimed at achieving zero accidents, psychological and human errors continue to pose risks, resulting in injuries and accidents in the workplace. As documented in the Mining Accident Database for 2019, the Porgera mine has witnessed the loss of 11 lives and severe injuries stemming from an explosion in an adjacent explosive storage facility on August 2, 1994.

Risk management is a paramount concern for OHS in the mining industry, encompassing underground and open-pit mining operations. Safety is central to mine operations, particularly for the Porgera Gold Mine in the Enga Province of Papua New

Guinea. According to Barrick's Safety and Health Management System from 2010, the Porgera Joint Venture (PJV) places the "safety first" policy at the forefront of its operations, aligning with mining safety regulations. Given its crucial significance, all mines establish dedicated Safety Departments collaborating with various other mine site departments, including Asset Protection, Community Affairs, Lands, Mill, Construction, and more. The mine safety department is pivotal in ensuring workers are well-trained in safety protocols, promoting a safety-conscious culture, and identifying and mitigating high-risk areas for people and property. Protocols are established to regulate worker behavior, mitigating ignorance and negligence to prevent risks to others and reduce the likelihood of incidents. Hence, effective modes of communication play a significant role in successfully implementing occupational health and safety for those who do not fully understand the safety procedures for preventing workplace accidents.

Theoretical Framework

The theoretical framework underpinning this study, titled "Effective Communication for Enhancing Occupational Health, Safety, and Risk Management in the Mining Industries in Papua New Guinea: A Case Study of Porgera Gold Mining in the Enga Province," encompasses various theories. These theories are integral to understanding the study's focus on effective communication within the mining industry's occupational health, safety, and risk management context.

Accident Causation Theories
Accident causation theories, including the pioneering domino theory developed by HEINRICH (1941) and subsequent updates by BIRD (1974), BIRD and LOFTUS (1976), KJELLEN (1987), HSC (1993), and REASON (1990), provide crucial insights into the sequential progression of events leading to accidents. These theories emphasize the interaction between latent and active failures that result in human errors or violations. A key takeaway is the importance of proactive top management intervention in establishing a safe work system. This study considers various domino theories to comprehensively address accident causation, a vital aspect of safety and risk management in the mining industry.

Ferrel's Human Factors Theory
Based on FERREL (1997), his theory of accidents revolves around a chain of human factors causes. He asserts that human errors are the primary causes of accidents resulting from overload, incorrect responses, and a lack of knowledge in performing tasks. Understanding and addressing human factors are critical in the challenging mining environment, where high-risk tasks are common. PETERSEN (1996) extends this idea by linking overload to human errors and accidents. REASON (2008) shifts the focus from unsafe acts to organizational management systems, while ADAMS (1976) highlights the role of workflow systems in operational errors leading to "technical errors" (unsafe acts or conditions). These theories collectively emphasize the multifaceted nature of accidents and the need for a

holistic approach to safety and risk management.

Firenze Systems Theory

Firenze (1978) emphasized a balanced approach to accident prevention, considering people, machines, and the environment as interdependent risk factors within a systems theory framework. Firenze recommended identifying factors before executing processes, taking into account workers' capabilities, tools and equipment used in tasks, and workplace environments. Understanding workers' abilities and adherence to standard procedures is crucial in a mining environment with numerous risks. Technical personnel, often with limited educational backgrounds, face elevated risks when exposed to environmental or unsafe work conditions. This theory provides insights into a systems-based approach to risk management.

Michalski Accident/Incident Theory

Michalski's (2004) risk management theory focuses on identifying, assessing, and controlling threats in business operations. This perspective underscores the significance of efficient risk management in achieving organizational goals and minimizing the impact of risk factors. The "Zero Injury" concept introduced by the Construction Industry Institute (CII) in 1993 aims to prevent accidents through effective safety programs, which applies to the mining industry's safety objectives despite developing and hidden hazards.

Laswell's Model of Communication

This study incorporates Laswell's (1948) model of communication, which comprises five components: who says what, in which channel, to whom, and with what effect? These components are used to analyze and evaluate the entire communication process within the health and safety risk management system.

(1) Who should be told?

Safety advisors, supervisors, safety committees, safety managers, and management communicate health and safety information to workers and subcontractors, providing expertise in hazard identification, risk assessment, safety training, incident investigation, and other safety measures.

(2) What should be told?

The content of the message or information should be clear and articulated effectively to address problems. Proper communication is essential during induction training for new employees, focusing on hazard identification and analysis and accident investigation. Language choice and use of appropriate words significantly impact safety communication, allowing employees to seek clarification when needed.

(3) In which channel: through what channel or medium

Health and safety information is disseminated through formal training, face-to-face communication, toolbox meetings, pre-start meetings, job safety analyses (JSAs), manual handling, seminars, annual reports, safety weeks, emails, websites, signs, posters, risk assessment reports, procedures, and processes. Selecting the appropriate communication

medium is vital for positively impacting workers' safety and achieving organizational safety standards.

(4) Whom: the audience

The recipients include surface and underground mine workers, Community Affairs teams, mill workers, environmentalists, contractors, and others. Effective communication is crucial for local hires to ensure they understand safety protocols and follow the rules when performing tasks.

(5) With what effect?

Health and safety training aims to achieve zero injuries and reduce Lost Time Injuries (LTIs) and related costs such as insurance claims and compensation. The reduction in negative effects depends on the quality of the safety management system. Effective communication can enhance clarity and understanding of different work conditions, improving worker productivity, reducing fatal accidents, and maximizing production.

This theoretical framework integrates diverse theories encompassing accident causation, human factors, systems theory, risk management, and communication models. It highlights their interrelatedness and collective relevance to the central goal of the study: exploring the role of effective communication in enhancing occupational health, safety, and risk management within the mining industry. This study is illustrated through the case study of Porgera Gold Mining in the Enga Province of Papua New Guinea.

Research Methodology

This study used a case study approach, focusing on the Porgera Gold Mining operation in the Enga Province of Papua New Guinea. This methodological choice allowed a detailed examination of this unique mining context's occupational health, safety, and risk management practices. Through interviews, observations, and document analysis conducted on-site, the study gathered detailed qualitative data, providing deep insights into how effective communication is pivotal in addressing health and safety challenges in the mining industry. By concentrating on this single case, the study unveiled the practical implications of the various theories and frameworks discussed above, offering valuable lessons and recommendations that can be applied not only to similar mining operations but also to enhance safety practices and risk management strategies in analogous high-risk industries in Papua New Guinea and worldwide.

Sampling Techniques

To collect relevant information, this study employed three non-probability sampling techniques: stratified sampling, convenience/accidental sampling, and purposive sampling.

Stratified Sampling Technique

The employee population was categorized into departmental groups and sections based on their qualifications and roles at various levels within the mine. There were ten distinct departments (strata groups): Mill, Logistics, Surface Mine, Underground, Community

Affairs, Contractors, Admin, Security (Asset Protection), Human Resources (HR & Finance), and Safety (Emergency Response and Mine Medical Centre). These strata groups were formed to gather data from workers who represented their respective sections and faced similar challenges related to effective communication in health and safety within the mine.

Convenience/Accidental Sampling Technique

Accidental or convenience sampling was utilized to collect primary data within each stratum. Data were collected from individuals who were convenient to approach based on time constraints and their availability at the mine site and respective camps. Given the company's fly-in or fly-out (FIFO) schedule, data were gathered through phone contacts with managers and supervisors during break times. This method was chosen for its flexibility, allowing data collection at both the researchers' and respondents' convenience.

Purposive Sampling Technique

Purposive sampling was employed to select superintendents, coordinators, supervisors, and senior safety advisors who possessed in-depth knowledge of safety matters due to their extensive experience with the company in reporting and managing safety procedures in their respective workplaces.

Data Collection Methods

Face-to-Face Interview

Key individuals were interviewed face-to-face using guided questions to obtain general information on safety and risk management systems, safety procedures, safety training, duty of care, responsibility, incident and accident occurrences, and more. A total of 30 employees were interviewed face-to-face at their convenient time and place.

Relevant Document Reviews

Literature reviews were conducted using books, safety training manuals, company reports and records, and internet sources. Internet sources were particularly valuable for historical context and current safety and risk management practices.

Case Study

As indicated above, the study employed the Porgera gold mine as a case study to collect relevant data from workers in all departments and sections of the mine who had experienced health and safety issues due to ineffective communication and employee training. Past work-related injuries and fatal accidents were reviewed from the Mine Medical Centre (MMC) in Porgera, examining the causes and impacts of these risks on workers, properties, and the workplace environment. The safety and health management systems of Barrick Porgera were also reviewed.

Questionnaire Administration

Structured questionnaires were distributed to workers at the mine site, with a total of

120 questionnaires distributed and 96 returned. The questionnaires were administered to respondents, allowing them to answer them independently.

Data Preparation and Analysis

Data were prepared and analyzed using the MILES and HUBERMAN (1994) interactive model of data analysis, which involved five approaches: data collection, data reduction, coding, data display, and conclusion. Data were collected from the targeted population in the Porgera mine using the specified techniques. The collected data, including survey responses, interview notes, and questionnaire answers, were coded into themes or groups for easier interpretation and comparison. Phone interview responses were also simplified and analyzed descriptively. Data were then displayed using tables, graphs, and charts to provide concise and graphical representations of patterns in line with the research objectives.

Ethical Considerations

Ethical issues were considered important throughout this research, from preparation and field entry to closing the fieldwork. Cultural sensitivity and respect for individuals and company cultures were critical to the research's success. Adherence to strict company policies was maintained when accessing the mine and interacting with respondents. The purpose of the research was clearly explained to interviewees before conducting interviews or administering questionnaires, and consent was obtained before proceeding. It was emphasized that the information collected would be used solely for educational research.

Study Findings and Analysis

Study Finds and Analysis:

The examination of study findings has encompassed several key domains. A detailed review was undertaken to assess the existing safety and risk management framework at the Porgera mine. This evaluation aimed to gauge the efficacy of the safety protocols and standard operating procedures (SOPs), particularly concerning personnel's comprehension and adherence to safety directives when executing their responsibilities. Additionally, the study delved into the various communication methods employed to disseminate pertinent safety information to employees, aiming to avert workplace incidents and accidents. Ultimately, the investigation discerned the pivotal role of effective communication in fortifying safety and risk management within the Porgera gold mine, fostering a safety culture.

Existing Safety and Risk Management System

The findings gleaned from evaluating the existing safety and risk management system at Barrick Porgera have spotlighted the substantial advantages of an adept and efficient safety management system. As delineated in Barrick's Safety and Health Management System Report (2010), the company's unwavering commitment to cultivating a zero-incident work environment hinges on teamwork and safety leadership principles. This ethos mirrors the company's overarching vision, encapsulated in the aspiration of "Ensuring the safety and

well-being of every individual, each day." Barrick is dedicated to fostering a secure and healthy workforce by adopting a zero-tolerance stance toward work-related injuries. This commitment is further highlighted by the company's resolute endeavor to pinpoint, mitigate, and govern workplace hazards to safeguard its workforce and others. Central to this ethos is a policy that holds each worker personally accountable for their workplace safety and holistic well-being.

Barrick Niugini Limited (BNL) boasts an efficacious safety and health management system, as noted in Barrick's Safety and Health Management Report 2010. This system is underpinned by nine integral elements: leadership and personal commitment, training and skill development, risk management, operational controls, policy framework, health and wellness initiatives, accident response mechanisms, emergency readiness measures, and performance management and evaluation. The company undertakes proactive measures to identify and comprehensively analyze potential hazards. These interrelated elements synergize to ensure an elevated standard of performance and the perpetuation of a continuous improvement ethos within the workplace. This concerted effort is encapsulated in the organizational safety culture, as highlighted by the company's performance metrics, which point out the efficacy of the extant system.

Nonetheless, the findings unambiguously signal that the safety management system at Porgera mine is not adequately meeting the prescribed standards, as elucidated in the monthly incident report by the Mine Medical Centre (MMC), accounting for a notable 2% of incidents. Daily medical reports detailing work-related injuries and accidents present considerable challenges for the mine's medical personnel and the company. This predicament is a conspicuous indicator of the company's output performance, signifying persistent issues within the workplace's safety and health management system. The company is bearing substantial operational costs, as the National report dated August 6, 2019, states that "Illegal miners are incurring monthly costs of K4.5 million to Porgera" (p.1). Consequently, the imperative lies in addressing these challenges by means of a comprehensive review of the safety management system.

Workers' Effectiveness in Understanding Safety Measures

The participants were asked to state their level of agreement with statements regarding the effectiveness of understanding safety systems and procedures. The results are presented in Table 5.1 below.

| Statement		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Safety officer is professionally trained.	Frequency	30	35	6	14	8
	%	31.3	36.5	6.5	14.6	8.3
Qualification of Safety officer is Diploma/higher in OHS.	Frequency	17	20	27	30	2
	%	17.7	20.8	28.1	31.3	2.1

Every employee understands well about safety languages during training or in-house meeting.	Frequency	10	26	17	40	3
	%	10.4	27.1	17.7	41.7	3.1
Injury or accidents still occur due to a lack of understanding of safety information.	Frequency	34	39	12	7	3
	%	35.4	40.6	12.5	7.3	3.1
Safety training given to me is adequate for identifying hazards and following SOPs in the workplace.	Frequency	25	40	15	29	7
	%	20.0	41.7	15.6	30.2	7.3
Peer teaching of safety rules is important in the workplace.	Frequency	45	31	10	5	7
	%	46.9	32.3	10.4	5.2	7.3

Table 5.1 illustrates that 40% of the respondents disagreed with the assertion that they have a poor grasp of safety terminology during training or internal meetings for assigned tasks. This contrasts with the fact that the safety officers at Barrick Porgera are professionally trained to enforce safety policies and programs. Furthermore, respondents rejected that they lack the necessary qualifications, such as a diploma or higher education in occupational health, safety, and risk management, suggesting that they may possess alternative qualifications that equip them to conduct safety awareness and training effectively. Specific health and safety risk management qualifications are essential for addressing safety-related concerns affecting personnel and property and overall well-being and health. Simplifying safety language to its most fundamental form is imperative to efficiently convey safety messages to employees, considering their varying skill sets, qualifications, and educational backgrounds. Additionally, employees' behaviors and attitudes are pivotal in their receptiveness to information managers and safety advisors disseminate during training programs.

In relation to Table 5.1, 41.7% of the respondents indicated that the safety training provided to individual employees is adequate for recognizing hazards and adhering to standard procedures in the workplace. This finding suggests that the majority of employees are well-educated and capable of adhering to safety rules and policies within their work environment. However, 30.2% of the participants reported not fully grasping the safety rules and procedures necessary to prevent hazards and near misses, reflected in cases where workers seek treatment at the Mine Medical Centre. Interestingly, 46.9% of the respondents relied on peer assistance to comprehend safety awareness, hazard identification training, incident assessment, and reporting. Peer-to-peer instruction in health and safety procedures fosters understanding among workers within the same section or group, enabling them to interpret safety terminology that resonates with both parties, particularly among citizen employees tasked with specific duties.

Communication methods used by safety professionals in Porgera mine

Figure 5.2 Shows some of the communication methods used by PJV to communicate with employees at the mine site effectively.
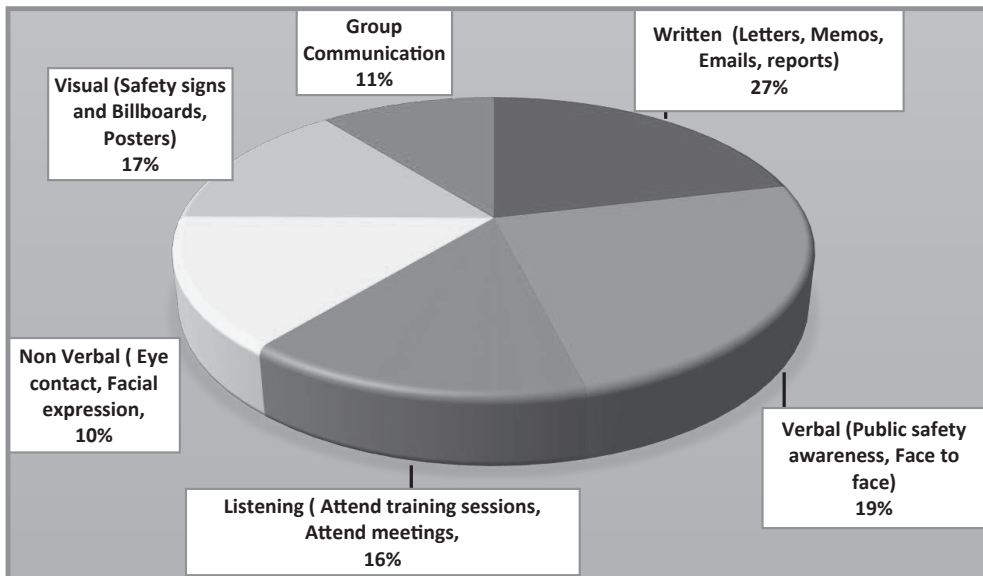
As depicted in Figure 5.2, 27% of the respondents indicated that safety professionals in the mine predominantly relied on written communication methods. This method encompassed emails, letters, reports, and memos. Subsequently, verbal communication methods, including face-to-face interactions, training sessions, and public safety awareness efforts, accounted for 19%. Visual communication tools, such as notices, posters, signs, and billboards, contributed to 17% of the communication landscape. Group-oriented safety communication practices, such as maintaining eye contact and active participation in training sessions, were also appropriately employed to convey safety messages to workers. Utilizing all these methods is equally significant and must be effectively integrated into the company's health and safety protocols to mitigate workplace accidents.

Upon closer examination of the communication methods employed by the company, it was discerned that written communication, specifically emails, memos, and reports, was primarily used by safety advisors and site supervisors within the workplace. Furthermore, the findings unveiled that public safety awareness campaigns were harnessed to communicate with communities affected by mining activities, particularly along the Highway from the provincial town to the mine site, to safeguard the well-being of individuals, properties, and the environment.

Additionally, an inquiry was made to ascertain which communication method was frequently employed by safety advisors and the management team. The results unveiled that 45% of the participants favored face-to-face communication as their preferred method of disseminating information. The majority of respondents specified that face-to-face communication was predominantly employed during monthly safety meetings (training sessions) for all employees, daily toolbox meetings, job safety analyses, cyanide awareness campaigns along the Highway, and intensive safety training at the mine site. This was

followed by signs and billboards, accounting for 17% of respondents. This non-verbal communication entailed displaying warning signs and posters to guide adherence to rules and alert individuals to potential hazards. Fundamental safety instructions and guidelines were established across all departments to ensure compliance. Hazardous areas were also cordoned off to prevent access, serving as communication. Crucially, the feedback loop and the comprehension of safety information among workers yielded positive results. A lack of understanding had previously contributed to injuries and accidents. LASWELL's Linear Communication Model (1948) underscores the significance of feedback in assessing communication effectiveness, particularly regarding employee comprehension, which can substantially enhance safety measures.

Moreover, effective communication is deemed successful when managers, supervisors, and safety advisors relay safety information to employees, and these employees comprehend the message and adhere to established standard operating procedures (SOPs) during task execution. The conveyed message must be lucid and succinct, offering straightforward, concise, and direct guidance to workers requiring it for comprehension and competence in their roles. Clarity constitutes a paramount facet of organizational communication, with mediums such as notice boards, posters, billboards, and email instrumental in motivating and informing workers about their responsibilities. Effective communication can also clarify and improve the performance of both employees and management when deviations from required standards arise. Communication can influence individual workers' attitudes, encouraging them to adhere to safety regulations and assume responsibility for their roles.

The Enhancement of Safety and Risk Management Systems Through Effective Communication
Effective communication plays an instrumental role in transmitting relevant messages from trainers to employees, augmenting comprehension to identify hazards faced by workers, and facilitating the implementation of control measures to mitigate them. Respondents were queried about their perspectives on effective communication as a pivotal component of health and safety management. Figure 5.3 portrays the outcomes, illustrating their recognition of the importance of effective communication in health and safety risk management within this hazardous mining environment.
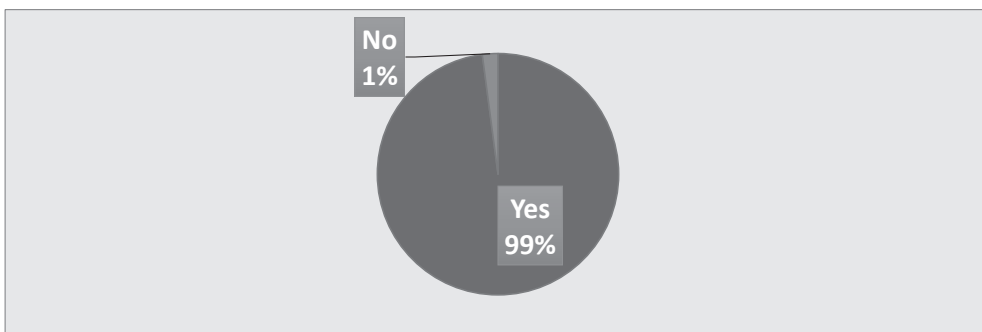

Figure 5.3: Effective Communication Enhances Health and Safety Management System

The respondents in Figure 5.3 above stated that nearly all of them (99%) agreed that effective communication enhances the company's health and safety management system. Effective communication is crucial at all levels of the organizational structure, where the safety management system is integrated into all departments. It provides a solid foundation for comprehending safety and health risk management decisions, enhances the overall effectiveness and efficiency of safety risk assessments, and significantly contributes to safety management at Barrick Porgera. Effective communication also strengthens the working relationships between the company and its employees, fostering public trust and confidence. Additionally, it can facilitate the appropriate involvement of subcontractors and all other interested parties in health and safety communication issues, ensuring high-quality safety management programs for the company.

When questions were asked about the areas of communication needed in the workplace, respondents provided answers based on their experiences with the company.
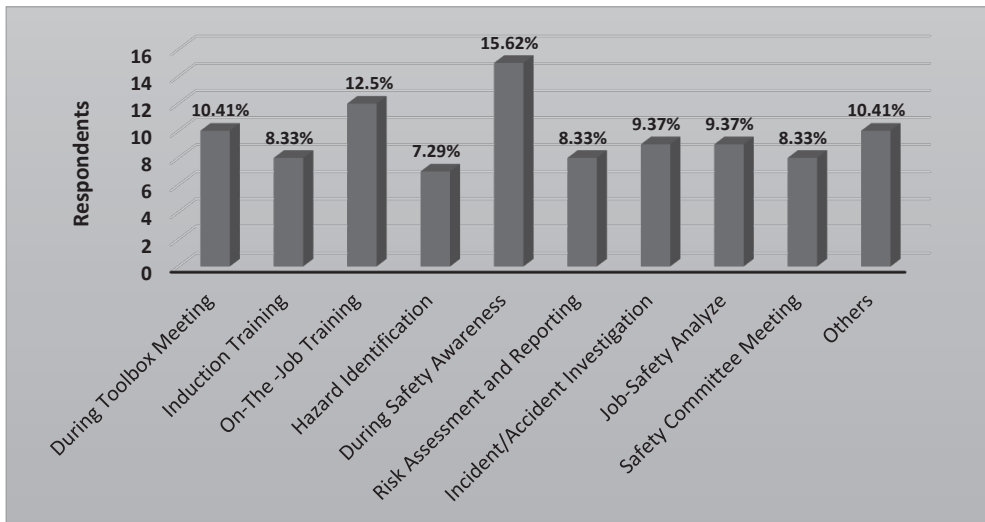

Figure 5.4: Shows the areas of communication needed in their workplace

Based on the findings presented in Figure 5.4 above, it becomes evident that communication is paramount in designing organizational inputs. This reflects management's commitment to fostering effective communication with line management, a critical factor for successfully executing safety programs. These programs encompass various activities at Porgera Mine, including safety awareness initiatives, induction training, hazard identification, risk assessment, audits, inspections, interviews, surveys, accident investigations, job safety analyses, safety committee meetings, and other equally essential endeavors. Furthermore, effective communication can persuade the management team to allocate funding and procure the necessary equipment, tools, and other resources required for implementing these diverse programs.

The study's results also show that health and safety communication plays a pivotal role in

enhancing effective planning and the engagement of safety committees. These committees are composed of top management, safety managers, human resource coordinators, safety engineers, and safety supervisors, and they contribute significantly to providing technical advice for the successful management of safety within the company. Through effective communication, the company can adopt a proactive approach to health and safety precautions, ensure compliance with safety policies, and continually strive to improve overall effectiveness.

Key Discussion Points

In this discussion section, we will furnish responses to the research questions posed in the introduction of this paper.

What are the PJV's occupational health, safety, and risk management practices' effect/issues on worker's productivity?
Occupational Health and Safety (OHS) Issues in the Mining Industry
The safety and well-being of employees must take precedence in all workplaces to minimize the risk to workers. OHS is of utmost importance in the mining industry, where employees in Barrick Porgera have been exposed to various hazards leading to incidents and accidents. The following are the main causes of workplace incidents and accidents in the Porgera mine:

i)   Physical hazards have been responsible for most of the incidents and accidents in various workplaces at the mine site. These hazards include noise from earth-moving machines that have damaged the eardrums of workers on both the surface and underground mine. Vibrations, welding, and exposure to hot materials have also affected workers due to careless tool handling and improper use of personal protective equipment (PPE).

ii) Illegal miners posed a significant security risk to the mine (The National 2019:1). They exerted immense pressure on mine security, leading to substantial expenditures by the company to address the issue. The illegal miners exploited vulnerabilities in the external perimeter of the mine boundary, resulting in ten illegal miners falling to their deaths between 2017 and 2019. In January 2019, two mine security personnel were reportedly shot by illegal miners. This information was kept confidential within the Porgera Mine Medical Centre.

iii) Inadequate training has contributed to many incidents and accidents at the mine site. Despite Barrick's effective safety training programs, many workers failed to understand the content of the training fully. Some incidents and accidents occurred due to the poor training and competency assessment by supervisors and coordinators.

iv) Improper lifting techniques and working at heights have resulted in more than five workers suffering injuries weekly, as the Mine Medical Centre reported in September 2018.

v)   Family problems and violence have affected many female workers, causing them to lose concentration while performing assigned tasks. According to FERREL (1997), his

theory of accident causation was based on a chain of events leading to failure. Frustrated landowners assaulted two Human Resource officers for laying off five local workers at the mine site. These aggressive landowners also damaged two company vehicles due to non-payment of land compensation. This information was revealed in the Community Affairs Coordinator's monthly report in June 2018.

vi) Carelessness in handling laboratory chemicals has resulted in skin burns for five workers, including two males and three females, every month, as reported at MM Centre in September 2018. These workers had difficulty dealing with hazardous chemicals without proper handling procedures and using correct PPE.

vii) There was a lack of proper monitoring and control systems to assess and inspect the workplace. Audits and assessments were lacking, which hindered the measurement of compliance levels in preventing hidden and emerging hazards that could lead to incidents and accidents.

Do PJV employees demonstrate a thorough understanding of and adherence to general health and safety protocols in various work areas within the mine?

The Porgera mine has an effective safety and health management system that integrates all departments and sections to protect the safety of its employees, subcontractors, properties, and equipment, ensuring a safer and healthier work environment. However, the results shown in Figure 5.1 indicate that the safety training provided was insufficient regarding the employees' understanding. This is because employees in the workplace have different skills, qualifications, and education levels for performing various tasks, which can lead to misunderstandings among those with difficulties in comprehension. Furthermore, workers' behaviors and attitudes are crucial in their receptiveness to information presented by managers and safety advisors during training programs, often resulting in incomplete comprehension of safety rules and procedures necessary to prevent hazards and near misses.

Therefore, it is essential to provide comprehensive training that equips them with relevant knowledge and skills to identify and report workplace hazards effectively. Many local contract workers have indicated that they do not have a strong command of the English language, primarily due to incomplete formal education. They find it challenging to understand the extensive list of rules and procedures written in English. It is advisable to convey information in plain language and use easily comprehensible danger signs, billboards, posters, and charts. They have expressed that many safety terms are too complex to grasp, and there is a lack of procedures for working in confined spaces. Additionally, senior officers have reported difficulties in following procedures on computer software used for reporting.

Moreover, it was identified that peer teaching of health and safety procedures and rules can enhance understanding, as two workers within the same group communicate and interpret safety instructions in their cultural language or a common language, such as Tok Pisin, which is appropriate for both workers performing specific tasks. Therefore, training and awareness programs are needed in various work environments within the mine.

How can effective communication enhance the safety and risk management system in the Porgera gold mine?

Effective communication was used appropriately by supervisors and employees to report identified hazards during toolbox meetings, training sessions, hazard identification, risk assessment and control, incident investigations, safety awareness programs, and more. For instance, clarity and voice projection were crucial during meetings and training sessions because participants needed to understand the safety information the trainers presented fully. Barrick Porgera has also utilized posters, billboards, and signs to disseminate safety information to its employees, ensuring they can protect themselves from visible hazards. The methods of presenting information must be clear and understandable for workers with lower levels of education.

However, there was a lack of effective communication in many of the company's health and safety programs. This includes training provided by supervisors and managers that many employees across various departments and sections did not fully understand. Trainers needed to adapt to different approaches, such as voice projection and using appropriate language to convey information in simple English to enhance clarity. Therefore, considering the educational background of workers and responding appropriately to feedback is crucial for all employees.

It is important to reflect on the safety management quality to integrate effective communication into policy development and align with the company's vision, mission, and strategic goals. Line management must communicate effectively to allocate financial resources from senior executive management to implement health and safety programs. Managers, supervisors, and workers must communicate appropriately to mitigate workplace risks, redesign engineering controls, and regularly evaluate the effectiveness of controls and procedures to achieve safety performance goals at Barrick Niugini.

Effective communication is crucial for reviewing and maintaining all applicable documents and the management support system. The management must update correct operating procedures for all work activities, including equipment recognition, personnel requirements, and logistics. Effective communication is essential for identifying hazards, calculating and analyzing risks, conducting incident and accident investigations, and assessing the effectiveness of monitoring and reviewing the company's system failures and weaknesses.

Conclusion and recommendations

Conclusion

This study focuses on how effective communication can enhance occupational health, safety, and risk management in the mining industries in Papua New Guinea. The study utilizes the Porgera gold mine as a case study to illustrate how effective communication can improve occupational health, safety, and risk management in the country's mining and other similar high-risk workplace industries. Integrating effective communication into Barrick's health and safety management system can promote a safety culture to achieve zero

workplace injuries. Effective communication strategies are vital in enhancing the safety and health management system within Barrick Porgera's organizational structure, including management commitment, effective policy development, and implementation. This entails providing demonstrative leadership, allocating funds for program implementation, and ensuring clear understanding and interpretation of information between employees and management to deliver required training programs for all workers. Communication can transform unsafe practices and behaviors among employees into positive attitudes when performing assigned tasks. It also enables line management to employ appropriate communication methods for facilitating various training programs across all worker levels to maintain a safe work environment and promote a safety culture in the company.

Recommendations

It is recommended that organizations adopt the following OHS and Risk Management system model into their company's practices. Barrick Porgera should monitor and evaluate safety management practices by ensuring that all safety policies and procedures are compliant with their employees in alignment with the proposed OHS management system model. OHS considerations must be thoroughly integrated into all company sections to establish a safer and healthier work environment for all workers.
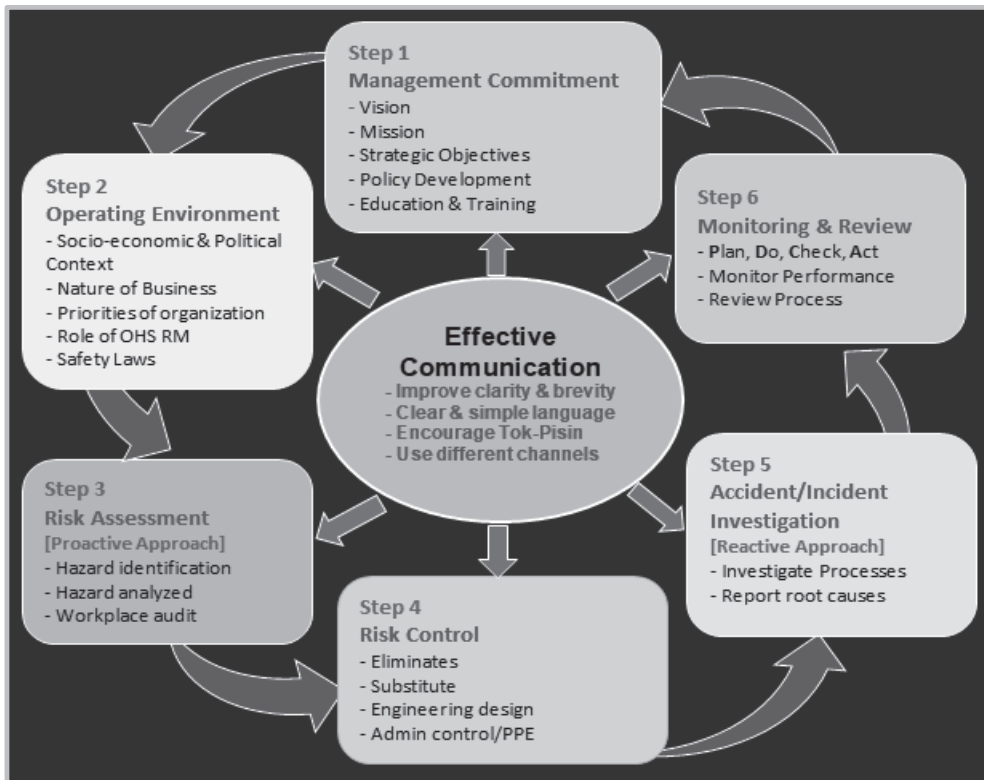

Figure 6.1: Proposed OHS Management System Model in the Mining Industry in PNG

Source: Yaro, (2019)

Figure 6.1 above shows that effective communication can be integrated into all the systems and programs of safety management in the mining and other high-risk workplaces in PNG.

Effective Communication

It is recommended that effective communication is an integral part of the organization's health and safety management system in the mining industry. Effective communication is crucial in promoting a positive safety culture and creating a safer and healthier workplace environment for all employees. It fosters understanding and clarity between management, workers, including line management and supervisors, providing a proper communication channel to implement the company's health and safety programs. There must be clear and precise communication during training sessions for all workers. This includes speaking slowly, choosing appropriate words, using the right tone, and considering employees with a lower educational background. The research has identified that many local employees need safety information presented in more straightforward English or 'Tok-Pisin' (PNG's common language) during meetings and training sessions to ensure full understanding. Incidents and accidents can still occur when workers do not fully comprehend the safety training provided.

Integrating Effective Communication in All Stages of Safety Management System

It is recommended that effective communication should be established at all stages of the safety management system to ensure clear understanding between employees, supervisors, coordinators, and management, thus preventing avoidable incidents or accidents in the workplace.

Step 1: Management Commitment

Management commitment is vital for developing a clear company vision, mission, strategic objectives, and policy development. The management team should set safety rules and procedures, allocate financial resources, identify employee training needs, and proactively address OHS issues in the workplace to drive the vision and mission of the company's safety management system.

Step 2: Operating Environment

Consideration of the operating environment is crucial during health and safety management planning. This includes the socio-economic and political context of the local area, business operations, and the nature of the business itself. Whether in mining, oil and gas, construction, manufacturing, or public or private organizations prioritizing safety, understanding the role of OHS in these business types and the legal penalties associated with business operations in PNG is essential. It is recommended to consider the size and type of business and its likelihood of posing health and safety risks to employees while implementing programs to address legal penalties, costs, and production.

Step 3: Risk Assessment

Risk assessment is a vital part of risk control aimed at mitigating hazards that could

lead to potential incidents and accidents in the workplace. This includes hazard identification and risk control. All employees and management must recognize and evaluate the risks in the work area that are likely to cause injury to workers, property damage, and environmental harm. It is recommended that Barrick should develop a hazard identification and risk assessment system to minimize preventable hazards that employees may encounter in their workspaces.

Step 4: Risk Control

Risk controls are applied to identified hazards, including operational and contractors' controls. When hazards are identified, five control measures are put in place, including (1) elimination (removing the hazard completely), (2) substitution (replacing the hazard with something safer), (3) engineering controls (modifying the design to reduce risks), (4) administrative controls (implementing new procedures with appropriate training), and (5) personal protective equipment (PPE). Proper training and awareness should be provided to educate workers about risk factors and promote a safe work environment in compliance with safety standards and procedures.

Step 5: Accident Investigation

Accident and incident investigations are conducted to identify and uncover the potential root causes of accidents in the workplace and report findings to management for corrective actions. This approach is known as reactive, where incidents or accidents have already occurred, leading to substantial expenses for investigations and addressing lost time injuries among employees. Strict adherence to accident investigation procedures is necessary for effective investigation and reporting for corrective actions.

Step 6: Monitoring and Review

Monitoring and review are crucial in the health and safety management system and involve all company workers. The PDCA system (Plan, Do, Check, Act) effectively manages health and safety. This approach is essential for meeting legal requirements where safety management systems are monitored and reviewed. It evaluates performance against Key Performance Indicators (KPIs) to demonstrate management's commitment to health and safety, ensuring quality performance. It is recommended that the company update its existing monitoring system to accommodate changes in the OHS management system in the workplace. This approach involves top management commitment, management accountability, employee involvement and participation, training and education, hazard identification and control, incident investigation and reporting, safety audit and inspection, and general safety evaluation for quality output and best practices. It includes workers from all organizational levels to promote worker morale and create a positive health and safety culture. The review process should involve supervisors, managers, and top-level management, assessing outcomes and making recommendations based on moral, legal, and economic implications. Improvement should follow the SMART principle (Specific, Measurable, Achievable, Realistic, and Time-bound). Any issues arising within this safety management system should be reported back to management (Step 1) for resolution.

Concluding remarks

This study has shed light on the importance of effective communication in occupational health, safety, and risk management within the challenging mining industry of Papua New Guinea, with a particular focus on the Porgera Gold Mining operation in the Enga Province. The findings of this research point out that effective communication serves as the cornerstone for promoting a culture of safety, thereby fostering a safer and healthier work environment for all employees.

Through this case study, it becomes evident that clear and precise communication is desirable and necessary, especially in a diverse work setting where employees have varying levels of education and skills. Communication gaps were identified, emphasizing the need for language accessibility, simplicity, and cultural relevance in safety training and awareness programs.

Moreover, this research illustrates that integrating effective communication into all stages of the safety management system, from management commitment to monitoring and review, is instrumental in preventing avoidable incidents and accidents. It enables organizations like Barrick Porgera to proactively address potential hazards, thereby ensuring the well-being of their workforce.

In light of these findings, it is recommended that organizations operating in high-risk industries, such as mining, consider the multifaceted role of effective communication in their health and safety management systems. By doing so, they can enhance safety outcomes and contribute to the broader goal of achieving zero injuries and cultivating a robust safety culture. Ultimately, this research highlights that effective communication is the basis upon which the foundations of safety and risk management are built, with the potential to transform workplace practices, attitudes, and, most importantly, the lives of those who work in these demanding environments.

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