OPERATOR DRIVEN MINING PRODUCTIVITY:

UNDERSTANDING THE IMPERATIVE OF A HUMAN-CENTRIC APPROACH

FOR BETTER PERFORMANCE. SAFETY AND SUSTAINABILITY

COOi studios

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OPERATOR-DRIVEN MINING PRODUCTIVITY

Operator-Driven Mining Productivity

UNDERSTANDING THE IMPERATIVE OF A HUMAN-CENTRIC APPROACH IN MINING FOR BETTER PERFORMANCE, SAFETY AND SUSTAINABILITY

Executive Summary

Enhancing Human Factors in the Global Mining Industry

In the dynamic landscape of the global mining industry, technological advancements have significantly impacted operations, focusing primarily on process efficiency and resource extraction. However, the critical human element within this multifaceted ecosystem has often been overshadowed, leading to pressing concerns about safety and productivity. Neglecting human factors in mining operations undermines the health & safety measures taken as the frequency of accidents is not reduced. This prompts the need for a holistic and sustainable approach.

Executive Summary

The mining industry's technological progress has outpaced the development of human factors and skills required for new technologies, such as automation and artificial intelligence.
This imbalance poses challenges to safety, working conditions, and the up-skilling of the workforce. Addressing this gap is essential for seamless technology integration and improved outcomes.

Amidst challenges like volatile commodity prices and growing environmental considerations, there is a call for a paradigm shift towards a human-centric approach. Recognising the interconnectedness of technological systems and human operators is crucial for fostering a safer, more productive, and operationally excellent mining industry.

The neglect of human factors is reflected in injury statistics, with fatigue emerging as a significant contributor to accidents. Understanding the multifaceted nature of fatigue, influenced by social, physiological, cognitive, and psychological factors, is crucial for improving worker well-being and overall performance.

Research conducted at a global mine, focusing on iron ore truck operators and remote drill operators, revealed insights into their experiences, ergonomic challenges, and communication dynamics. The study categorised human errors in mining operations, shedding light on failure patterns and their implications.

Executive Summary

Work-related and non-work-related factors contributing to fatigue among drill operators were identified, emphasising the impact of work time arrangements, physical workloads, temperature extremes, noise, stress, and poor ergonomic design. Non-work-related factors included undiagnosed medical conditions, living conditions, lack of exercise, and certain medications.

Understanding the human factors of operators, encompassing social, physiological, cognitive, and psychological aspects, is crucial for optimising productivity. The transition to autonomous drilling presents new challenges, necessitating a focus on education and training programs tailored to the evolving needs of the workforce.

The following guide delineates our approach to achieving heightened productivity through a strategic focus on human factors optimisation within the workplace. It encompasses inclusive and design thinking methodologies, along with a human-centered approach. This holistic guide aims to foster a resilient, engaged, and ultimately productive workforce.

INTRODUCTION

Introduction

In the rapidly evolving landscape of the global mining industry, technological advancements have become the pivotal point, steering the course of operations and influencing economic dynamics.

These innovations, while transformative, have predominantly focused on enhancing the efficiency of mining processes and optimising resource extraction. However, amidst the fervour for technological progress, there is a critical aspect that has often been overshadowed the intricate ecology of the production environment, where human elements constitute a vital subsystem

Within this multifaceted ecosystem, comprising technological systems, ecological processes, and human factors, it becomes evident that the strides in technological advancement have not been uniform across all three dimensions.

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Notably, the human element, integral to the success of mining endeavours, has frequently found itself in the shadows of technological innovations.

This imbalance has given rise to a pressing concern, as the neglect of the human ecology within mining operations has far-reaching implications.

Introduction *(continued)*

The consequences of this neglect are manifested in a higher frequency of accidents and incidents, casting a shadow over both the safety and productivity of mining activities. Recognising the interconnectedness of technological systems and human operators is imperative for fostering a holistic and sustainable approach to mining practices. This exploration into the dynamics of the mining workforce, encompassing psychological, sociological, and organisational facets, seeks to unravel the repercussions of this technological asymmetry. By addressing the human factors systematically, we aim to shed light on a pathway towards improved safety, heightened productivity, and operational excellence in the mining industry.

The mining industry has focused on improving equipment, machinery and methods that have led to more advanced hardware and software, equipment with higher reliability and productivity, and other technological advancements.

Whilst these investments have improved both safety and productivity as well as reduced casualties and maintenance workload, however, the risk of accidents is still relatively high.

Most investigations post incidents have been due to insignificant integration of human factors (HFs) as a part of the planning, operation, and maintenance activities.

A comprehensive mining system is processes, technology and people, and inevitably human error plays a role in all aspects. Even the most advanced technologies and innovations require human factors to be considered as these technologies require significant knowledge and skills.

Introduction *(continued)*

As technology advances, it is evident that human factors and skilling of staff to support this automation have not progressed at the same pace as the large scale and rapid uptake of technology; the internet of things, artificial intelligence, automation and the like.

The installation of new technologies demands a revisit of environmental, operational or maintenance skills that are required to support these technologies. In order for the mining industry to better integrate these technologies, the understanding of human behaviours must be explored and understood and strategies put in place for change management and address the technology impact with the intention to improve safety, working conditions and up-skilling opportunities of the workforce.

In the face of challenges such as volatile commodity prices and growing environmental considerations in the mining sector, there is a pressing need for a paradigm shift towards a human-centric approach.This shift involves distilling insights into the various factors influencing human performance and decision-making within mining contexts.

Furthermore, it aims to outline strategies and best practices that organisations can embrace to fully harness the potential of their human capital. Our study was designed to gain an in-depth understanding of the daily experiences of operators at a global mine, with a specific focus on identifying factors contributing to overall worker fatigue.

Employing an immersive research methodology, including an ethnographic study of both truck and drill operators, our research sought to uncover valuable insights for enhancing worker well-being and performance in the mining industry.

THE OUTCOMES OF THE NEGLECTION OF HUMAN FACTORS

The Outcomes of the Neglection of Human Factors

The South African Department of Mineral Resources & Energy (DMRE) reported 1124 general injuries in the mining sector for the year 2022, reflecting a slight decrease from the 1171 injuries reported in 2021. The persistent high number of injuries raises significant concerns not only for mine safety but also for its impact on operator-driven productivity.

Fatigue stands out as a predominant cause of injuries, with the DMRE's guidelines for risk-based fatigue management emphasising its multifaceted origins, including work time arrangements, poor ergonomics, environmental and work-related factors, and personal factors like insufficient sleep, health, nutrition, and lifestyle choices. Recognising the intertwining of these risk-based factors with individual lifestyle choices is crucial, as addressing them becomes imperative for enhancing safety measures and mitigating adverse outcomes associated with neglecting the human dimension in mining operations.

Beyond injuries, several contributors have substantial implications for operator-driven productivity in mining operations. These contributors encompass inadequate training, equipment malfunctions, communication breakdowns, lack of safety protocols, environmental hazards, human error, inadequate ergonomics, challenges related to shift work, psychosocial factors, and inadequate risk assessments. This report will delve deeper into these contributors, examining their direct and indirect impacts on operator productivity and proposing comprehensive strategies to mitigate risks and cultivate a safer, more productive mining environment

OUR METHODOLOGY

Our Methodology

During our research at a global mine, we observed both iron ore truck operators as well as remote drilling operators, some of whom had migrated from manual drilling to remote drilling. The study employed a combination of direct field observations, interviews, and data analysis to gather comprehensive insights.

Data Collection

Conducted Semi-structured interviews with drill operators

Assessment into the ergonomic challenges of operators

Drawing cause and consequence

Data Analysis

Conducted observational study with truck operators

Synthesise operator study and interview findings

Our Methodology

Our Methodology

Truck operator

While studying the job of iron ore truck operators, we took a close look at how well they performed their tasks. This involved understanding how they handle heavy machinery, carry out loading and unloading processes, and navigate through different types of mine terrain. This investigative approach sought to capture a nuanced understanding of the operators' execution of their responsibilities within the complex operational context of the mining environment.

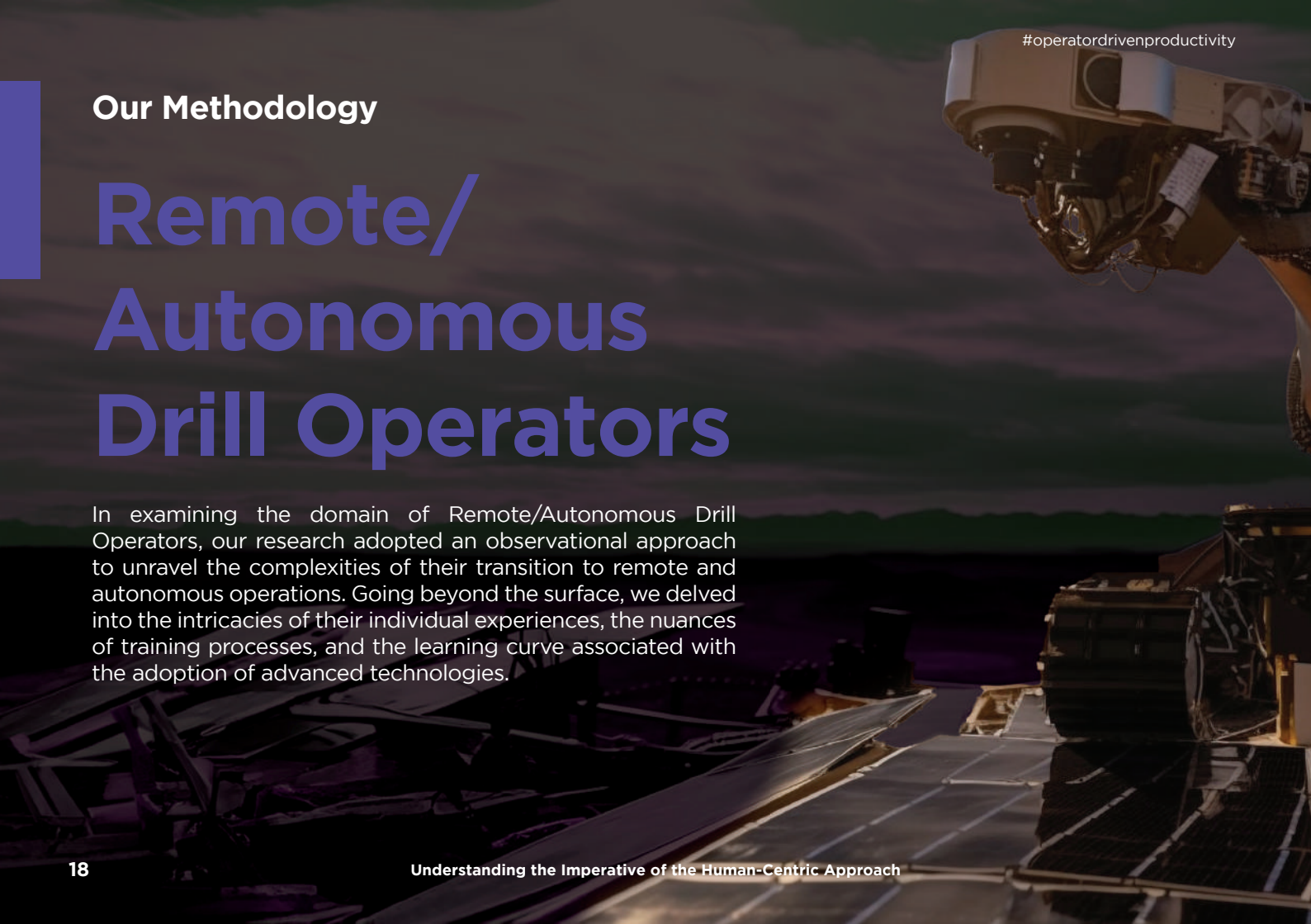
Moreover, the observation extended beyond mere task execution to encompass an evaluation of the physical strain endured by operators during prolonged work hours. This facet of the examination aimed to clarify the impact of extended labour on the operators' well-being.

In a parallel vein, the assessment delved into the ergonomic challenges encountered within the cabin, recognising the significance of operator comfort and safety within the confined workspace. Furthermore, the research explored the intricate dynamics of communication, both among operators and in their interactions with mine personnel.

Our Methodology

Remote/ Autonomous Drill Operators

In examining the domain of Remote/Autonomous Drill Operators, our research adopted an observational approach to unravel the complexities of their transition to remote and autonomous operations. Going beyond the surface, we delved into the intricacies of their individual experiences, the nuances of training processes, and the learning curve associated with the adoption of advanced technologies.



Our Methodology

We delved into task monitoring through remote interfaces, decision-making processes guided by real-time data, and the intricacies of the human-machine interface, evaluating user experiences with control interfaces and the responsiveness of feedback mechanisms.

OBSERVATION OF A MINING OPERATOR

Functions of a Drill operator

Functions of a Drill operator

In the intricate realm of mining operations, drill operators play a pivotal role, executing critical functions that are fundamental to the mine's efficiency and safety. Understanding the nuanced nature of these functions is paramount for evaluating the cognitive and physical demands placed on drill operators during their operational endeavours. These functions shed light on their significance in the broader context of mining activities.

Functions of a Drill operator

Sensing, Storage, and Information Processing

Sensory Aspects

Drill operators engage their senses—seeing, hearing, and feeling—to navigate the intricate environment of mining operations. The visual acuity required for assessing geological formations, the auditory alertness for detecting equipment sounds, and the tactile sensitivity for interacting with machinery collectively form sensory interactions crucial to their role.

Memory Requirements

Memory, both procedural and contextual, is a necessity in the drill operator's repository. From recalling intricate procedural steps in operating machinery to retaining crucial contextual information about the mining site, the memory demands on drill operators are extensive and varied.

Cognitive Processes

Information processing stands at the heart of a drill operator's cognitive engagement. Analysing complex data, deciphering patterns in geological formations, and making split-second decisions require a cognitive prowess that is finely tuned to the demands of the mining environment.

Functions of a Drill operator

Contribution of basic education to maturing these functions

Decision-Making Process

Basic education serves as a fundamental cornerstone for individuals engaged in critical roles, such as drill operators in the mining industry. It lays the groundwork for essential cognitive skills, analytical thinking, and problem-solving abilities. As individuals receive a basic education, they develop a robust foundation that enables them to effectively assess geological data, interpret sensor feedback, and formulate strategic drilling approaches. Basic education acts as the scaffolding upon which more advanced decision-making skills can be built, providing a crucial starting point for navigating the intricacies of the mining environment.

Execution of Actions

The execution of actions, likewise, hinges on the foundation of basic education. As individuals acquire basic education, they cultivate the necessary cognitive and physical capabilities required for roles such as drill operators. Basic education imparts the skills needed to control drilling equipment with precision, execute physical movements accurately, and communicate vital information clearly. This foundational education lays the groundwork for technical proficiency and effective communication, essential components for successful execution in the dynamic and demanding field of mining. In essence, basic education serves as the bedrock upon which individuals can build expertise, fostering the capacity to execute actions with competence and confidence in mining operations.

HUMAN ERROR

Understanding the Imperative of the Human-Centric Approach

Human Error

Despite technological advancements and stringent safety protocols in mining operations, human error persists as a potential consequence of compromised or incomplete execution of essential functions. Recognising and categorising human errors become imperative in the pursuit of bolstering safety measures and optimising operational outcomes.

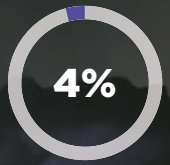
This section explores the different types of human errors observed in mining, each stemming from the failure or compromise of specific functions, each with its distinct characteristics and implications. Fatigue, a common factor contributing to human error, can manifest in various ways, adversely affecting cognitive and physical capabilities, thus warranting a closer examination in the context of mining safety and performance optimisation.

Human Error (%) Occurrence

Information processing

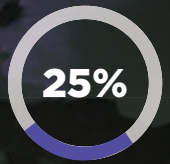
Failure to recognise a perceived warning

Issues with information processing may result in errors in recognising the significance of a warning, hindering the operator's ability to interpret the gravity of potential hazards.



Underestimation of hazard

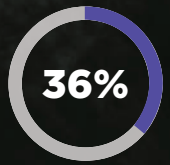
Information processing errors can contribute to the underestimation of hazard severity, often rooted in misjudgement. This miscalculation may lead to insufficient precautions being taken.



Sensing

Failure to perceive warning

If the sensing function is compromised, operators may miss crucial warnings due to sensory limitations or distractions, leading to an initial failure in recognising potential hazards.

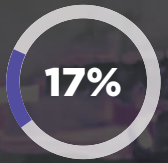


Human Error (%) Occurrence

Decision making

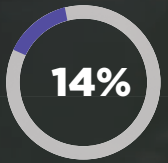
Failure to respond to a recognised warning

Decision-making errors can occur when operators, despite recognising a potential hazard, fail to make appropriate decisions or take necessary actions to mitigate the identified risk.



Responded to warning but ineffectively

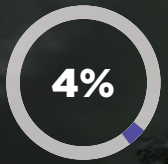
Decision-making and execution errors may transpire if the response to a warning is not executed effectively. Ineffectual responses can worsen the situation rather than addressing the issue.

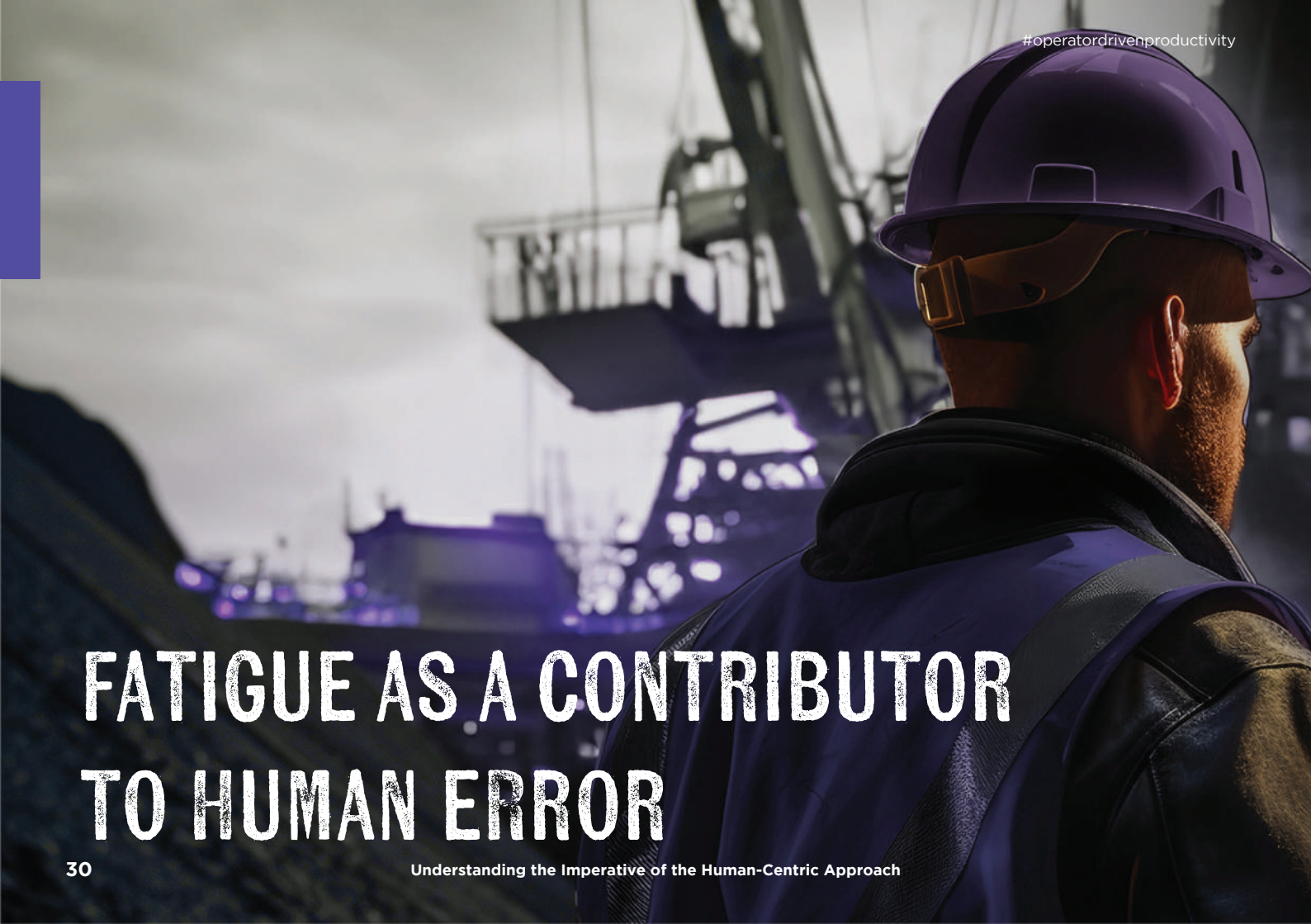


Execution of actions

Inappropriate secondary warning

Execution errors can manifest in generating inappropriate secondary warnings in an attempt to rectify an initial mistake. This may lead to confusion, unnecessary disruptions, or a misguided focus on less critical aspects of the operation.





FATIGUE AS A CONTRIBUTOR TO HUMAN ERROR

Understanding the Imperative of the Human-Centric Approach

Fatigue as a Contributor to Human Error

Fatigue, characterised by a state of weariness or exhaustion, poses a formidable challenge to optimal human performance in mining. This section explores the multifaceted nature of fatigue, recognising its diverse origins encompassing social, physiological, cognitive, and psychological factors.

Fatigue as a Contributor to Human Error

Social

Work time arrangements, including long shifts and extended commutes, significantly influence fatigue.
Social dynamics within the work environment, encompassing team interactions and communication patterns, impact overall well-being.

Physiological

The physical demands of mining, characterised by high workloads and exposure to temperature extremes, contribute to physiological fatigue.
Excessive noise, common in mining environments with multiple alarms, further strains the body, contributing to fatigue.

Cognitive

Cognitive fatigue manifests when mental processes, involved in decision-making, information processing, and attentional demands, become overtaxed.
The intricate nature of the work contributes to cognitive fatigue, potentially compromising performance.

Psychological

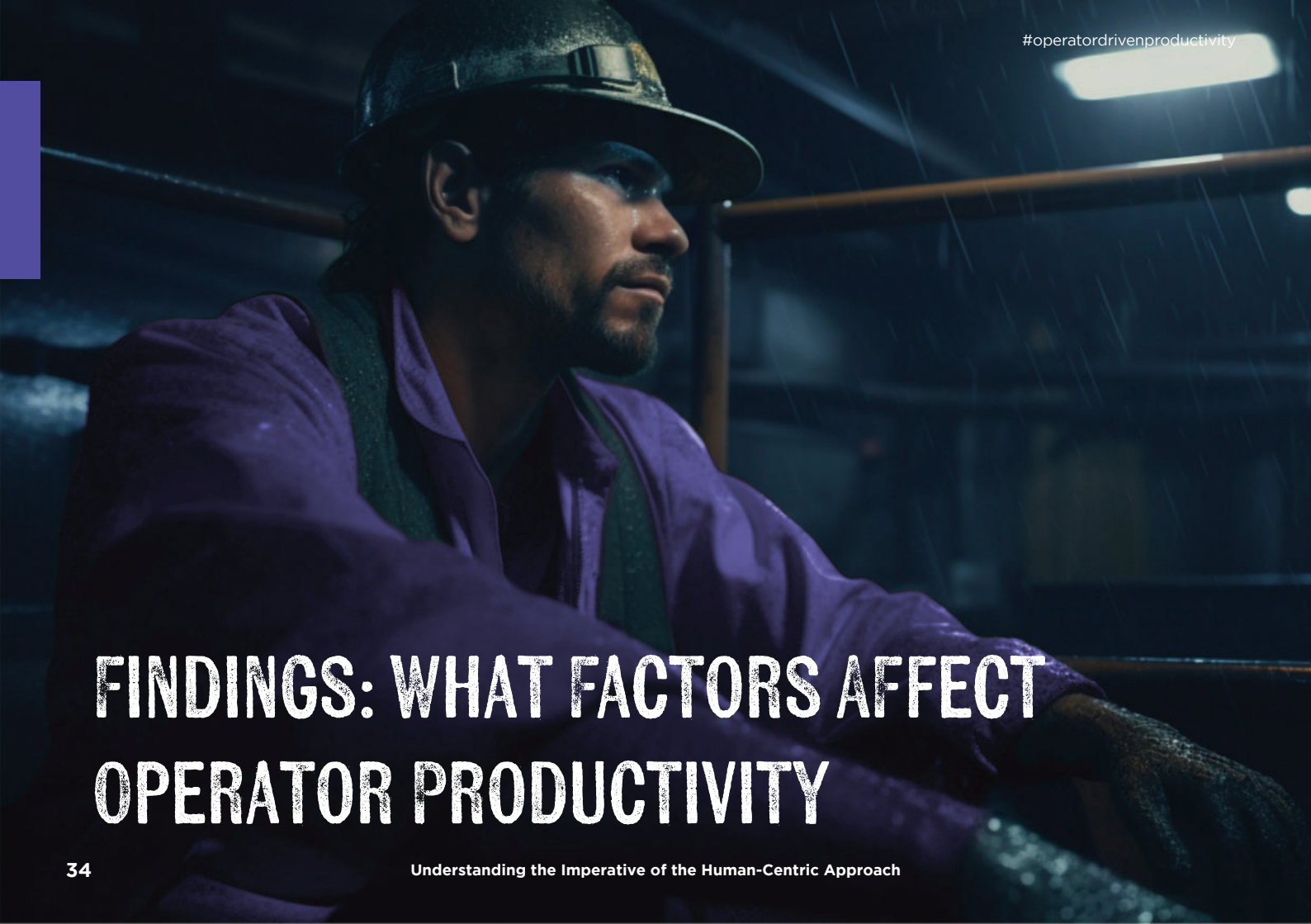
Work-related stress and poor ergonomic design of workstations and equipment play a significant role in inducing fatigue.
Mental strain from the mining environment affects psychological well-being, influencing overall fatigue levels.

Fatigue as a Contributor to Human Error

The interplay of social, physiological, cognitive, and psychological factors gives rise to fatigue, resulting in diminished alertness, compromised decision-making, and an increased risk of accidents.

Contributions to Human Error

Traditionally, mining is considered a high-risk industry, but advancements in technology and safety have led to noticeable decreases in incident and injury rates. However, the Human Factors (HFs) associated with operation and maintenance must be addressed to further enhance safety. Human Error (HE) is present in mining and mineral industry operations, influencing the safety, success and effectiveness of tasks. The impact of HFs and HEs, falling into categories like safety and ergonomic risks, injuries, accidents, mining equipment, automation, and new technologies, as well as mineral processing plants, underscores the complexity of addressing fatigue as a contributor to human error in the mining industry.



FINDINGS: WHAT FACTORS AFFECT OPERATOR PRODUCTIVITY

Findings: What Factors Affect Operator Productivity

The section focuses on work-related and non-work-related factors that contribute to operator productivity among drill operators in mining operations with a focus on fatigue as one of the factors affecting operator productivity.

Findings: What Factors Affect Operator Productivity

Work-Related Fatigue Factors

Work Time Arrangements

Findings reveal that extended work shifts and prolonged commutes to work significantly contribute to fatigue among drill operators. The cumulative effect of extended hours without adequate rest negatively impacts both physiological and cognitive performance. Operators work from 06:00 till 21:00 per day including travel time to and from work additionally operators rarely take breaks other than bathroom or smoke breaks.

High Physical Workloads

The study identifies a correlation between high physical workloads and increased fatigue levels. Engaging in physically demanding tasks over prolonged periods leads to muscle fatigue and a decline in overall alertness.

Temperature Extremes

In the Northern Cape, where the weather is typical of desert and semi-desert areas with large dry regions, fluctuating temperatures, and varying topographies, operators face challenging conditions. The physiological strain of temperature variations further accentuates the impact of fatigue. Working in such environments, characterised by temperature extremes, whether excessively hot or cold, has been identified as a contributing factor to operator fatigue. The annual rainfall in the region is sparse, ranging from only 50 to 400mm per annum. In summer, afternoon temperatures usually range from 34 to 40º C.

Findings: What Factors Affect Operator Productivity

Excessive Noise (Multiple Alarms)

The presence of excessive noise, particularly from multiple alarms, has been identified as a significant contributor to cognitive fatigue. Truck operators have multiple alarms for proximity, fatigue and distraction that constantly sound. Constant exposure to loud and disruptive sounds in the mining environment adds an additional layer of stress and exhaustion.

Work Stress

Work-related stress emerges as a prominent factor influencing fatigue levels among drill operators. The pressure associated with meeting production targets, coupled with the dynamic nature of mining operations, contributes to heightened stress and subsequent fatigue.

Poor Ergonomic Design of Workstations & Equipment

Findings suggest that the ergonomic design of workstations and equipment plays a crucial role in fatigue. Poorly designed work environments contribute to physical strain and discomfort, contributing to operator fatigue over time. For truck operators their cabins screen displays are positioned directly in the operator's line of sight to leading the need for excessive head movement, the operator cabins do not entirely follow the principle of "most frequent use" where items that are used the most and are essential to operating the truck are the closest while other controls, screens or switches are further away.

Findings: What Factors Affect Operator Productivity

Non-Work-Related Fatigue Factors

Undiagnosed Conditions

Undiagnosed medical conditions, such as sleeping disorders, chronic fatigue syndromes, tuberculosis, chronic pain, heart problems, and HIV, have been identified as non-work-related factors contributing to operator fatigue. Unaddressed health issues significantly impact overall well-being and performance.

Living Conditions (Housing, Nutrition, Alcohol Abuse)

Suboptimal living conditions, including inadequate housing, poor nutrition, and alcohol abuse, have been found to correlate with increased fatigue levels. Lifestyle factors outside the workplace play a crucial role in influencing overall operator health and fatigue. Additionally, operators living in the mine-provided hostels are not allowed to stay with their partners as male and female residents are separated thus many miners would prefer alternative accommodations like informal accommodations like “Shacks” to stay with their families.

Findings: What Factors Affect Operator Productivity

Lack of Exercise

A sedentary lifestyle, marked by a lack of regular exercise, is associated with heightened fatigue levels among drill operators. Physical inactivity contributes to a decline in overall fitness and resilience against fatigue.

Certain Medications

The use of certain medications has been identified as a non-work-related factor influencing operator fatigue. Understanding the impact of medication on alertness and performance is crucial for mitigating potential side effects.

Human Factors of Operators

Human Factors of Operators

HOW SOCIAL, PHYSIOLOGICAL, COGNITIVE, AND PSYCHOLOGICAL CONTRIBUTE TO PRODUCTIVITY

Human Factors of Operators

Social Factors

In the mining industry, the interaction between manual truck operators and autonomous drill operators is shaped by social factors. Operators often come from lower-income communities, impacting their home life and overall well-being. Irregular working hours for manual operators affect family dynamics, health habits, and work-life balance. Targeted training initiatives are crucial to address evolving skill requirements for manual operators and ensure a smooth transition for autonomous drill operators dealing with advanced technologies.

Physiological Factors

Manual truck operators face substantial physical demands, including prolonged sitting, manual handling of heavy machinery, and exposure to environmental conditions. Physiological factors such as fatigue, musculoskeletal strain, and injury risks are inherent in their roles. Autonomous drill operators, on the other hand, experience a shift in demands, focusing on prolonged concentration on digital interfaces. Understanding the impacts of extended screen time and sedentary work on their well-being is crucial for optimisation.

Human Factors of Operators

Cognitive Factors

Cognitive factors play a significant role in the performance of both manual truck operators and autonomous drill operators. Manual operators require spatial awareness, decision-making skills, and the ability to navigate complex terrains. Cognitive demands increase in challenging conditions. Autonomous drill operators engage in tasks requiring high-level cognitive functions, such as monitoring real-time data and troubleshooting. Understanding the cognitive load of each role is essential for effective training and task optimisation.

Psychological Factors

Psychological well-being is vital for job satisfaction and performance. Manual truck operators may find satisfaction in hands-on tasks but face stressors related to physical demands and safety hazards. Autonomous drill operators, despite reduced physical risk, may encounter stressors related to overseeing automated systems and potential technical glitches. Addressing psychological aspects, including stressors and motivators, is essential for fostering a supportive work environment.

RECOMMENDATIONS TO MINES

Recommendations to Mines

- Navigating the Digital Shift in Mining: Balancing Original and New Task Demands
- Enhancing Productivity through Human Factors Optimisation
- Fatigue as a contributor to human performance
- COOi's guide to Inclusive and Resilient Design: Prioritising the Operator's Perspective

Navigating the Digital Shift in Mining: Balancing Original and New Task Demands

1. Understand the Autonomous Landscape

Familiarize yourself with the growing trend of autonomous drilling systems in the mining industry. Explore recent statistics indicating increased adoption, especially in the deployment of autonomous drilling rigs.

2.Transform Operator Roles

Recognize the evolving role of drill operators, moving from manual to automated operations. Embrace the shift towards responsibilities focused on remote monitoring, data interpretation, and troubleshooting automated systems.

3. Adapt to New Requirements

Acknowledge the additional burdens and requirements placed on drill operators in the transition. Adapt to the displacement of traditional sensory functions with an emphasis on handling heightened information processing demands.

Navigating the Digital Shift in Mining:
Balancing Original and New Task Demands

4. Address Environmental Impact

Consider the broader impact on the operator's work environment beyond operational adjustments. Understand the fundamental alterations in sensory experiences and how they influence the operator's interaction with the drilling system.

5. Prioritise Education and Training

Recognize the imperative need for education and training programs to facilitate a smooth transition. Equip the workforce with the necessary skills to navigate the nuances of autonomous technologies, ensuring a comprehensive understanding of the best fit for an autonomous operator.

ENHANCING PRODUCTIVITY THROUGH HUMAN FACTORS OPTIMISATION

Enhancing Productivity through Human Factors Optimisation

Enhancing Productivity through Human Factors Optimisation

Human Factors for Workplace Productivity

A strategic emphasis on human factors within the workplace extends beyond mere investment in employee well-being; it serves as a direct pathway to heightened productivity. The fundamental premise that better humans lead to better work underscores the profound impact that considerations such as ergonomic design, cognitive workload management, and psychological support can have on overall job performance. Organisations that prioritise the optimisation of work environments, accommodating the physical and mental needs of their workforce, cultivate an atmosphere where individuals can operate at their best.

Training for Resilient, Productive Teams

Comprehensive training programs further empower employees to master tasks efficiently and make informed decisions. A workplace that acknowledges and addresses the cognitive, physiological, and psychological aspects of its workforce lays the foundation for a more resilient, engaged, and productive team. The synergy between a focus on human factors and heightened productivity not only improves the quality of work output but also establishes a positive feedback loop, fostering employee satisfaction, retention, and ultimately, the long-term success of the organisation.

Enhancing Productivity through Human Factors Optimisation

Integrating Home and Workplace for Operator Well-Being

To enhance operator well-being and productivity, it is essential to integrate considerations from both home and workplace factors. At home, regular assessments of operators can identify potential health issues, with periodic health tracking through wearables monitoring vital signs such as heart rate. Educational programs on the impact of nutrition, alcohol, and abuse on productivity contribute to operator well-being, along with the encouragement of regular exercise and the implementation of competitive sports initiatives to promote physical activity.

Optimising Workplace for Operator Performance

In the workplace, factors such as work time and noise play crucial roles. Consideration of shortened shifts and the introduction of more continuous breaks in alternative environments allow for adequate restoration and downtime. Addressing excessive noise involves ensuring the functionality of noise reduction devices in all trucks and implementing rational alarms during specific activities. Additionally, ergonomic design improvements, such as redesigning the cabin layout to bring frequently used gadgets closer to the driver, optimise accessibility and contribute to overall operator well-being and job performance.

Enhancing Productivity through Human Factors Optimisation

1 Challenging entrepreneurial environment

Globally, entrepreneurs face obstacles in the journey of achieving success in the business world. These obstacles are exacerbated in the African context, as entrepreneurs face barriers in accessing finance, lack of support for innovation, poor infrastructure, and sourcing skilled labour.

2 Intellectual Property constraints

Innovative start-ups face another challenge with South Africa's regulations of intellectual property rights. Commercial exploitation of intellectual property derived from publicly funded research comes with stringent conditions. Support from public institutions, like universities for example, is crucial and the funding into R&D provided to these institutions can act as a catalyst in the innovation process. However, the contrasts of use of publicly funded innovations presents commercialisation challenges for entrepreneurs

Enhancing Productivity through Human Factors Optimisation

3

Limited Venture Capital Funds

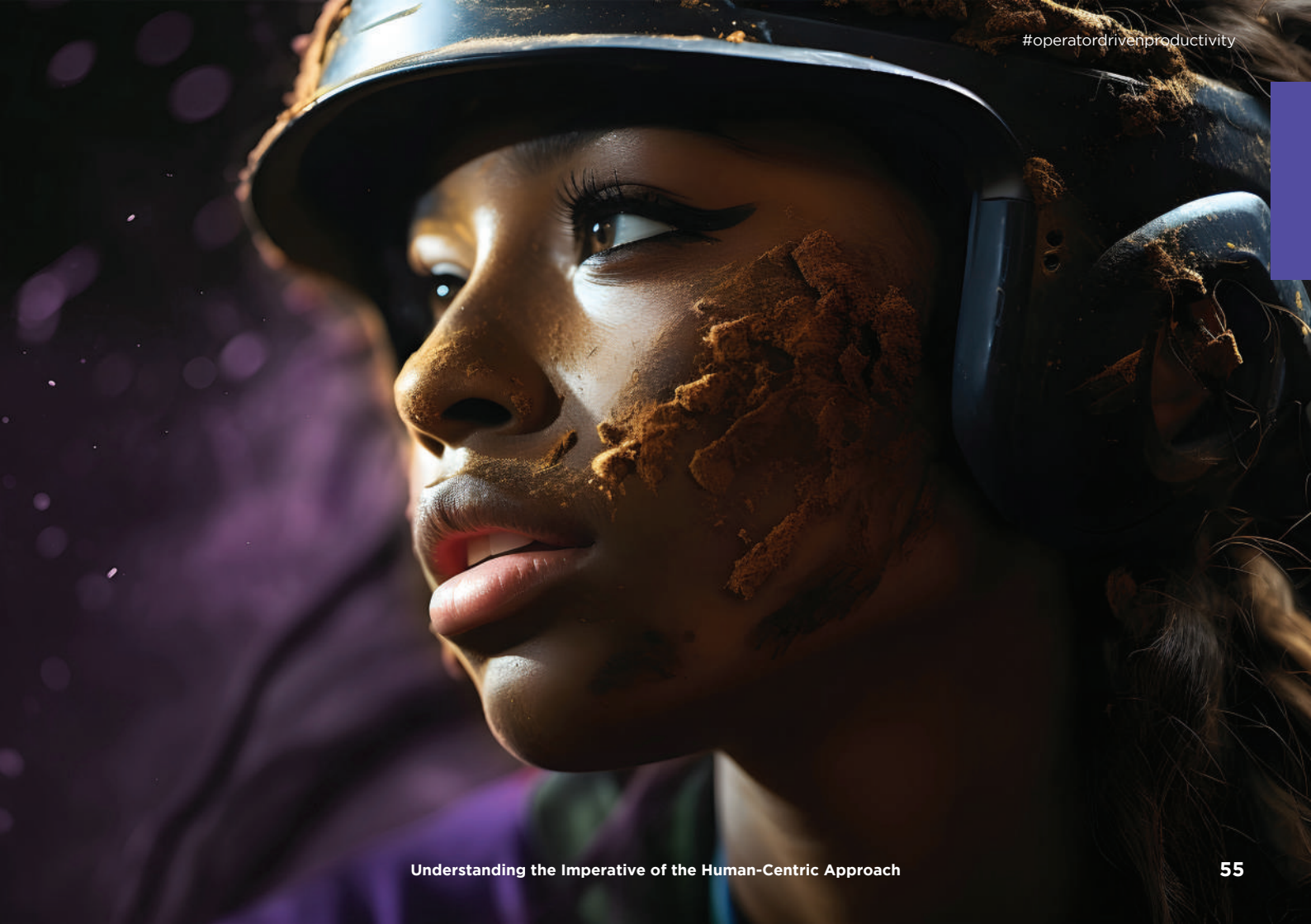
Venture Capital and investment experts at the African Venture Capital Association's conference expressed how South Africa should, ideally, triple the number of venture capital funds operating in the country. As of 2021, Two hundred and two (202) venture capital funds were operating in South Africa across different sectors. Entrepreneurs seeking capital injections for their businesses usually struggle to access capital, especially at the early stages of the business.

4

Lack of suitable Entrepreneurial Skills

South Africa's business landscape requires an advanced skill set from entrepreneurs to overcome challenges and succeed. Opportunities to gather such skills are not easily accessible. In addition to obtaining all suitable skills needed as an entrepreneur, finding skilled labour is often a difficult task.

FATIGUE AS A CONTRIBUTOR TO HUMAN PERFORMANCE



Fatigue as a Contributor to Human Performance

Cognitive

1 Complex decision-making and information processing, and attentional demands lead to cognitive fatigue potentially compromising performance.

- Run individual and team challenges of problem-solving and decision-making
- Encourage the completion of alpha education

Social

2 Influenced by long shifts and extended commutes, social dynamics and communication patterns in the work environment impact overall well-being.

- Promote pre-shift sleep on public transport
- Smaller public vehicle commutes for shorter rides to mines
- Company rewards for good performance linked to health and wellness

Fatigue as a Contributor to Human Performance

Psychological

3 Work-related stress and poor ergonomic design induce fatigue, affecting psychological well-being and overall fatigue levels.

- Improved ergonomics of in-cabin
- Limit technologies to essentials only

Physiological

4 High workloads, extreme temperatures, and excessive noise contribute to physiological fatigue in mining.

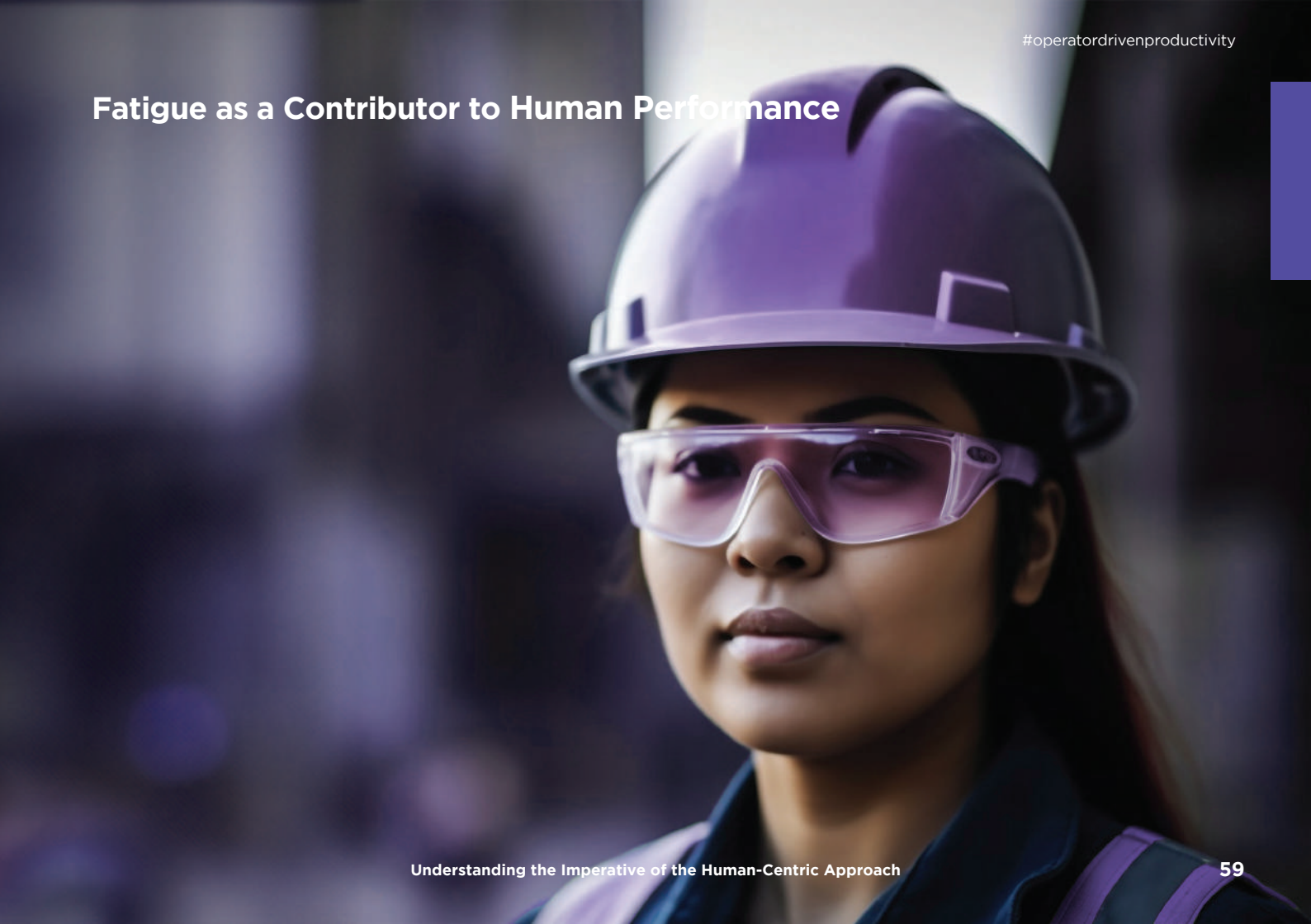
- Synchronise the various alarms (to reduce sirens based on circumstances times of day weather etc
- Enforced stretch breaks and lunch in alternative environments

Fatigue as a Contributor to Human Performance

As the mining industry undergoes a transformative shift towards digitalisation, particularly in the adoption of autonomous drilling systems the findings underscore the necessity for targeted training initiatives, acknowledging the distinct demands placed on operators.

The integration considerations from home and workplace factors becomes paramount, emphasising the importance of ergonomic design, effective communication and comprehensive well-being programs to foster resilient, engaged and productive mining teams.

Fatigue as a Contributor to Human Performance



COOi's guide to Inclusive and Resilient Design:
Prioritising the Operator's Perspective

1. Discover: User-Centric Ethnography
- Engage in ethnographic studies to understand diverse operator needs thoroughly.
- Document workflows, identifying critical tasks that resilient technology must support.

2. Describe: Inclusive and Resilient Design Principles
- Infuse inclusive design principles into technology with a focus on diverse operator abilities.
- Prioritise simplicity and intuitive interfaces, reducingcognitive workload and fostering resilience.

3. Design: Collaborative Innovation
- Involve operators throughout the design process, leveraging insights from diverse perspectives.
- Conduct usability testing to align the final design with various operator mental models.

COOi's guide to Inclusive and Resilient Design:
Prioritising the Operator's Perspective

4. Prototype: Inclusivity and Resilience Assessment
- Perform pre-implementation inclusivity assessments, ensuring technology benefits all operators.
- Employ user feedback loops during the prototype phase to iteratively refine inclusivity features and resilience mechanisms.

5. Test: Piloting and Holistic Evaluation
- Pilot the technology in a controlled environment, gathering real-world data on safety, efficiency, and operator satisfaction.
- Assess inclusivity and resilience during the pilot.
- Utilise comprehensive evaluation results to make informed decisions for further enhancements.

By adopting this comprehensive guide, mining companies can create technology that is both inclusive and resilient, tailored to operators' diverse needs. COOi Studios excels in design with offerings such as ethnographic studies, pilot management, service design, and expertise in design thinking and user experience, ensuring heightened operational efficiency, safety, and an optimal user experience.

Summary

In summary, our extensive research at a global mine unveiled intricate aspects of mining operations, encompassing the roles of iron ore truck and autonomous drill operators, human error classifications, and the challenges affecting operator productivity, the most prevalent being fatigue. The study elucidated the multifaceted functions of drill operators, ranging from sensory interactions to complex cognitive processes and decision-making. Furthermore, it shed light on the various factors contributing to operator fatigue, both work-related and non-work-related. The exploration of human factors, encompassing social, physiological, cognitive, and psychological dimensions, emphasised the evolving landscape for both manual and autonomous operators. As the mining industry undergoes a transformative shift towards digitalisation, particularly in the adoption of autonomous drilling systems, the findings underscore the necessity for targeted training initiatives, acknowledging the distinct demands placed on operators. The integration of considerations from home and workplace factors becomes paramount, emphasising the importance of ergonomic design, effective communication, and comprehensive well-being programs to foster resilient, engaged, and productive mining teams.

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