EXPLORING THE INFLUENCE OF ODOUR HABITUATION ON RISK PERCEPTION AND SAFETY BEHAVIOUR IN RUBBER MANUFACTURING

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UNIVERSITI UTARA MALAYSIA
AUGUST 2025

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Thesis Submitted to
School of Business Management, Universiti Utara Malaysia,
in Partial Fulfilment of the Requirement for the
Master of Science (Occupational Safety and Health Management)

Pusat Pengajian Pengurusan Perniagaan
SCHOOL OF BUSINESS MANAGEMENT
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Abstrak

Bau industri merupakan ciri persekitaran yang ketara dalam sektor pembuatan getah. Walaupun perkara ini lazim, namun kesan pendedahan berpanjangan kepada keselamatan pekerja masih kurang diterokai. Kajian ini bertujuan untuk meneroka kesan pendedahan bau yang berpanjangan, terutamanya tentang bagaimana pelaziman bau mempengaruhi persepsi risiko pekerja dan tingkah laku keselamatan dalam industri pembuatan getah di Malaysia.Walaupun persepsi risiko diiktiraf secara meluas sebagai penentu utama keselamatan tempat kerja, terdapat kajian yang terhad mengenai cara pelaziman bau mempengaruhi penilaian risiko oleh pekerja dari masa ke semasa. Untuk menangani jurang pengetahuan ini, kajian ini menggunakan reka bentuk kajian kes kualitatif untuk meneroka mekanisma yang mendasari dinamik risiko berkaitan bau. Penyiasatan tersebut berpandukan oleh *Risk Perception-Unsafe Behaviour Formation Model* atau Model Pembentukan Pelakuan Tidak Selamat- Persepsi Risko untuk merangka peranan penyusaian deria dalam membentuk tingkah laku keselamatan pekerja.Data dikumpul melalui temu bual separa berstruktur dengan pekerja daripada kedua-dua peranan kerja pendedahan langsung dan tidak langsung, disokong dengan pemerhatian secara terus di fasiliti pembuatan getah. Analisa tematik mendedahkan spektrum pembangunan pelaziman bau yang dipengaruhi oleh pelbagai pemangkin penyesuaian. Pelaziman bau menyumbang kepada pelbagai bias persepsi yang diperkukuh oleh norma sosial dan batasan dalam kawalan organisasi. Penemuan juga menjelaskan jurang tingkah laku, terutamanya apabila bau tidak dikenali secara sedar. Walaupun terdapat cabaran-cabaran ini, pekerja telah mencadangkan penambahbaikan praktikal seperti latihan kesedaran, PPE yang disesuaikan dan amalan keselamatan secara penyertaan atau *'participatory safety'*. Hal ini mencerminkan kesedaran mereka mengenai ketidakcukupan konteksual intervensi tersebut. Berdasarkan dapatan ini, kajian telah mencadangkan strategi kawalan berlapis bagi menangani risiko sistemik dan tingkah laku dalam persekitaran intensif bau.Kajian ini juga membentangkan perspektif lanjutan mengenai pembentukan risiko dengan menyepadukan penyesuaian deria dan dinamik kontekstual. Penemuan ini juga menekankan kepentingan untuk mengadakan intervensi adaptif dalam persekitaran bau yang intensif dan menyediakan asas untuk penyelidikan akan datang dalam situasi persekitaran industri yang sama.

Kata kunci: pelaziman bau, pembuatan getah, penyesuaian deria, persepsi risiko, tingkah laku keselamatan

Abstract

Industrial odours are a distinct environmental feature of rubber manufacturing environment. Despite its prevalence, the impact of prolonged exposure to worker's safety remains underexplored. This study aims to explore the effects of extended odour exposure, particularly on how odour habituation influences worker's risk perception and safety behaviour in Malaysian rubber manufacturing industry. Although risk perception is widely recognised as key determinant of workplace safety, there is limited research regarding how odour habituation affects worker's risk appraisal over time. To address this gap, the study adopted a qualitative single-case study design to explore the mechanisms underlying odour-related risk dynamics. The investigation was guided by the Risk Perception-Unsafe Behaviour Formation Model to frame the role of sensory adaptation in shaping worker's safety behaviour. Data were collected through semi-structured interviews with workers from both direct and indirect exposure roles, supported with direct observations at the rubber manufacturing facility. Thematic analysis revealed a spectrum of habituation development that were influenced by various adaption catalysts. Odour habituation contributed to a range of perceptual biases that were reinforced by social norms and limitations in organizational controls. The findings also highlighted behavioural gaps, particularly when odours were no longer consciously recognised. Despite these challenges, workers proposed practical improvements including awareness training, tailored PPE and participatory safety practices. This reflects their awareness regarding the contextual inadequacy of the interventions. Based on these insights, the study recommended a multi-layered control strategy to address both systemic and behavioural risks in odour-intensive environment. This study presents an extended perspective on risk formation by integrating sensory adaptation and contextual dynamics. The findings also underscore the need for adaptive, perception-informed interventions in odour-intensive environments and provide a foundation for future research across similar industrial environments.

Keywords: odour habituation, rubber manufacturing, sensory adaptation, risk perception, safety behaviour

Acknowledgement

First and foremost, I would like to express my deepest gratitude to Allah SWT because despite multiple hurdles throughout conducting the study, I managed to complete it.

I would like to extend my heartfelt appreciation to my respected supervisors, Dr. Syazwan Syah bin Zulkifly and Dr. Siti Hawa binti Harith for their invaluable guidance, and encouragement throughout the course of this study. Your constructive feedback and detailed explanations have been crucial in shaping this research. I am also thankful to the other academic staff at Universiti Utara Malaysia, for providing the resources and support that have facilitated my study journey.

I would also like to thank my beloved family, especially my mom who has been very understanding, particularly during times I had to prioritise my academic commitments while she was in the hospital. Not to forget, my best friend, Jack O' Lantern, for always offering thoughtful advice regardless of time or circumstance. Their presence has made this journey less overwhelming and more meaningful.

Special thanks to the management and workers of the participating rubber manufacturing facility for their willingness to share their time and insights. This study would not have been possible without their openness and cooperation.

Lastly, to my friends, course mates or journey-mates, also everyone who has offered encouragement, assistance, or simply kind words along the way, thank you for being part of this journey.

I am truly grateful to each person who has contributed, directly or indirectly, to the completion of this study.

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List of Abbreviations

ABC	Antecedent-Behaviour-Consequence
BBS	Behaviour-Based Safety
DEMATEL	Decision Making Trial and Evaluation Laboratory
ERPs	Event-Related Potentials
HOC	Hierarchy of Controls
ICONS	Individual, Contextual, Cognitive, and Social Factors
JD-R	Job Demand-Resources
NIOSH	National Institute of Occupational Safety and Health
SEM	Structural Equation Modelling
SD	System Dynamics
SME	Small and Medium Enterprises
SMR	Standard Malaysian Rubber
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
VR	Virtual Reality
WS-HOC	Work Systems Hierarchy of Control

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Safety behaviour is a critical aspect of safety and health at every workplace setting, especially in manufacturing sector. This is because the manufacturing sector is well known for regular exposure to physical, chemical, ergonomic, and psychological hazards that can contribute to workplace accidents (Lee et al., 2024). Abidin et al. (2021) postulated that the safe behaviour among the workers can significantly minimize such risks in the manufacturing sector. Safety behaviour, which is defined as the worker's actions and active participation in adhering to safety rules and contributing to safety improvements, is shaped by factors such as job characteristics, individual traits and organisational aspects (Grote, 2019). For example, such behaviour may include actions such as adhering to safety guidelines and safe working practices (Ali & Zulkaple, 2023). However, ensuring worker's safety behaviour is challenging due to significant hazards in manufacturing environments, especially in high-risk industries such as rubber manufacturing.

In Malaysia, the rubber manufacturing industry is a vital economic sector, employing a significant workforce and contributing to the nation's exports. As of March 2025, the employment for rubber-based products industry was 102351 workers across rubber production and manufacturing sectors (MRB, 2025). However, the manufacturing industry in Malaysia has seen a worrying trend in workplace safety incidents, which necessitates an investigation into the factors affecting safety behaviour among workers.

This is supported by the recent statistics in Malaysia, which revealed that from January to October 2023, 60 percent of the 6,951 reported workplace accidents occurred in the manufacturing industry (DOSH, 2023). With a substantial portion linked to rubber manufacturing, this highlights the importance of safety practice in the industry.

The nature of rubber manufacturing is considered as high risk due to the imminent hazards associated with its process. The rubber workers faced hazards such as chemical, physical and psychological hazards that can lead to occupational health issues. According to Valeeva et al. (2020), workers in rubber manufacturing are exposed to serious health risks from hazardous chemicals like benzene and dichloromethane, challenging work environment such as high noise levels, and physical exertion. Among these risks, exposure to industrial odours related to rubber manufacturing in particular poses a serious threat to the workers due to potential long-term effects (Zhang et al., 2025). This is because the manufacturing process relies heavily on chemicals that emit persistent, strong odours that are not only offensive, but it can pose health risk to workers if they were exposed to it in high concentration. For example, N-butyraldehyde that is used in both natural and synthetic rubber production is considered as highly irritating (Zhang et al., 2024). This is supported by findings from Guadalupe-Fernandez et al. (2021) which suggested that exposure to industrial odours will significantly impact the health and well-being of people by deteriorating their physical state with symptoms like headaches, cough, and nausea.

There are different kind of roles and type of works within rubber manufacturing industry, and it will be associated with different levels of exposure to industrial odours and hazards. For example, production workers will be exposed to higher concentrations of chemicals and odour during physical handling in manufacturing processes. This is aligned with findings from DeBono et al. (2020) who found that workers that are involved in physical processing such as during mixing, blending, bonding, and labouring are more susceptible to develop health symptoms from exposure to rubber fume. In other way, those who is not exposed to rubber directly may experience limited exposure. Another thing to consider is that the difference of exposure to the industrial odour will lead to varied perspectives on risk and safety behaviour across roles; those working in production may be more prone to desensitization as compared to management. This discrepancy made it important to understand the role-based differences so that safety considerations can cater for the specific needs of each group.

Besides, those rubber workers that work for extended time will have a prolonged exposure to industrial odours, and this can lead to a desensitization process known as odour habituation. This is explained by Fontana et al. (2023) which highlighted that repeated exposure to odours can modify olfactory perception which then led to olfactory habituation which is characterised by a reduced behavioural response to continuous odour stimulation. While Kim et al. (2021) explained how repeated exposure to hazards at workplace can lead to worker having habituation to these risks, increasing the likelihood of workplace accidents. In other words, habituation contribute to unsafe behaviours due to impaired risk perception. In the context of rubber manufacturing, workers may become habituated to the odour produced during the

production process. This odour habituation can cause underestimation of the presence of potentially hazardous industrial odour, due to familiarity. This is also considered as a biased risk perception.

Risk perception is considered as a major determinant of safety at workplace because it influences how workers behave in response to potential hazards. According to Putranti et al. (2023), worker's risk perception shapes their safety behaviour, while influencing the likelihood of accidents at the workplace. Therefore, insights on how risk perception influences safety behaviour would be useful in safety risk management. But there is lack of research exploring the cause of biased risk perceptions that contributed to unsafe actions among workers (Qiu et al., 2024). This further emphasizes the need for exploring the factors that influence a risk perception and its connection to unsafe behaviour so that better interventions can be put in place to address these issues.

It is important to address biased risk perception because it can distort the worker's capacity of decision-making and increased worker's exposure to hazards. This is why correction of this biased perception through targeted control measures are very important. One of the examples for correcting this issue is through cognitive approaches like training sessions that are focused on risk awareness and recalibrating workers' perceptions of hazards. For example, Kim et al. (2023) demonstrated the use of virtual simulation for such purposes. The benefits of such interventions are also highlighted in Hunziker (2019), where the author emphasized that training programs aimed at educating workers about common cognitive biases can help to improve their ability to recognize and correct any distortions. Since an effective control measure will be useful

in managing distorted risk perception, this highlights the importance of assessing and evaluating the adequacy of existing control measures available in rubber manufacturing industry so that safety behaviours can be ensured.

Since rubber manufacturing revolves around hazards such as exposure to the strong industrial odours, it is important to understand the potential impact it can have on the workers. This is why in this study, the behavioural impact of continuous exposure to industrial odour, specifically regarding how odour habituation influences risk perception and the worker's safety behaviour was explored. This research focused on bridging the gap in understanding the cognitive determinants in safety behaviour such as biased risk perceptions. More specifically, the study aimed to explore how odour habituation differs across exposure groups and how it subsequently affects worker's safety behaviour through the analytical lens of Risk Perception-Unsafe Behaviour Formation Model. To address this, the research was conducted at a rubber manufacturing facility with persistent odour-related complaints from the surrounding communities and the workers.

1.2 Problem Statement

The key problem that this study addressed is the impact of odour habituation on risk perception and safety behaviour among workers in rubber manufacturing, a sector characterized by high exposure to many occupational hazards. This concept is critical in the rubber manufacturing industry due to the frequent exposure to hazardous chemicals, machinery, and industrial odours. As previously mentioned, the

manufacturing sector contributed to a significantly large portion of the reported workplace accidents in Malaysia. According to the statistics from MITI (2023), a substantial portion of the cases were attributed to rubber manufacturing, due to its economic significance and high workforce numbers. However, there is lack of data that specifically addresses occupational accidents or diseases linked to industrial odour within this industry. This gap is concerning as the industry was proven as one of the major contributors of odour emissions, releasing various toxic compounds that poses significant risk to the workers during manufacturing processes (Zhang et al., 2025).

Despite of the known risk, Zhang et al. (2025) pointed that the impacts associated to odours from rubber manufacturing process remain to be underexplored and often overlooked in most existing research. A documented case highlighted the odour-related issues from rubber manufacturing industry in Malaysia. For instance, in 2024, a rubber processing factory in Sungai Petani, Kedah was penalized due to public complaints about strong, unpleasant odours that were traced back to the production of Standard Malaysia Rubber (SMR) at its facility ("Rubber Factory to Clean up Act Due to Stink," 2024). This case highlighted how the industrial odours associated with rubber manufacturing has affected surrounding communities, and how it may pose risks to the workers that were exposed to the odours over time. Therefore, the phenomenon of industrial odour exposure in rubber manufacturing calls for an in-depth investigation into its potential impacts on the worker's safety and health.

One crucial aspect to explore is regarding the factors that influence worker's safety behaviour. According to Muduli and Sinha (2021), most workplace accidents are associated with workers' behaviour, so it's important to delve into the underlying causes of those unsafe actions. In rubber manufacturing, one of the concerns is regarding odour habituation, where workers gradually become desensitized to persistent industrial odours which can distort their risk perception. Existing literatures demonstrated that prolonged exposure to strong odours can lead to olfactory habituation or desensitization (Fontana et al., 2023; Kim et al., 2020; Li et al., 2023). This desensitization effect extends to risk perception, as workers may begin to underestimate the severity of potential hazards, increasing the likelihood of unsafe behaviours. The effect of habituation on risk perception that can diminish worker's situational awareness is explained by Guadalupe-Fernandez et al. (2021). However, up to date, there is limited study that addresses this issue, especially in context of Malaysian rubber manufacturing industry. This signify that there is insufficient empirical research regarding the relationship of odour habituation to risk perception biases and safety behaviour of workers, which suggested a significant evidence gap.

Despite these evident risks, there are notable knowledge gap in current research exploring the relationship between odour habituation, risk perception, and safety behaviour. Existing studies on the impact of industrial odours have been conducted but it is only focused on the public exposure (Guadalupe-Fernandez et al., 2021; Hassan, 2023; Li et al., 2023; Piccardo et al., 2022), particularly regarding health concerns. However, these studies only focused on the health impacts of the industrial odour to general public and not specified to the manufacturing workers where exposure is more

frequent and intense. This highlights how there is lack of research that considers habituation as a potential implication from prolonged exposure to the industrial odour involving the workers.

While in the context of occupational safety, most previous research tends to focus broadly on risk perception's impact on safety (García-Mainar & Montuenga, 2024; Handoko et al., 2022; Hannani et al., 2023; Madaleno & Sousa-Uva, 2021; Putranti et al., 2023; Saedi et al., 2024). However, only few studies go in deep to understand the potential factors affecting risk perception (Huang et al., 2019; Qiu et al., 2024; Xia et al., 2020). Notably, the specific cognitive effects of habituation, especially to industrial odours and how it may affect occupational safety remained underexplored. This oversight highlights a critical knowledge gap in understanding how odour desensitization influences risk perception and safety behaviour. Although some research has explored for interventions that account for habituation in safety management (Kim et al., 2021, 2023; Lee & Kim, 2022), there are lack of research that specifically addresses odour habituation in workplace. This gap in research highlights how most occupational safety practices often undermine the role of sensory desensitization as a form of habituation that can impact worker's hazard recognition and risk awareness.

Besides, there is also a methodological gap as many studies regarding safety behaviour mostly employed quantitative method (e, g., Putranti et al., 2023; Saedi et al., 2024; Zhao et al., 2021) that provided a measurable outcome. However, such studies lack in-depth data that is required to understand an underexplored phenomenon such as odour

habituation. As a result, there are lack of qualitative insights such as the workers' subjective experiences which are crucial for us to develop understanding on how odour habituation influences their risk perception. In addition, population gap is also evident in the previous literatures. Most studies have been conducted in construction industry (Chae et al., 2024; Han et al., 2021; Kima et al., 2024; Li et al., 2020; Meng et al., 2021; Muñoz-La Rivera et al., 2021), signifying a limited attention to high-risk sectors like rubber manufacturing, where the unique challenges of prolonged exposure to industrial odours remain unexplored.

Other than methodological and population limitations, the theoretical groundworks of odour habituation research remain underdeveloped. Previous studies did employ theories like Antecedents-Behaviour-Consequences (ABC) Theory (Mazzetti et al., 2020; Muduli and Sinha, 2021) and Job Demand Resources (JD-R) Theory (Derdowski & Mathisen, 2023; Xia et al., 2020) in safety behaviour context. However, there is limited research applying such models to examine how sensory adaptation such as odour habituation can influence safety related decisions in occupational settings. This highlights the theoretical gap that exists in the academia.

In a high-risk industry like rubber manufacturing plant, where vigilance is essential for accident prevention, biased risk perception can be devastating. Biased risk perception and unsafe behaviours will not only increase the risk of workplace accidents but also cause some financial loss to the rubber manufacturing industry. This is caused by potential loss of productivity, medical costs, and potential legal liabilities. Furthermore, such incidents may impact rubber manufacturing workers' morale and can tarnish the

industry's reputation, complicating efforts to attract and retain skilled labour. If left unaddressed, the ongoing risk to worker health and safety could also result in tighter regulatory scrutiny and a loss of public confidence in the industry's commitment to safe working conditions.

However, risk perception is subjective in nature, and there is no specific guideline or benchmark to discuss the true risk perception experienced by the rubber manufacturing workers. In order to gain better understanding on this subjective matter, Risk Perception-Unsafe Behaviour Formation Model was used as an analytical lens. This creates an opportunity to refine or expand existing theories to include sensory adaptation as a critical factor influencing risk perception and safety behaviour. Therefore, this study aims to bridge the existing knowledge gap by examining how odour habituation shapes rubber manufacturing worker's risk perception and, consequently, their safety behaviour. Insights from this research contributed to a more nuanced understanding of workplace safety behaviour, helping to develop targeted safety programs that consider sensory habituation and the individual differences in risk perception among workers.

1.3 Research Questions

The research questions established for this study are as follows:

1. How does the occurrence of odour habituation vary among workers from different odour exposure groups in the rubber manufacturing industry?
2. In what ways does odour habituation influence workers' biases in perceiving the risks associated with industrial odours in the rubber manufacturing industry?
3. How does risk perception influences worker's safety behaviour in the rubber manufacturing industry, as outlined in Risk Perception-Unsafe Behaviour Formation Model?
4. What kind of control measures have been implemented to enhance workers' awareness of risks associated with industrial odours, despite habituation?

1.4 Research Objectives

Based on the research questions outlined above, the following research objectives have been established for this study:

1. To explore how the occurrence of odour habituation varies among workers from different odour exposure groups in the rubber manufacturing industry.
2. To explore the impact of odour habituation on workers' risk perception biases in the rubber manufacturing industry.
3. To explore the role of risk perception in influencing worker's safety behaviour with reference to Risk Perception-Unsafe Behaviour Formation Model.

4. To identify and recommend control measures for improving safety practices that address effects of habituation.

1.5 Significance of the Study

This section outlines the key outcomes of this study, highlighting the practical, empirical and theoretical significance in the context of occupational safety, particularly in rubber manufacturing industry.

1.5.1 Practical Contributions

This outcome of this study contributed various practical insights by examining how odour habituation affects worker's risk perception and their safety behaviour. For rubber manufacturing companies, the findings provided actionable insights for mitigating odour-related risks including interventions to address sensory habituation and its implications. At the industry level, this research could act as a benchmark to build cognizance on the impact of odour habituation on safety behaviour in other suitable settings. Due to the nature of industrial odour, the findings of this study may also be used to inform guidelines for imposing stricter controls in workplace prone to odour emissions so that associated hazards can be minimized. Beyond immediate application, the research also contributed to the occupational safety knowledge by establishing a groundwork for studying other sensory adaptations in the workplace. While not directly used for informing policies, the research could initiate discussions about incorporating sensory habituation in root cause analyses of workplace accidents.

1.5.2 Empirical and Theoretical Contributions

Empirically, this study filled a gap in the existing literature on occupational safety within the context of Malaysian rubber manufacturing industry, where limited research has explored the relationship between odour habituation and safety behaviour. By examining variables such as odour habituation and risk perception, this study contributed novel empirical data to the body of knowledge on occupational safety and health. This information is valuable not only for researchers focusing on industrial safety but also for industrial psychologists, health experts, and policymakers aiming to understand factors that impact safety compliance among industrial workers exposed to environmental stressors such as odours. The study's findings may encourage further research into industrial hygiene and behavioural safety in various manufacturing contexts.

By using Risk Perception-Unsafe Behaviour Formation Model as the analytical lens, this research delves deeper into how odour habituation influences risk perception and safety behaviour among employees. While the study provided context-specific insights, its principal theoretical contribution lies in extension of the model to include odour habituation as an antecedent to risk perception. The study also emphasized the interceding role of risk perception in the relationship between odour habituation and safety behaviour, thus providing a framework for understanding how workers may become unsensitised to specific dangers through prolonged exposure to sensory stimuli. This refinement expands the existing theory with new dimensions while supporting the existing knowledge and offers a conceptual foundation for future research to be conducted in similar contexts.

1.6 Scope of the Study

The focus of this study is on developing understanding on how industrial odour habituation affected workers' safety behaviour in the rubber manufacturing industry, with an emphasis on the mediating role of risk perception. The primary objective of this study is to explore how repeated exposure to industrial odours affects workers' awareness and responses to safety risks. Key variables in this study include odour habituation, workers' roles, and existing control measures, as these factors are likely to shape how employees perceive hazards and respond to safety protocols. Risk perception plays an interceding role linking odour habituation to safety behaviour by influencing workers' awareness and responses to potential risks. While safety behaviour itself, acts as the central outcome of the study.

To achieve the objective of this study, a qualitative single-case study design was used. This approach allowed for an in-depth understanding of habituation, risk perception and safety behaviour manifests in an environment known for odour nuisance. One-on-one semi-structured interviews were conducted with the group of workers from the selected rubber manufacturing company (Company A). This allowed for a more thorough discussions with the respondents through open-ended response. A total of 8 participants were selected from several roles with varying levels of exposure to industrial odour to allow for more range of perspectives on their experience and safety practices. Through interviews and direct observations, this study explored how workers perceive industrial odours, assess associated risks, and follow safety practices.

1.7 Definition of Key Terms

In this study, several key words associated to both independent and dependent variables are important to be understood as a basis of the entire research framework which are described as follows.

Odor habituation: According to Kim et al. (2020), odour habituation is a phenomenon that occurs as a result of repeated exposure to an odour, and which leads to a reduced response to the odour. This is also considered as a sensory adaptation, which can lead to a reduced perception of the presence or intensity of odours.

Exposure Group: In the rubber manufacturing industry, role that each individual worker holds in the factory may influence their level of exposure to odours which present various security risks, depending on the tasks performed and the proximity to chemical processes. According to Dick (2023), workers responsible in production of rubber products will be involved in various processes such as mixing, milling, vulcanizing, and finishing. Workers with such job responsibilities are considered to be in the direct exposure group due to the frequent and close proximity to the sources of odour-emitting substances. In contrast, workers in office settings that are physically separated from the odour sources will be indirectly exposed (indirect exposure group). These categorisations of the exposure level are used to explore if there really exists some variation in safety consciousness due to odour habituation.

Risk perception: Inouye (2017) defined risk perception as the ability of an individual to discriminate certain expanse of risk. Risk perception is subjective, and it depends on the cognitive capacity of the individual worker.

Control measures: According to Brown (2020), control measures are barriers that is put into place for controlling risks as it can reduce the severity and likelihood of the potential hazards. In a high-risk workplace like rubber manufacturing industry, control measures are really important in ensuring the worker's safety and health. Effective control measures are important in ensuring that workers are still protected from harms despite habituation to the industrial odour produced in the manufacturing process.

Safety behaviour: Grote (2019) defined safety behaviour as the worker's adherence to safety rules and proactive safety improvements at work while according to Adi et al. (2021), safety behaviour is the actions that reflected their safety compliance and safety participation. In the rubber manufacturing industry that is known with continuous exposure to industrial odours, safe behaviour is crucial in ensuring the well-being of the workers.

1.8 The Organisation of the Study

This chapter or Chapter 1 is the introductory part of this study. This chapter provides an overview of the research, including the background of the study, problem statement, research objectives, research questions, and the significance of the study. The scope of the research and key definitions are also outlined to establish the context for the investigation. This is followed by an extensive review of past research in the next chapter.

Chapter 2 explores into existing literature, focusing on the key variables (safety behaviour, odour habituation and risk perception). The chapter also discusses the mediating role of risk perception and relevant underpinning theories, including the Risk Perception-Unsafe Behaviour Formation Model and Behaviour-Based Safety Theory. Gaps in the literature are identified, justifying the need for this study.

Chapter 3 follows with explanation regarding details regarding the research methodology, including the research framework, hypotheses development, and qualitative design adopted for the study. It also covers operational definitions, variable measurement, data collection methods, sampling strategy, and data analysis techniques, ensuring a rigorous approach to address the research objectives.

Chapter 4 includes the findings of the study, with the analysis of the collected data from the conducted interviews. The findings are organized according to the key themes of the study that includes odour habituation, risk perception and safety behaviours of the workers. It is then followed by discussions of the key findings and the interpretations for each theme.

Chapter 5 concludes the study with summaries of the key findings and the contributions to the field of occupational safety. This chapter highlights the limitations of the study and proposes area of focus for future research to explore on. Practical recommendations are also provided for integrating the study's findings into safety management strategies. The chapter is concluded with the overall conclusion of the research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter focused on past literatures on relevant topics regarding the impact of odour habituation on worker's perception and safety behaviour. This includes the existing studies on key themes like safety concerns in the rubber manufacturing sector, the role of industrial odour and its effects, the concept and implications of odour habituation, and the critical relationship between risk perception and safety behaviour is explored. In addition, this chapter evaluates factors influencing these dynamics and discusses relevant theoretical frameworks to explain the mechanisms driving unsafe behaviours. Through this literature review, relevant gaps are identified, highlighting the significance of addressing odour habituation in rubber manufacturing context.

2.2 Safety Concerns in Rubber Manufacturing Industry

Safety concerns in the rubber manufacturing industry are significant due to the various hazardous conditions that workers encounter daily. As a high-risk environment, rubber manufacturing involves exposure to harmful chemicals, high temperatures, and physical demands, making strict safety protocols essential. Historically, concerns over hazards in the rubber manufacturing industry grew as cases of occupational health issues among workers increased. According to Belickzy and Fajen (2011) Peter Bommarito, the former president of the United Rubber Workers Union, pioneered efforts in highlighting health concerns which in turn helped initiate research on rubber

industry workers in the 1970s and 1980s. His advocacy led to numerous epidemiological studies that examined the health risks associated with rubber manufacturing (Fine & Peters, 1976; Parkes et al., 1982; Peters et al., 1976; Tyroler et al., 1976). Following these studies, National Institute of Occupational Safety and Health (NIOSH) developed the Special Hazard Review on the Rubber Products Manufacturing Industry (93-106) (NIOSH, 1993), underscoring the seriousness of this issue and the need for ongoing assessment and safety improvements in the industry.

The initial trend in research regarding hazards associated with rubber manufacturing focused on the health effects and mortality among rubber workers, particularly caused by cancer (Chamot et al., 2023). International Agency for Research on Cancer (IARC, 2012) has concluded that rubber workers exposed to curing fumes, processing dusts, and industrial talc had increased risks of cancer and respiratory disease. In the following decades, research trends shifted towards understanding the broader context of occupational safety and health risks. For example, studies by Pavana and Gowda (2022) as well as Zinab et al. (2019) began to explore the effectiveness of safety measures to mitigate safety and health risks. In this later phase of research, there was a revolving focus from merely identifying health hazards to actively managing and reducing them in the workplace.

Studies regarding safety in rubber manufacturing has previously been conducted in the Southeast Asian region. For example, Shantha Kahatapitiya et al. (2022) explored the safety practices in rubber industry in Sri Lanka while several studies in Thailand have addressed odours concerns associated with rubber manufacturing (Danteravanich &

Waijarean, 2024; Saksorngmuang et al., 2020; Songkhla & Rakkamon, 2020). Notably, according to the Panicker and Varghese (2022), Thailand recorded more published studies regarding rubber workers Thailand as compared to other countries in the same region. This finding suggested that there is lack of publications regarding safety in rubber manufacturing despite of the considerably large scale of rubber industry in Malaysia.

While past research in the context of rubber industry has been conducted in Malaysia, most of it only explore on health impacts on the workers. For example, in Kassim et al. (2019) and Lim et al. (2018), the effects of environmental factors such as noise and temperature on the rubber worker's health were explored. While a more recent study by Nizam et al. (2023) the impact of illumination on the worker's muscle health in the rubber scrap factory was investigated. This trend highlighted that the previous studies in Malaysia were more inclined to the health aspects of the rubber workers instead of the behavioural-related impacts such as industrial odour habituation.

2.2.1 Industrial Odour in Rubber Manufacturing Industry

The emission of industrial odour can be considered as one of the safety concerns in rubber manufacturing industry. Previous studies have explained how Volatile Organic Compounds (VOCs) and other odorous chemicals released during industrial activities contributed to the emission of the industrial odours (Jia et al., 2021; Meng et al., 2019). Within rubber manufacturing setting, where the usage of such chemicals is prominent, odour emission is unavoidable in the industry. A key study by Kamarulzaman et al.

(2019) successfully determined the sources of odour emission that is linked to the main processes in rubber manufacturing such as during raw material storage, drying, and bacterial reactions. The findings indicated the main contributor of the emission comes from hot vapours released during the drying process of rubber crumbs and from the raw material itself.

In a different study, Danteravanich and Waijarean (2024) managed to differentiate and characterise the different components of odour emitted by rubber industry in Thailand. Their results highlighted that exposure to VOCs such as formaldehyde poses significantly higher cancer risk to men as compared to women. Their study also indicated that the odorous emission are mostly comprises of gases like hydrogen sulphide, ammonia, and volatile fatty acids like acetic acid, propionic acid, butyric acid, isobutyric acid, valeric acid and isovaleric acid. Jia et al. (2021) has described how these types of emissions were linked to significant olfactory nuisance and deterioration of human health.

While in rubber manufacturing context, research has been conducted by Zhang et al. (2023) to assess the potential health risks and odour impacts from VOC emitted from the facility. Their findings indicated that the level of odour pollution in rubber industry was significant, with strong smells contributed by acetaldehyde and acrolein. This highlights the significant presence of industrial odour in rubber manufacturing industry and the potential impact on the worker. Another growing concern is regarding the impact of industrial odour to psychological health of individuals exposed to it. Findings by Eykelbosh et al. (2021) has proven that extended exposure to odours can result in

stress, poor mental health, and a general decline in well-being. While study by Goshin et al. (2021) revealed that those living closer to industrial odour sources have heightened annoyance levels which attributed to their health issues. This suggested that those in close vicinity to the source of industrial odour such as the rubber workers may develop psychological symptoms.

Research on industrial odour has notably evolved across the timeframe. Early studies were mainly focused on identification and quantification of odour emissions to address environmental concerns (Liu et al., 2020; Zheng et al., 2020; Zhou et al., 2019, 2020). However, these studies were only focused on the importance of controlling odour emission due to environmental concerns instead of human impacts. In more recent years, studies have shifted to focus on management and mitigation of dour emissions in industrial settings (Duan et al., 2023; Liu et al., 2024; Wang et al., 2023), with a specific consideration regarding technological resolutions for reducing harmful odour levels. However, despite of growing emphasis on management, the psychological and behavioural impacts of industrial odours on workers have yet been underexplored.

In the context of health impacts of industrial odour, previous research mostly focused on the effects to public instead of industrial workers (Guadalupe-Fernandez et al., 2021; Hassan, 2023; Li et al., 2023; Piccardo et al., 2022). Despite of limited scientific literatures on the impact of industrial odour on worker's safety behaviour, there are one study that has drawn attention to the potential threat posed by the odour. A study by Oleszkiewicz et al. (2023) has explored the effect of odour exposure on the individual's postural imbalance. The findings suggested that continuous exposure to such odours in

industrial settings could disrupt worker's balance and hence, their safety. However, this study does not investigate how habituation to such odour can affect the worker's risk perception and the impact on their safety attitude.

While the cited studies provided insights on the general health impacts of industrial odours, there remains a gap in understanding the potential psychological, cognitive, and behavioural consequences for workers regularly exposed to these odours. This gap is particularly concerning in rubber manufacturing industry where continuous exposure to strong industrial odour can result in attenuation of sensitivity and skewed risk perceptions, potentially leading to unsafe behaviours. Therefore, understanding how odour habituation influences workers' risk perception and safety behaviour is very crucial for improving workplace safety and developing targeted interventions to address these challenges.

2.3 Safety Behaviour in Safety Management

In a high-risk environment, safety behaviour is a key element in occupational safety. The progress of safety behaviour in safety management in research is highlighted by Rusyda and Abdul Aziz (2021). They have devised the definition of safety behaviour by integrating viewpoints and insights from clinical psychology, industrial psychology, and organizational psychology, and social learning theory. According to their outlook, safety behaviour refers to the individual's actions taken to prevent accidents and injuries that includes both conscious and unconscious actions, influenced by factors like

fear and compliance with safety protocols. While Adi et al. (2021) describes safety behaviour as the worker's individual actions that contribute to the development of safe work environment which is indicated by safety compliance and safety participation.

Globally, past literatures have pointed that safety behaviour has a crucial role to play in preventing workplace accidents. For example, Wong et al. (2023) explored the behaviour responses to safety stimuli that affects how perceived threat is formed. The study found that performing safety behaviours in response to safety stimuli strengthens threat beliefs. This contradiction highlights the complexity of safety behaviour, as engaging in these actions may inadvertently heighten fear of danger. A prominent study to note is conducted by Songkhla and Rakkamon (2020) where they explored safety behaviour in the rubber manufacturing industry in Thailand. They found that, despite the health risks associated with handling chemicals like ammonia, workers often failed to wear proper protective equipment. This unsafe behaviour underscores the importance of addressing gaps in both safety training and compliance.

While in Malaysia, safety behaviour research has gained focus particularly in manufacturing contexts. Fauzi et al. (2022) examined the correlation between safety practices and safety behaviour among workers in Malaysian Small and Medium Enterprises (SMEs). They found that a moderate positive relationship exists between the safety practices and safety behaviour. Their study highlights the need for stronger enforcement of safety practices to foster safer behaviours. While Amirah et al. (2024) investigated the impact of safety behaviour, particularly safety compliance and safety leadership, on improving organizational safety culture. They found that these

components significantly influence the establishment of a robust safety culture in manufacturing setting. However, these studies do not focus on rubber manufacturing context in Malaysia.

In the context of safety management, Behaviour-Based-Safety (BBS) has emerged as an approach that integrates safety behaviour to enhance workplace safety. According to Skowron-Grabowska and Sobociński (2018), the emergence of BBS can be traced back to the late 1970s and it is difficult to pinpoint the inventor of this management approach. However, BBS has been made famous for safety improvement in industrial context in study by Geller (2001). Niciejewska and Obrecht (2020) study goes deep into understanding how modifying unsafe behaviour can be made using BBS. They alleged that a behavioural approach to improve workplace safety should start with identifying and analysing dangerous behaviours, understanding their root causes, and lastly, adjustment at both worker and management levels. They emphasised that with this approach, unsafe behaviour can be monitored and reduced by encouraging workers to adopt safe practices.

The benefits of BBS have been widely documented in previous studies. Yang et al. (2024) supported this with an evaluation of the effects of a BBS observation program in enhancing safety behaviour and improving the safety climate at work. They discovered that such program in fact promoted safety behaviours and over time created an optimistic safety environment. Similarly, Zakaria et al. (2024) scrutinized the effectiveness of a BBS Observation Program (BSOP) in Malaysia's manufacturing sector. Their findings indicated a significant decrease of unsafe behaviours with an

increase of the safe actions among workers, demonstrating the adaptability of BBS principles in Malaysian contexts.

While both safety behaviour and BBS programs have shown its potential in improving safety outcomes, there are still some challenges remain in addressing the behavioural gaps observed in certain aspects. For example, in a study by Songkhla and Rakkamon (2020), they have noted the persistent issue of rubber workers neglecting the usage of personal protective equipment, emphasizing the need for deeper understanding of individual's accountability. This finding highlights the importance of identifying and addressing the underlying psychological and behavioural factors that contribute to unsafe practices, which could help enhance compliance with safety protocols and reduce risks in the workplace, particularly high-risk industries like rubber manufacturing.

2.3.1 Factors Affecting Safety Behaviour

Safety behaviour is affected by several factors that can be categorized or grouped. For instance, Han et al. (2021) studied the factors affecting safety accidents in the context of safety climate. They categorised the factors into two categories which are human factors and environment factors. They found that human factors involved are worker's acceptance and worth, worker's involvement and relationship, worker's commitment, their safety behaviour, safety perception, safety attitude. While environmental factors include guidelines and procedures, supervisory setting, organisational management, and training. While Muñoz-La Rivera et al. (2021) categorized factors affecting safety

into four aspects that include general aspects, materials and equipment, environment and human aspects. Their study also indicates that factors involving human aspects contribute to more unsafe work behaviour in construction.

There is a noticeable trend in research regarding safety behaviour where studies (Putranti et al., 2023; Saedi et al., 2024; Zhao et al., 2021) examine the impact of factors like safety climate, safety knowledge and safety leadership on safety behaviour. All studies point that there is a positive correlation between those factors to safety behaviour. Positive safety climate and stronger leadership will contribute to safer behaviour among workers. However, most of the study employed quantitative method and lack of in-depth data regarding each factor. This is line with the findings by Meng et al. (2021). They also highlighted that the mechanism related to unsafe behaviour formation is multifaceted and require a better in-depth, multi variable approach to be explored.

Aspects of safety climate and safety culture is usually mentioned in safety behaviour studies. This is because, both safety culture and safety climate can be used to describe attitudes, behaviours, and mental frameworks that highlights the approach to safety. However, there is distinct feature of both terms. According to Han et al. (2021), safety culture is the underlying values, attitudes, perceptions, and competencies of individuals and groups regarding safety, while safety climate is visible aspects such as tools, techniques, and expressions used by the organization to demonstrate its commitment to safety.

This is why some studies have different approach on viewing the intricate relationship between safety behaviour and safety culture. Unlike the previous study that highlight safety culture as a factor impacting safety behaviour, Amirah et al. (2024) suggested the otherwise. In their study, they used Structural Equation Modelling (SEM) approach to determine the impact of components of safety behaviour, which are safety compliance and safety leadership, on safety culture. They suggested that safety behaviour is a factor that affects safety culture in an organisation. While in a different study, Soltanzadeh et al. (2021) explored the relationship between safety climate and unsafe behaviour at work. They found that key factors influencing unsafe behaviours include management commitment, workplace safety, ignoring errors, education, and work experience. They highlighted that workers with more experience of accident or near-misses tend to act unsafely. This finding suggested that are potential habituation related to past incidents.

While most of the studies focus on external factors affecting worker's safety behaviour, some of the studies explore the interpersonal and cognitive factors that affect their action. For example, study by Tao et al. (2023) employed a study that consider personality, cognitive factors and safety attitude of workers in determining safe behaviour as an outcome. An integrated model was developed to predict unsafe behaviours among nuclear power plant workers, focusing on personality traits, cognitive functions, and safety attitudes. Their findings suggested that key personality traits such as conscientiousness, neuroticism, openness, and agreeableness significantly influenced unsafe behaviours, either directly or indirectly. They also highlighted the mediating role between personality traits and unsafe behaviours as a critical cognitive

factor. These findings suggest that interventions to improve safety performance should consider individual's difference to mitigate unsafe behaviour at work.

Similarly, study by Shakerian et al. (2020) also explored cognitive factors in unsafe behaviour formation. The study attempted to explore unsafe behaviour cognitive factors that contribute to human error in industrial settings using a hybrid approach combining fuzzy Decision Making Trial and Evaluation Laboratory (DEMATEL) and interpretive structural modelling (ISM). The findings pointed on the inadequacy of personal resilience and habitual rule ignorance as a significant predictor of unsafe behaviour. While Derdowski and Mathisen (2023) explored the psychosocial factors that may affect unsafe behaviour, but by employing Job Demand-Resources (JD-R) theory. They speculate that there is a relationship between the psychosocial factors and safety at a workplace. They found that job demand factors can lead to mental health impairing effects in workers, which may serve as precursors to unsafe behaviour. The study stressed out on the importance of focusing on mental health and psychosocial well-being of workers in high-risk work environments.

In Malaysia, there are some research done that addressed factors affecting safety behaviour in manufacturing industry. Rahim et al. (2023) attempted to recognise the factors affecting safety culture in manufacturing industry in Malaysia. They have conducted systematic mapping of the variables that influence the safety culture. They have concluded that behavioural aspects were the most important part of safety culture, followed by situational and psychological aspects. Similarly, Saraih et al. (2021) also attempted to identify the influential factors that contribute to positive safety behaviour

but using quantitative analysis. They found that there is significant positive relationship between safety management practices, safety compliances and safety behaviour among workers in the manufacturing industry in Malaysia.

The studies reviewed highlight the complexity of safety behaviour and the multifaceted factors that influence it. While existing literatures has provided substantial insight into the role of safety climate, leadership (Putranti et al., 2023; Saedi et al., 2024; Zhao et al., 2021), and cognitive factors (Derdowski and Mathisen, 2023; Shakerian et al., 2020; Tao et al., 2023), there is a significant gap in exploring the impact of cognitive biases caused by industrial odour habituation and safety behaviour, particularly in the rubber manufacturing industry. Many studies have been quantitative in nature, failing to capture the subjective experiences and psychological factors that influence safety behaviours, such as habituation to hazardous industrial odours. Additionally, while some studies (Amirah et al., 2024; Han et al., 2021; Soltanzadeh et al., 2021) have explored how safety culture and safety climate influence behaviour, there is limited understanding of how sensory desensitization affects workers' decisions. This reflects an opportunity to fill the gap with qualitative research that explores the psychosocial and cognitive dimensions of safety behaviour.

2.4 Risk Perception and Safety Behaviour

The term risk perception has been defined in several studies. According to Grima et al. (2021), risk perception or perception of risk is defined as the subjective judgement that people develop about the features, severity, and ways of dealing with risks. While according to Lambrou et al. (2023), risk perception is the aspect of the perceived probability in case a hazardous incident will happen and the perceived consequences of that occurrence. The concept of risk perception was explored deeper by Hoorens (2020), where the author described it as the way people assess potential outcomes from specific actions, while integrating analytical and experiential evaluations. The author also highlighted that the risk perception involves analytical judgement of the event of likelihood and impact while integrating experiential decision using intuition and expressive reactions to the potential risk (Hoorens, 2020). To simplify, the concept of risk perception incorporates how individuals interact with all factors to form an overall sense of risk's extent and relevance.

The trends in research regarding risk perception has changed over time. In a study by Goerlandt et al. (2021), this trend is explored using scientometric analysis. They found that studies regarding risk perception is highly interdisciplinary. According to their findings, most of the studies stem from psychology and social sciences but throughout time, it has extended into more area such as environmental sciences, medicine, and engineering. This broad scope of research reflects the diverse context and importance of risk perception in different sectors. Similarly, Siegrist and Árvai (2020) also revised on the past research on risk perception for the past four decades that managed to reveal

several key findings. They highlighted that risk perception is crucial to decision making process but its causal relationship with hazard acceptance require further investigation. They also mentioned that there should be more research exploring on how risk perception relates to other factors like attitudes and emotions. This suggested that a study on the impact of risk perception on behaviour is very beneficial to the scientific community.

While in the context of occupational safety and health, research on risk perception has gained increasing attention. This is supported by Özbakır (2024) who implied that studies related to risk perception is new, indicating the trend shift in research of this decade. This is why, research on risk perception on safety management perspective will be relevant to be explored. Despite the growing body of research on risk perception, gaps still exist, particularly concerning the causal relationship between risk perception and industrial accidents. For instance, study by Alrawad et al. (2022) explored the worker's risk perception on occupational and environmental hazards using psychometric paradigm approach. While their findings highlighted the relationship of worker's perception of risk and their workplace environment, their study lacks exploration on the causative factors behind the phenomenon.

Furthermore, Oppong (2021) cited how most existing theories in safety management focus primarily on operationalizing incidents, overlooking the complex interplay between risk perception and safety outcomes. To address this, they employed concept from Risk Chain Process Model using SEM to empirically test how risk perception influences risky behaviour and decision-making. The findings highlighted that risk

perception directly impacts behaviour, which in turn influences risk exposure. However, this study's focus on quantitative methods limited its ability to explore the causal relationships between risk perception and safety behaviour, particularly in real workplace context. While Chionis and Karanikas (2022) also discovered that that even the most inclusive frameworks and still missing out on several aspects of risk perception and communication factors. Their study also suggested that more research that focus of importance of incorporating risk perception and communication into safety behaviour interventions should be conducted.

A key study by Li et al. (2020) have validated the mediating role of risk perceptions on worker's safety behaviours. By using several regression models, they have visualised that mediating effects of risk perceptions on the cognitive biases are influenced by the type of risk perceived (environmental or behavioural). To be specific, availability biases and confirmation biases effect on safety behaviour is mediated by environmental risk components as compared to overconfidence that relies mostly on behavioural risk perception. This suggested that the impact of cognitive biases that occurs due to odour habituation on the worker's safety behaviour will be mediated by behavioural risk perception of the worker.

The reviewed studies illustrate the growing recognition of risk perception's crucial role in shaping safety behaviour. While much of the existing literature has focused on defining and quantifying risk perception (Eby et al., 2023; Grima et al., 2021; Hannani et al., 2023; Hou et al., 2024; Zhao et al., 2021), there is still limited exploration of the causal relationships between risk perception and safety outcomes, particularly in high-

risk industries such as manufacturing. While several quantitative studies (Li et al., 2020; Tao et al., 2023; Xia et al., 2020) did explore the mediating role of risk perception in developing worker's cognitive biases and their unsafe behaviours, they are lacking in-depth explanation of the intricate relationship of the factors. This suggests that a qualitative exploration on the nature of mediating role of risk perception will provide more insights.

2.4.1 Factors Influencing Risk Perception

Several factors influence risk perception, depending on the type of risk perceived. According to Eby et al. (2023), objective occupational risk is defined as the inherent level of danger associated with a specific job, while subjective risk is a personal assessment, shaped by social influences, of the likelihood of harm, potential loss, and feelings of vulnerability due to exposure. While according to García-Mainar and Montuenga (2024), subjective risk perception is shaped by the beliefs of risk's likelihood, and its severity which is affected by factors such as personal, cognitive and organisational factors. They described that the personal factors include personality and motivation; cognitive factors include knowledge and experience; and organizational factors include workplace culture and norms.

As a result of different kind of factors affecting risk perception, many scholars have done various research on this subject. Hannani et al. (2023) conducted a causal analysis of safety risk perception among Iranian coal mining workers, by Fuzzy Delphi and DEMATEL methods to identify the main factors influencing risk perception. The

research findings indicated that the factors involved belong to five main categories: individual, organizational, environmental, task-related, and external factors. Among those factors, the most significant was organizational factors such as safety culture and management style while personal protective equipment (PPE) and risk aversion played very minor roles in determining workers' attitudes toward risk. The findings highlight the role of organizational dynamics on workers' risk awareness and underscore the essential need for having targeted interventions at the organizational level to improve risk awareness and safety practices.

While Zhao et al. (2021) investigated the influence of safety attitudes, knowledge and leadership among chemical industry workers in their perceptions toward risk using SEM and System Dynamics (SD). The investigation found that safety attitude and leadership gave a direct positive impact on risk perception, while safety knowledge significantly influences perceptions of risk severity but not risk probability. The findings suggested that while knowledge alone cannot fully explain risk perception, leadership and its attitude are indispensable factors in shaping workers' consciousness of safety risks. Similarly, Saedi et al. (2024) explored on how safety climate influences workers' perceptions and tolerance of dangerous situations. By employing Partial Least Squares-SEM, the study has demonstrated that a positive safety climate increases the worker's willingness to put up with risk management practices. They also found that worker's risk perception significantly influences their keenness to adopt safety measures. This highlights the need for establishing a sound and robust safety climate that can improve worker's risk perception.

To allow for better understanding on the complexity of risk perception, researchers have developed frameworks to investigate its influencing factors. For instance, Jenkins et al. (2024) has proposed a framework called as ICONS (individual, contextual, cognitive, and social factors) which integrated several psychological considerations to explore how individuals perceive and respond to risks. The framework was used in both of their empirical studies that involve a large number of participants (a total of 4228 participants) to determine whether benefits, dread and individual responsibility were the major key dimension for risk perception. The results indicate that there is a need to consider synergies between these three factors when predicting how people will respond to risks.

While some studies employed existing theories to investigate the factors influencing risk perception such as in Xia et al. (2020). The study used Job Demand-Resources (JD-R) model, exploring its dual role as both a hindrance and a challenge to safety behaviour. The findings indicate that an emphasis on work safety significantly minimises perceived risks that also transforms into drivers for more safe behaviours. The authors also highlight the importance of social dynamics such as coworker and supervisor relationships to encourage proactive safety practices by leveraging worker's risk perception. In a different study, Man et al. (2021) extended the understanding of risk perception by integrating the Technology Acceptance Model (TAM) and Theory of Planned Behaviour (TPB) to explore the acceptance level that Hong Kong construction workers have for PPE usage. The research showed that a strong safety climate significantly increases workers' attitudes toward PPE adoption, while affective risk perception enhances workers' intention to use PPE. The findings highlight the need

to address both emotional and cognitive dimensions when promoting safety behaviour and reveal how working environments can influence intervention initiatives positively.

A recent study by Qiu et al. (2024) delve deeper in understanding the mechanism of development of biased risk perception and the factors involved in it. The study also explored how cognitive anchoring effects influences worker's risk perception and unsafe behaviour. Key findings from this study indicate that high-risk situations tend to cause workers to overestimate the risks of unsafe behaviour, thereby reducing the likelihood of them engaging in such actions. While personal accident experiences decrease their risk perception and increase the worker's unsafe behaviour tendencies. Another important point to note is on the impact of near miss or minor accidents that can lead to complacency as compared to severe accidents that improves the worker's risk perception. The findings from this study suggested that there is a need for further research on the anchoring effect that may be used to improve risk perception accuracy.

Altogether, the reviewed studies provided a cohesive understanding of risk perception that is influenced by a combination of individual, organizational, and contextual factors. Frameworks like ICONS in Jenkins et al. (2024) and JD-R model in Xia et al. (2020) provide valuable insight into how individual worker's experiences, cognitive processes, and workplace environments shape their risk perception. While other factors like leadership, safety climate, and attitudes have proven as pivotal in influencing risk awareness, as demonstrated by reviewed studies (Hannani et al., 2023; Saedi et al., 2024; Zhao et al., 2021). However, these studies only focus on external factors and quantitative methods, leaving a critical gap in understanding the subjective experiences

and cognitive dimensions of risk perception, particularly in high-risk industries like rubber manufacturing.

2.5 Habituation of Industrial Odour

Habituation is a process that occurs over a period of time. According to Uribe-Bahamonde et al. (2019), a decrease in response of repeated stimuli is not caused by changes at the sensory or motor level, instead it is due to a learning process which is also known as habituation. Habituation yields such profound advantages to us, which is described by Merchie and Gomot (2023) who mentioned that habituation is indispensable for human as it allows us to adapt to the environment by focusing less on repeated stimulus and respond quickly to any changes. In other words, it is necessary for human to adapt the environment by forgetting familiar things such as repeated stimuli so that we can pay attention to new stimulus. Despite of being an unavoidable process, habituation is said to be detrimental to risk perception.

Within the broad context of sensory habituation, there is a phenomenon called as odour habituation, which refers to reduced sensitivity resulting from repeated exposure to odours. The phenomenon was characterized by Kim et al. (2020) as a diminished neural and behavioural responses to repetitive olfactory stimuli, which is relevant in various contexts, including industrial settings. The results of their study also demonstrated that olfactory event-related potentials (ERPs) can be altered within 200 ms, indicating a rapid onset of habituation. Putting it more simply, their discovery indicated that odour

habituation can happen in under a minute. This fast onset of odour habituation may pose challenges to workers who are exposed to persistent odours in industrial setting.

There are various factors which can influence onset of odour habituation. As indicated by Ferdenzi et al. (2014), it is influenced by factors such as the perceiver's age, sex, motivational state, the context in which the odour is encountered, and the characteristics of the odorant itself, such as its structure or concentration. Recent studies have focused on exploring each of the factors contributing to variations in odour habituation, such as repeated exposure. Pellegrino et al. (2017) suggested that long term habituation occurs when individuals are exposed to the odour for a longer period such as weeks and months. A more recent findings by Pellegrino et al. (2020) highlighted that prolonged exposure to odours reduces perception, and weaker odour stimuli result in faster habituation. This suggested that those that will be more exposed to the odour in rubber manufacturing will develop reduced perception to the odour.

In another perspective, Hintschich et al. (2024) highlighted how exposure may affect habituation, particularly due to age. Their findings found that older people are more affected by olfactory habituation due to the extended exposure. They also suggested that the olfactory function of older people might be compromised, causing them to be more susceptible to odour habituation. However, Mignot et al. (2021) finding suggested differently, with results indicating both older and young adults experienced same level of odour habituation. However, they noted that the extent of the long-term odour habituation is specific to the odour that is exposed to the individuals. This is also supported by Sinding et al. (2017) who said that different physicochemical properties

of the odorant can influence the extent of odour habituation. This trend suggested that different types of odours, especially those released in rubber manufacturing process may pose different effects on the habituation process.

A different study by Li et al. (2023) explored how concentration and pleasantness of odour affects olfactory desensitization process. Their findings indicated that desensitization to odour intensity occurs for both pleasant and unpleasant odours while affective habituation only happens for pleasant odours at lower concentrations. This might suggest that workers who are exposed to persistent odours may become less sensitive to their intensity, reducing their ability to detect hazardous odours. This is concerning particularly in rubber manufacturing where ability to detect odour can act as a warning signal.

2.5.1 Odour Habituation and Its Relation to Risk Perception and Safety Behaviour

The intricate relationship between habituation and risk perception has already been explored, with many studies presenting the impact it has on worker's behaviour in high-risk settings. A previous study by Daalmans (2013) suggested that habituation can weaken safety associated processes such as safety alertness and vigilance. Thus, workers may consider something risky as less threatening, leading to a more relaxed demeanour despite of being in an unsafe situation. This phenomenon is very concerning especially in occupational settings where constant exposure to hazards can lead workers to underestimate the severity of risks, ultimately compromising workplace safety.

Study conducted by Boso et al. (2024) further strengthened this notion, especially regarding odour habituation. They have listed habituation bias as one of the key judgemental biases that will influence an individual's perception of sensory inputs. According to the study, habituation is significant because it alters sensory perception and interferes with individuals' ability to link the stimulus to their decision-making processes. While in the context of odour nuisance, Suffet and Braithwaite (2019) have focused on risk perception's profound impact upon people's reaction to odours and their suspected toxic components. The study highlighted that the extent of response to the odour risk is shaped by personal and cultural values and attitudes. This aligns with the concept that habituation influences how risks are perceived and also how effectively workers respond to potentially hazardous stimuli like industrial odours.

Building on these ideas, several studies have applied the concept of risk perception in management of workplace safety, particularly on implementation of control measures. For instance, Lee and Kim (2022) has explored long-term effects of risk habituation on safety behaviour in construction work environments. They specifically analysed the impact of safety-reminding interventions, comparing fixed-repetitive alarms and behaviour-feedback interventions. Their study found that behaviour-feedback interventions were more effective in reducing habituation to risk as compared to repetitive alarm systems. This study emphasized that incorporating feedback-driven interventions into safety protocols could significantly improve workers' risk perception and safety behaviour over time.

Another notably significant study by Kim et al. (2021) attempted to explore the effects of risk habituation in a road construction environment, particularly focusing on "struck-by" hazards. "Struck-by" hazards refer to the danger of getting hit and injured by any object or equipment, emphasized on account of potential accidents at the construction site (Almaskati et al., 2024). The researchers utilized virtual reality (VR) simulations to simulate accidents and combat risk habituation, and they found that the interventions were effective in reducing desensitization to workplace hazards. In a more recent study, Kim et al. (2023) expanded on their previous work by exploring how virtual accidents could help reverse risk habituation. Their findings established that experiencing a simulated accident in VR can effectively mitigate habituation by stimulating both sensory responses and behavioural reactions. This finding is critical for occupational safety, as it suggests that immersive training programs using VR can counteract desensitization, improve hazard recognition, and potentially reduce workplace injuries. The integration of sensory and behavioural levels in this research also provides a robust framework for understanding the mechanisms of risk habituation in high-risk environments.

A key study that emphasised on the impact of odour perception on rubber workers was conducted by Zhang et al. (2024). The study explored the impact of Volatile Organic Compounds (VOCs) and odour perception on rubber workers, revealing the dual nature of risk perception in high-risk environments. The findings highlighted how risk perception could act as both a hindrance and a challenge, depending on the context. Interestingly, they found that supervisor safety climate could worsen the impact of risk perception on safety behaviours, while a positive coworker safety climate reversed the

detrimental effects. This discovery substantiates with the idea that factors such as social and organizational factors can significantly influence how risk perception affects safety behaviours.

All of the reviewed studies, habituation is seen as an important variable in crafting risk attitude and precautions. Most significantly, they show that the continual exposure to hazard sources such as industrial odour will result in desensitization, which in turn will impair worker's ability for perceiving risk accurately. Furthermore, the studies suggest that interventions like VR-based simulators, safety cues, and behavioural feedback systems can help mitigate the risk habituation through restoring the worker's sensory awareness (Kim et al., 2021, 2023; Lee & Kim, 2022). As a result, the findings underscore the need to address the control measures implemented in rubber manufacturing to mitigate the effects of habituation. These insights are also vital for understanding how to combat risk habituation, particularly in high-risk industries like rubber manufacturing, where workers' safety behaviours are critical in preventing workplace accidents.

2.6 Supporting Theories

For establishing a strong groundwork, this research is guided by the Risk Perception-Unsafe Behaviour Formation Model developed by Huang et al. (2019). This model was selected as the primary analytical lens because of its direct relevance to the central focus of this study, which is on how a risk source (odour habituation) influences risk perception biases and consequently, worker's safety behaviour in rubber manufacturing industry.

2.6.1 Risk Perception-Unsafe Behaviour Formation Model as Analytical Lens

Risk Perception-Unsafe Behaviour Formation Model builds on the traditional Risk Perception Theory by Slovic (1987). This model provided a detailed pathway that can be used to explain the development of unsafe behaviours resulting from biased risk perception. Therefore, this model served as an exclusively focused analytical framework for understanding how odour habituation influences cognitive processes and subsequent behavioural outcomes. This is better than a direct or linear approach by Heinrich Domino's Theory (Heinrich, 1931), that oversimplifies the complexity of workplace incidents, as noted by Busch (2019).

Besides, previous theories such Antecedent-Behaviour-Consequence (ABC) model, made famous by Geller (2001),were lacking in-depth dimensions needed to explain odour habituation. In rubber manufacturing, workers who become habituated to persistent odours may perceive them as non-threatening, resulting in reduced hazard recognition and unsafe behaviours. Unlike ABC model, the chosen model can capture both the psychological (risk perception) and sensory (habituation) processes that

influence workplace behaviour. By highlighting these mechanisms, the model offers a structured approach to map the progression from sensory adaptation to unsafe behaviour.

Studies such as Li et al. (2020) and Qiu et al. (2024) have noted that risk perception plays a mediating role in development of cognitive biases and unsafe behaviours. Therefore, having a model that can illustrate this link will be very insightful. This is why Risk Perception-Unsafe Behaviour Formation Model suited the best, especially when the influence of risk perception was explored as a key theme throughout this study. Other than that, the model also introduced the concept of identified and unidentified biases in risk perception. The model's emphasis on identifying and addressing biases also aligned with the study's objective to develop targeted interventions for mitigating odour habituation's impact on safety behaviour in the rubber manufacturing industry.

Thus, this model not only helps in framing the research questions and analysis, but it also guides the interpretation of the results particularly regarding how habituation dulls risk awareness and influence safety decision-making. It further informs the identification of control measures that can address these perceptual gaps. Overall, the framework enables a more comprehensive understanding of the psychological mechanisms underlying the phenomenon of odour habituation and safety behaviour.

2.6.2 Analytical Lens (Visualised)

In qualitative research, the role of a research framework is different from quantitative studies. According to Tsindos (2023), a framework may be used to help aligning research questions, processes and interpretations within the broader research scope of a qualitative study. In other word, the framework will not impose variables for testing but rather provide conceptual grounding that will guide interpretation. In the context of this study, the Risk Perception-Unsafe Behaviour Formation Model was adopted as a guiding analytical lens to support for exploration of how odour habituation influences workers' risk perception and behaviour in the rubber manufacturing industry.

The visualisation (Figure 2.1) illustrates how the model can be used to guide the interpretation of how odour habituation, influences risk perception and safety behaviour in this study. The model also identifies pathways that can lead to either safe or unsafe behaviour, emphasizing the role of control measures in mitigating potential risks. As workers become accustomed to industrial odours, their risk perception may be impacted, introducing potential biases. Identified biases allowed for intervention through control measures, such as training, to promote safer behaviour. However, unidentified or uncontrolled biases can result in unsafe behaviour.

Unlike quantitative frameworks, this analytical lens was not used to define measurable variables but rather act as a guidance for the researcher to alert with relevant dynamic within the data obtained. Ultimately, the framework highlighted the importance of implementing control measures to address altered risk perception due to odour habituation, ultimately aiming to improve safety practices.

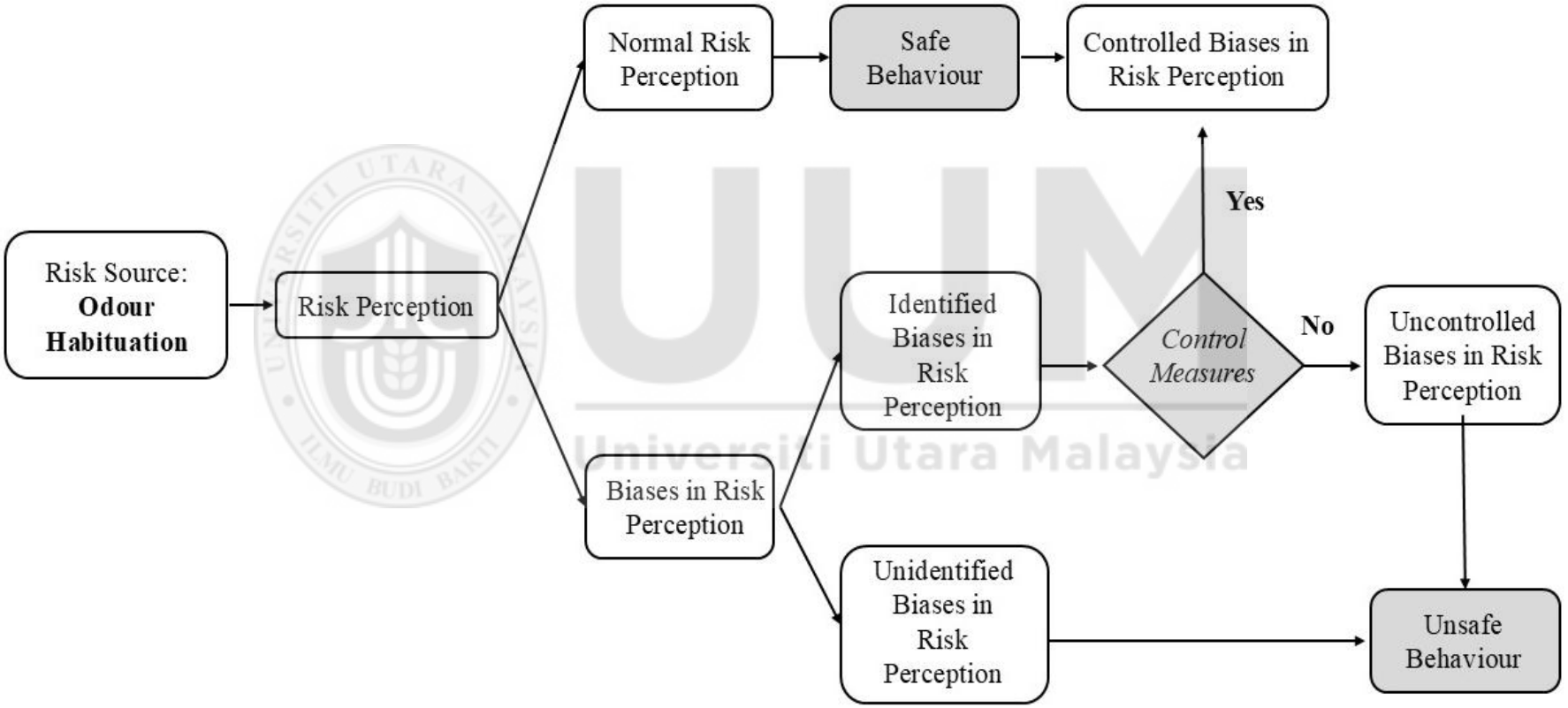

Figure 2.1
Analytical Lens Guiding Exploration of The Odour Habituation Phenomenon based on the Risk Perception-Unsafe Behaviour Formation Model

2.7 Summary of the Chapter

This chapter explored the interlinkage of safety behaviour, risk perception, and odour habituation within the context of the rubber manufacturing industry. The reviewed studies reveal that odour habituation can desensitize workers to environmental hazards, thereby influencing their risk perception and potentially compromising safety behaviour. Additionally, the chapter also disclosed the broader psychological and organizational factors that shape safety outcomes, emphasizing the role of control measures in mitigating habituation effects. By synthesizing existing research, the chapter identified critical knowledge gaps, particularly concerning the Malaysian rubber manufacturing sector, and underlines the need for qualitative exploration of these complex relationships to develop more effective safety management practices.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter comprises of the method that was used in this research to investigate the relationship between odour habituation, risk perception, and safety behaviour among workers in the Malaysian rubber manufacturing industry. It consists of research framework, hypotheses development, research design, including the qualitative approach chosen to address the research. The operational definition, research instrumentation, data collection, sampling, data collection, research sampling, data collection procedure and techniques of data analysis also discussed to provide overview of the methodological approach underpinning this study.

3.1.1 Operational Definitions

To ensure clarity, the following key terms were defined for this study:

Odour habituation: In this research, odour habituation is the process which rubber manufacturing workers become accustomed to industrial odours over time, potentially diminishing their sensory alertness. This will impact the worker's ability to recognize associated risks and the level of situational awareness. The level of extent of odour habituation is suggested to vary across different roles and exposure levels in the rubber manufacturing industry.

Risk perception: In the context of this research, risk perception is the rubber manufacturing workers' subjective assessment of the risks posed by industrial odours in their work environment. It includes how the workers interpret and internalize senses

such as odours from their working environment, that will influence their thinking and safety responsiveness. In this study, risk perception is linked to odour habituation, where workers may perceive certain hazards as less severe due to prolonged exposure.

Safety behaviour: In this study, safety behaviour is the actions of rubber manufacturing workers regarding safety protocols and practices within their work setting. For this study, safety behaviour is observed in relation to odour habituation and risk perception. The objective is to look at how these two variables might promote or hinder specific modes of safe practice at the workplace.

Exposure group: In this research, exposure group refers to the classification of workers based on their frequency and proximity to the sources of industrial odour at their work setting. There are two distinct groups identified which are direct exposure group and indirect exposure group. Direct exposure group includes workers that are routinely involved in rubber processing activities or frequently exposed to odorous emissions. Indirect exposure group includes workers whose role are administrative and located away from production area, with limited exposure to the chemical operations.

Control measures: In this research, control measure refers to the existing practical measures implemented to mitigate the impact of odour habituation on worker's risk perception. This also include interventions for keeping the workers aware of risks associated with industrial odours and ensuring continued safety at work.

3.2 Research Design

This study employed a qualitative single-case study design to explore the impacts of odour habituation to risk perception and safety behaviours of rubber manufacturing workers. This design was chosen because it allowed for in-depth exploration of the worker's experience and subjective interpretation of in relation to long-term exposure to industrial odours within their daily work environment. According to Priya (2021), single-case study is well-founded when the case under study is atypical, revelatory or a quintessential instance of a particular phenomenon. This aligns with the nature of the current study where odour habituation was explored as a phenomenon through a revelatory case approach. Therefore, a rubber manufacturer located in northern region of Malaysia (pseudonym: Company A) was selected as a candidate for the case study.

The study also utilised a cross-sectional time zone where data were collected at a single point in time to capture a snapshot of odour habituation phenomenon among rubber workers. The researcher conducted one-on-one interviews and performed in-depth analysis of the selected workers' experiences. This study adopted an inductive qualitative approach, beginning with the research questions, followed by data collection which facilitates the exploration and interpretation of the findings within the analytical lens of the Risk Perception-Unsafe Behaviour Formation Model (discussed in chapter 2). The findings were presented through thematic analysis, in which the data were systematically sorted into codes, categories, and subcategories. This research design enabled exploration of the nuanced experiences of workers regarding their exposure to industrial odours and its impact on safety practices.

3.3 Data Collection Strategy

Multiple strategies were implemented to ensure comprehensive and credible data gathering. Data was gathered through in-depth, semi-structured interviews, direct observations of workers in their natural work environment and accessible archival records review. This approach allowed for a comprehensive understanding of individual perceptions, experiences with odour exposure, and safety practices. Furthermore, to achieve a comprehensive understanding of the research topic, the researcher employed a methodological triangulation. This approach was chosen because it helped to add depth and credibility of the data collected (Fusch et al., 2018). As described by Arias Valencia (2022) this approach involves using two or more qualitative methods to examine a single phenomenon as a means for cross validating the emerged themes. For this study, face-to-face interviews, direct observations and archival data review were conducted as a part of the methodological triangulation. This is in line with the suggested data collection method for qualitative case study by Bazen et al. (2021).

3.3.1 Rubber Manufacturing as The Study Site

The rubber manufacturing industry was selected as the study site due to its unique suitability for examining odour habituation phenomena. The industry's characteristic which is strong, persistent odours from processing chemicals (Zhang et al., 2023) create consistent exposure conditions ideal for studying sensory adaptation. Additionally, Zhang et al. (2024) noted that such conditions provide valuable opportunities to observe how prolonged exposure influences workers' risk perception and safety behaviours. These factors, combined with the practical relevance of findings for occupational safety

in chemical-intensive industries, make rubber manufacturing an optimal environment for this investigation.

For this study, a well-established rubber manufacturer located in northern region of Malaysia was selected. The company was assigned a pseudonym to protect its identity: Company A. Company A specialised in processing of raw rubber into a variety of products including Standard Malaysian Rubber (SMR), industrial rubber goods and miscellaneous rubber specialties. The processing facility and its on-site office have been operating close to the nearby community for more than a few decades, making the area well known for the rubber-related activities. Given its long-established operations and the noticeable odour emissions within the surrounding community, the company was deemed highly relevant to the context of this study.

3.3.2 Sampling

For a qualitative study, sample size is affected by the data saturation. Staller (2021) mentioned that qualitative research allows reflexive approach of continually assessing and adjusting the adequacy of the sample throughout the study, unlike predetermined sampling size in quantitative studies. Rahimi and Khatooni (2024) explained that data saturation is reached when further data collection fails to yield novel information relevant to the research question and only reinforces existing findings. In this study, sample size was adjusted to include 8 workers. This is because, the researcher noticed that the data saturation was reached by the sixth interview. Two additional interviews were conducted to confirm the redundancy of the key emerging themes. The richness and depth from each participant contributed to early data saturation, making the smaller size sufficient for achieving the study's objectives. This aligned with the findings by

Hennink and Kaiser (2022) which confirmed that a small sample size can be adequate to capture all necessary insights in a qualitative study, especially when the study scope is focused. Furthermore, Rahimi and Khatooni (2024) highlights, saturation is facilitated through clear research questions, selecting information-rich participants, understanding the phenomenon's sensitivity, and using triangulation during data collection and analysis.

This study employed two type of sampling techniques namely purposive sampling and snowball sampling. Purposive sampling was used in this study to select participants who work in roles with varying degrees of exposure to industrial odours. This is because purposive sampling involves the selection of a sample that has the most information about the phenomenon under study, as explained by Rahimi and Khatooni (2024). This means that the method can facilitate the researcher in achieving data saturation in this study. Ting et al. (2023) elaborated on how a purposive sampling technique can ensure a manageable sample size while still able to capture a broad spectrum of workers' perspectives. This approach will ensure that a range of perspectives related to odour habituation and risk perception will be well represented despite of the small sample size.

Subsequently, snowball sampling technique was used to complement the purposive strategy. According to Nyimbili and Nyimbili (2024), snowball sampling technique is one of the purposive sampling strategies that focuses on finding relevant participant that can lead to other participants with the same characteristics. In this study, the researcher obtained information recommendations regarding suitability of participants for the two exposure groups (direct and indirect exposure) based on the recommendation of Human Resource (HR) department at Company A. Based on the

recommendation, researcher proceeded to identify and invite subsequent participants through referral, following snowballing technique.

3.3.3 Recruitment

The population of this study included workers in various work departments within the selected rubber manufacturing plant, based on the research objective. Company A is a subsidiary of a large manufacturing group that employs over 50000 workers across its various operations. However, the exact number of workers under rubber production was not specified. For this study, the accessible population that fulfilled inclusion criteria was limited to 120 on-site workers stationed at the rubber processing plant. The inclusion and exclusion criteria of the participants were as follows:

Inclusion Criteria:

- *Occupation*: Workers currently employed at the selected rubber manufacturing plant in Malaysia (Company A).
- *Job role:* Workers who work at the rubber manufacturing facility. This includes workers who are regularly exposed to industrial odours in their daily work environment (e.g., those working in areas such as raw material storage, drying, or chemical treatment) and indirectly exposed on-site workers such as administrative workers in the office.
- *Minimum Work Experience*: Workers with at least 6 months to 1 year of experience in the rubber manufacturing industry, to ensure they had sufficient duration of exposure to industrial odours, which will influence development of habituation and risk perception biases.

Exclusion Criteria:

- *Workers with Olfactory Impairments:* Workers with sensory impairments would interfere with the study's focus on odour habituation and its impact on risk perception.
- *Temporary or Part-Time Workers:* Temporary or part-time workers who do not have long-term employment in the rubber manufacturing industry will not be exposed consistently to the odour and have the experience necessary to assess risk perception and habituation accurately.
- *Off-site Workers:* Workers that does not work at the rubber processing facility such as remote workers. For example, workers in management positions, unless they are directly involved in manufacturing or are regularly exposed to industrial odours.

Participants were recruited purposively to ensure representation of workers meeting the inclusion criteria with varying levels of odour exposure. The researcher collaborated with the Human Resources department to obtain a list of eligible workers. To further expand the sample, snowball sampling was employed by requesting initial participants and HR personnel to recommend other suitable candidates. Interviews were arranged at times convenient for participants to minimize work disruption. Participation was entirely voluntary, with confidentiality assured and the option to withdraw at any time without penalty. Before beginning, all participants were requested to sign a written consent (Appendix C) form reaffirming their rights to privacy and confidentiality of information they provide.

3.3.4 Data Collection Method

In this study, the data collection procedure involved several steps to guarantee the confidentiality of participants and also to ensure rigorous analysis.

Data collection was conducted in two phases:

Phase 1- Primary data collection: The primary data were gathered through in-depth semi-structured interviews and direct workplace observations. The interview sessions were conducted in person which constitutes face-to-face conversation in adherence to the ethical requirements and the participant's consent. Each interview session took around 15-20 minutes, and the participant's response was recorded in audio format with the participant's knowledge and consent. The researcher also took detailed notes and memos to capture key insights. Direct observations of participants at work were carried out to gain further insights into their behaviours and interactions in their workplace. The focus was given on the worker's safety behaviour such as PPE adherence and odour-related responses. This observational data supplemented interview results by providing actual behavioural response data. Data was collected until saturation of data is achieved. After the interviews and observation, the qualitative data obtained were transcribed, organized and prepared for coding and thematic analysis.

Phase 2- Secondary data collection: Secondary data were obtained from accessible online archival records to provide additional context and enable comparison on the behavioural trends in similar settings. This was done to supplement the finding's interpretation and support validation of the primary data.

3.3.5 In-depth Semi-Structured Interviews

This research was conducted using semi-structured, in-depth interviews as the main instrument. The main reason for this is because of the flexibility it offers. According to Osborne and Grant-Smith (2021), semi-structured interviews are common in qualitative research because it allows flexibility while accommodating various philosophical approaches. This is because of the freedom the participants have in the interview due to the open-ended nature of the interview questions. However, a preset of questions or guides is needed to steer the conversation. Elhami and Khoshnevisan (2022) highlighted how the interviews should be preplanned with general questions or topic guide that will serve as a base for the conversation or a conversation starter.

Therefore, a set of interview protocol (Appendix A) was constructed based on the research objectives. The interviews were conducted primarily in Bahasa Malaysia and English to cater for the participant's comfort and understanding. Participants' response functioned as indicators for determining key variables (odour habituation, risk perception, control measures and safety behaviour). Each key variables were examined through thematic analysis, derived from participant narratives, by using a coding framework to identify patterns.

3.3.6 Recording and Transcription of Data

The interview response was also made available in audio format with the participant's knowledge and consent. The transcription process followed a verbatim protocol, capturing participants' spoken words exactly as they were expressed, including pauses, filler words, and non-verbal cues where relevant. This approach ensures the authenticity and accuracy of the data, preserving participants' original meaning and tone. Verbatim

transcripts were essential for maintaining the integrity of qualitative analysis and supporting reliable interpretation. The interviews were manually transcribed in, with timestamp to allow for cross-checking. The participant's response and interviewer part are noted accordingly.

3.3.7 Translation of Data

Transcribed interviews were manually translated into English (word by word) by the researcher. The usage of phrases was chosen to appropriately signify the emotions and nuance of the responses. Cultural adaptation of idioms or phrases were also considered. For instance, slang terms such as *"mangli"* were translated to the closest meaning in English which is "used to it".

3.4 Data Analysis

In this study, data analysis was conducted using thematic analysis. To support the analysis process, the researcher opted for using The Systematic Thematic Analysis Process Model proposed by Naeem et al. (2023) that emphasizes on conceptualisation through interpretation. As highlighted by Naeem et al. (2023), the integration of inductive richness and deductive clarity can improve the theoretical strength of qualitative research. This is important because in this study, the analysis was informed by the Risk Perception-Unsafe Behaviour Formation Model which served as guiding analytical lens. The method proposed by Naeem et al. (2023) enabled the development of conceptual understanding based on the emerged themes through inductive analysis. Unlike relying entirely on a deductive approach, the proposed method allowed for a

structured interpretation that aligned with theoretical underpinnings of the study without restricting the nature of emerged themes.

3.4.1 Thematic Analysis Process

While the researcher integrated the proposed analytical model, the analysis still followed the basic six-step thematic process by Naeem et al. (2023), which is described as follows:

i. Data Familiarization: The researcher immersed themselves in the data by reading interview transcripts, observation notes, and related materials to gain an overall understanding.
ii. Keyword Selections: Key words and phrases were identified from the selected quotes to capture the essence of participants' statements.
iii. Coding: Relevant data excerpts were systematically coded and organized to represent meaningful concepts.
iv. Theme Development: Codes were grouped into broader themes and subthemes that reflected the research objectives and provided deeper insights.
v. Interpretation: Themes were interpreted within the theoretical framework to understand their implications for the study context.
vi. Conceptualization: Findings were synthesized into a conceptual model illustrating the relationships between key constructs and informing practical applications.

3.4.2 Data Familiarization and Keyword Selection

After transcribing the interviews, the researcher conducted an initial reading of the raw transcripts (Appendix D) and observation notes (Appendix G) and online records to gain a comprehensive understanding of the data. Key words and phrases were identified from the selected quotes to capture the essence of participants' statements.

3.4.3 Coding

This study employed integrated coding approach that combined model-derived categories with inductive coding of workplace themes. The extracted excerpt or data were systematically coded and categorized into a coding table (Appendix E). Appropriate codes were assigned to best reflect the content of the phrases. For example, the participant's quote "Alright, it's rubber odour. The smell of raw and processed rubber is different" was coded as 'Rubber Odours'.

3.4.4 Theme Development

The codes were categorized into key themes (Appendix F) that reflected the research questions, such as "Odour Experience and Habituation Spectrum," "Exposure Group Variation," and "Odour-Driven Risk Perception." Subthemes were also developed to give more dimension and support deeper interpretation. The categorized theme was refined to ensure they accurately capture the data, supported by specific quotes and observational notes (Appendix G).

3.4.5 Interpretation and Conceptualization

Conclusions were drawn from the themes and be structured within the Risk Perception-Unsafe Behaviour Formation Model. Implications for safety practices and risk

perception theory within the context of the rubber manufacturing industry was then discussed. Insights derived from the interpretive analysis were synthesised into an extended model (Figure 5.1) illustrating the interrelationships between odour habituation, risk perception, and safety behaviour. This model integrated feedback loops for control measure improvements, providing a dynamic representation of the study's findings.

3.5 Data Trustworthiness

The trustworthiness of this study was ensured through strategies aligned with the principles outlined by Ahmed (2024) ensuring credibility, transferability, dependability, and confirmability. These principles were operationalised within the six-step thematic analysis framework proposed by Naeem (2023), which provided a systematic, transparent, and data-driven approach to analysis. Moreover, credibility was reinforced through methodological triangulation, combining in-depth interviews with direct workplace observations along with archival record review to validate emerging themes. Together, these measures ensured that the findings remained firmly anchored in participant narratives while maintaining methodological integrity. The overall trustworthiness strategies are highlighted in the Table 3.1.

Table 3.1
Trustworthiness Strategies Applied in The Study

Trustworthiness Component	Strategies Applied	Application in This Study
Credibility	Prolonged engagement	Conducted on-site observations and in-depth interviews to build rapport and gain nuanced insights into participants' experiences.
	Reflexivity	Incorporated reflexive interpretation during coding to remain aware of and bracket researcher biases.
	Triangulation	Used interview data, direct workplace observations and archival record to cross-verify findings.
Transferability	Thick descriptions	Provided detailed descriptions of the study site, participants, and data collection process to enable readers to assess applicability in other contexts.
	Clear sampling strategy	Documented purposive and snowball sampling procedures with explicit inclusion and exclusion criteria.
Dependability	Methodological documentation	Outlined all stages of the research design and six-step thematic analysis process for full transparency.
	Audit trail	Maintained systematic records of transcripts, coding tables, theme development, and analysis decisions for traceability.
Confirmability	Reflexivity	Documented interpretative decisions within coding tables to ensure interpretations were firmly grounded in participant narratives.

3.6 Ethical Considerations

3.6.1 Ethical Approval

This study adhered to the strict ethical standards that was set by UUM Research Ethics Committee (JKEP UUM). Prior to data collection, the research proposal was submitted to the committee for reviewing the ethical requirements in the study design.

3.6.2 Institutional Concerns and Consent

The company that served as sampling site (where the participants were selected and interviewed) were contacted and requested for a written consent prior to recruitments of participants. The researcher also catered to the participant's need and arranged interviews at times convenient for each of them to avoid disruption of their regular duties.

3.6.3 Informed Consent Process

For each participant, written informed consents were obtained before the interview session. Participants were made sure that they understand the full research information sheet (available in bilanguage). This information sheets (Appendix B) outlined details about the potential risks and benefits of the interview, explanations about their voluntary nature of the participation and their right to withdraw from the interviews. It also included the measures taken to ensure their anonymity and confidentiality. Participants were also informed that they can choose not to answer any question or withdraw from the study at any time without consequences.

3.6.4 Risks and Benefits

There were limited risks associated with participating in this study. However, participants may still experience mild psychological discomfort while discussing past experiences. The direct and indirect benefits from participating in this study were also explained in the research information sheet.

3.6.5 Privacy, Confidentiality and Data Management

Pseudonyms were used to protect both participants and the company. Participants from direct exposure group was assigned the prefix "D" (e.g., D-1, D-2) and indirect exposure group "I" (e.g., I-1, I-2). These pseudonyms were used consistently in the transcript, analysis and thesis to ensure anonymity. No identifying information was included in the final thesis. Audio recordings and transcript were stored and accessed by the researcher only for analysis purpose and will be destroyed after a stipulated time.

3.6.6 Declaration of Conflict of Interest

The researcher declared no conflicts of interest related to this study. This means that the researcher had no financial, personal, or professional affiliations that could inappropriately influence the conduct, outcomes, or reporting of this research.

3.7 Summary of Chapter

This chapter has described the methodological foundation of this study. This includes the best strategies to conduct this study and its justifications. The chapter introduces the qualitative framework the study design for allowing in-depth insights from workers in the rubber manufacturing sector to be obtained. By clearly defining variables, selecting appropriate sampling methods, and utilizing robust data collection and analysis techniques, the chapter establishes the reliability and validity of the research approach. Together, these elements form the groundwork for addressing the research objectives of this study.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the qualitative findings from the in-depth interviews conducted with selected workers at a rubber manufacturing plant (Company A). The participants were categorized into direct exposure (4 workers) and indirect exposure groups (4 workers) according to their work roles (see Table 4.1). The table summarised the participant's demographic and information critical for interpreting the findings. Data were analysed thematically and organised according to the four research objectives, with major themes and subthemes supported by participant's quotes. All excerpts are presented in original language used during interviews, followed with English translation provided for clarity. The analysis provided insights into how workers perceive, experience and respond to odour habituation in their workplace. Extended discussions for each theme and subthemes, including theoretical interpretation are presented in the following chapter.

Table 4.1
Participant's Information

Exposure Group	ID	Gender	Age	Job Role/Title	Department/Work Location	Main Tasks	Experience in Current Role (Years)	Total Experience in Rubber Manufacturing (Years)	Shift Pattern
Direct	D-1	Female	49	Operator	Raw Material Department	Receive and deal with raw rubber	3	17	Office hours
Direct	D-2	Male	39	QC Operator	Production	Processing of Rubber	1	3	Rotating shift
Direct	D-3	Female	41	Dispatch Operator	Logistics	Dispatch of raw and produced rubbers	10	17	Office hours
Direct	D-4	Female	43	Laboratory Assistant	Laboratory	Testing of raw materials	7	7	Office hours + OT
Indirect	I-1	Female	29	QC/QA Admin	QC/QA/Office	Management for QC/QA	5	5	Office hours
Indirect	I-2	Male	57	Dispatch Manager	Logistics	Management for Logistics Department	30	38	Office hours
Indirect	I-3	Male	46	Production Supervisor	Production	Supervision of Production and Raw Material	12	20	Office hours
Indirect	I-4	Female	25	HR Admin	Human Resources/Office	Administration of HR Department	5	5	Office hours

Note: Prefixes used for participant ID (D =Direct Exposure Group) and (I = Indirect Exposure Group).

4.2 Occurrence of Odour Habituation Among Different Exposure Groups

This section presents an analysis on the odour habituation occurrence among workers from different exposure groups, Direct (D) and Indirect (I) in the rubber manufacturing environment. There were several critical dimensions emerged from the analysis, which include variation in initial odour responses, the development of habituation and desensitisation reversibility among the workers. The differences in habituation experience between the exposure groups were also explored along with factors that acted as catalysts for adaptation. The findings are outlined in the following subsections.

4.2.1 Initial Odour Reactions

When asked to describe the of odours they usually encountered and their initial reactions, participants reported varying response that reflects unpleasantness:

> *"Saya tak boleh terima. Waktu interview pun macam tak boleh terima, ya lah bau kuat."* (Participant I-1)
>
> ["I could not stand it. Even during the interview, I could not tolerate it, yes, the smell was strong"]

While other participants added on how the odour lingered even after work:

> "*... lepas tu sampai balik pun anak kata, "Woi ibu bau busuk, pergi mandi dulu.", macam tu sekali dia melekat ke baju kita.* (Participant D-1)
>
> ["…when I went home, my kids said, "Wow, mom, you smell bad, go take a shower first.", that is how it is, it sticks to our clothes."]

However, while most participants reported tolerance to the odour, a few of them experienced physical discomforts from the exposure of the odour:

"Macam kena sakit kepala sikit lah. Ada lah juga sikit-sikit." (Participant D-4)

["Like I got minor headache. Got a little bit of reactions."]

Meanwhile another participant described how she coped with the discomfort by emotionally detaching from the odour for her family:

> *"Masa mula-mula tu memang orang kata tak tahan juga. Tapi bila fikir "aish, aku nak cari duit untuk keluarga, aku kena tahan bau ni", Jadi tahan lah."* (Participant D-1)
>
> ["At first, yeah, I would say that could not stand it. But then I thought, " I need to earn money for my family, I have to endure this odour", so I did"]

These excerpts illustrate that initial exposure to industrial odours was perceived as overwhelming and unpleasant. Although some of the workers may tolerate the odour, some of them still had psychological and physical discomforts.

4.2.2 Habituation Development

Following initial unpleasantness with the industrial awareness, most of the participants agreed that there is a shift in their odour sensitivity over time. Participants exhibited varying timelines of adaptation, with some showing rapid habituation within hours of exposure:

> *"... lepas interview pun macam dah familiar dah. Macam cepat je familiar, sekejap je. Mungkin dah biasa pun."* (Participant I-1)
>
> ["After went back out after the interview, I already felt familiar with the smell. It was quick—maybe I just got used to it."]

While others reported rapid habituation occurring over a few days of working:

> *"Rasa macam sekejap lah, tak sampai…tak makan tahun lah. rasa dah 2-3 hari datang, dah biasa."* (Participant D-2)
>
> ["It felt like it was quick, did not take long. Not even years — felt like just 2–3 days and I was already used to it."]

However, most participants, from both direct and indirect exposure groups described gradual habituation:

> *"Ada perubahan la, lama dah biasa lah. Dah mangli (lali) lah. Tak ada apa dah lah."* (Participant D-4)
>
> ["There is a change, I have gotten used to it over time. I am desensitized now. It is nothing anymore."]

Additionally, some of them reported a complete internalization of the odour:

> *"Sebab kita dah biasa hari-hari. Bau dah jadi macam sebati lah. Kita dah tak bau apa dah.* (Participant I-3)
>
> ["Because we are used to it every day. The smell has become a part of us already. We do not smell anything anymore."]

The narratives highlighted how habituation happens upon industrial odour exposure. While the timeline and extent of habituation varied among the workers, the major trend indicated an overall decline in awareness of the odour. This was observed across both exposure groups, suggesting that every worker is susceptible to odour habituation.

4.2.3 Reversible Sensitisation

While most of the participants reported being gradually habituated to the odour, some of them shared that they regained sensitivity after being away from workplace:

> *" Kami macam bila tiba dalam ni kan, memang tak rasa dah getah tu bau busuk. Tapi bila duduk luar daripada kilang, bau lah."* (Participant D-3)
>
> ["When we are inside the factory, we do not smell the rubber stink. But once you are outside, you can smell it."]

While others reported that they were more sensitive to the odour after changing work role, particularly from direct exposure to indirect exposure group:

> *"Kita duduk di bahagian pejabat ni, dia ada sekali-sekala tu, dia bau lah. Sekali-sekali tu ya. Tapi, masa saya duduk di bahagian proses tu, memang tak ada apa-apa lah. Dia ada datang (bau) sebab lama kita dah tinggal"* (Participant I-3)
>
> ["In the office area, once in a while, you will smell it. Just occasionally. But when I was working in the processing area, I did not notice anything. The smell returns because we have been away from it for a while."]

These examples revealed that desensitisation was affected by odour exposure duration and short absences can reinstate sensitivity and awareness to odours after some time.

4.2.4 Direct vs Indirect Exposure Differences

Participants experienced significant differences in level of exposure to odour in their workplace. These role-based exposure differences influenced development of odour habituation among the workers. For instance, most of directly exposed workers assumed that everyone is uniformly exposed to the odour:

> *"Kita sama, sama. Sebab kita kerja kilang getah, bau tu memang ada."* (Participant D-1)
>
> ['We are all the same. Because we work in a rubber factory, the odour is there."]

Despite this general perception among direct exposure group, some participants did acknowledge the difference in the odour intensity, especially in the processing area:

> *"Sama saja. Ya, bila masuk saja dalam kilang, Kawasan kilang ni. Biasa dah kalau kami semua. Kalau macam nak bau itu memang… kata macam bau busuk sangat, dekat bahagian proses lah."* (Participant D-3)
>
> [It is the same. Yeah, once we enter the factory area, we are already used to it. If talking about extreme bad odours, it is usually in the processing area.]

Meanwhile, most of the indirectly exposed workers noted that they remained more sensitive (retained sensitivity) to the odour as compared to those in production area:

> *"... orang duduk dekat pejabat ni, dia akan mudah bau lah. Kalau duduk di bawah ni (bahagian proses), dia kurang dah (kesedaran)".* (Participant I-3)
>
> ["…those who sit in the office will be more sensitive to the smell. "If you are downstairs (production), it is reduced (awareness)']

Another participant added that regular exposure made habituation more likely to happen among those in the direct exposure group:

Kalau saya rasa, orang yang selalu terdedah ni dia pun dah terbiasa lah benda tu. Dah tak ada masalah dah. Lebih mudah terbiasa, Berbanding kita jarang-jarang bau kan. (Participant I-4)

["I think people who are regularly exposed to it have gotten used to it. It is no longer a problem. It is easier for them to get used to it compared to those who rarely smell it."]

Overall, the findings reflected on the role-dependent variation among the workers. Indirectly exposed workers tend to retain greater sensitivity compared to directly exposed workers.

4.2.5 Adaptation Catalysts

In addition to exposure variation, there are other factors identified as catalysts that influenced how workers developed odour habituation. For example, some participants believed that habituation to odours was subjective and dependent on individual differences:

Benda ni bergantung pada individu. (Participant D-1)

["It depends on the individual."]

Others noted that their familiarity with the rubber from childhood contributed to their adaptability:

Semua macam peneroka semua getah lah, tanam getah. Macam kami biasa. Tak ada lah kata pening ke biasa lah. (Participant D-3)

["Everyone was involved with rubber tapping, planting rubber. We are used to it. It does not make us dizzy or anything — it is just normal."]

While some participants reported that living nearby the factory contributed to their familiarity with such odours. For them, the smell had become a part of their daily life:

> *"Tapi saya duduk dekat sini dah lama, rumah pun dekat sini. Jadi macam dah terbiasa bau getah dekat sini."* (Participant I-4)
>
> ["I have stayed around here for a long time; my home is also nearby. So, it is like I am used to the rubber smell here"]

Additionally, some of them had past working experiences with various types of odours, which improved their tolerance to the odour produced from rubber manufacturing:

> *"Lagipun akak dah biasa banyak kerja. Jadi macam-macam kerja, macam-macam bau kita dah pernah alami. Jadi kita dah biasa lah puan."* (Participant D-1)
>
> ["Besides, I am already used to doing all sorts of jobs. Different jobs, different odours — I have experienced them all. So now, I am used to it, madam."]

The above extracts highlighted that odour habituation is not purely a result of exposure, but it is also contributed by personal and social factors.

4.3 Impact of Odour Habituation on Worker's Risk Perception Biases

This section presents the analysis on the extent of risk awareness and impacts of odour habituation on how workers perceive and respond to risks in their workplace. The following subsections present the emerged key findings regarding the risk perception biases along with associated psychological and environmental factors.

4.3.1 Cognitive Biases

The analysis found that at the cognitive level, worker's perception of risk was shaped by assumptions that downplayed the relevance of odour as a safety concern. For example, the following excerpt illustrates how workers undermine risk due to perceived impermanence of odour exposure:

> *"Ya, tak pernah risau. Sebab bau saja kan. Macam bila kita balik rumah, kita boleh mandi. Betul tak? Kita boleh sabun banyak-banyak. Bau itu hilang."* (Participant D-3)
>
> ["Yeah, I have never been worried. It's just an odour, right? Like when we get home, we can shower. Right? We can use lots of soap. The odour will go away."]

While some participant compared the rubber odour to daily life experience, using familiarity heuristics as a cue for safety:

> *"Macam bau ni tak ada kena mengenai dengan kesihatan kita. Sebab dia macam, contoh kata macam sampah… Sampah bila bau pun sama juga kan-busuk juga"* (Participant D-1)
>
> ["Like the odour issues, no concerns. Because there is no connection to our health. Because it is like, for example garbage… Garbage also smells, also stinks."]

Over time, workers normalised the presence of odour and assumed that, since there were no immediate or past accidents caused by the smell, it was no longer a cause for

concern. For example, the following excerpt exemplifies the presence of both normalcy and optimism biases:

> *"Tak risau lah, tiada kes lagi lah. Tak tahu lah, mungkin dah umur 50 orang macam nanti, tak tahu… Sebab ni, kita muda lagi."* (Participant D-2)
>
> ["I am not worried, there is no cases. I do not know, maybe when we are 50 or older, not sure... Because now, we are still young."]

Another more concerning form of bias to highlight was cognitive detachment to risks, particularly among long-term workers:

> *"Tak bahaya… Macam dah, dah lalilah senang cerita."* (Participant D-2)
>
> ["Not dangerous… It's like, we have become numb to it, simply put."]

These findings suggest that odour habituation influenced worker's appraisal of risk by reinforcing assumptions that downplay the associated hazards from the odours due to its familiarity. Such assumptions were manifested in form of normalisation, rationalisation or dismissal of hazards due to repeated exposure to odours.

4.3.2 Behavioural Biases

At the behavioural level, odour habituation led to a conditioned desensitization where participant's responses diminish due to repeated exposure. This can be observed within observable behavioural adaptations. For instance, conditioning led workers to attentional filtering odour-related information unless it violated their expectations. This is especially true for direct exposure workers:

"Biasa dah proses, dah masak. dia bau macam getah dah masak, macam tu lah. Kalau bau-bau lain tu, saya tak pasti pula… susah nak nilai." (Participant D-2)

["Once it has been processed, heated, it smells like cooked rubber, that's all. As for other odours, I am not sure… hard to judge."]

Despite general habituation, participants expressed concern when there were changes in the odours especially for those perceived as 'chemical' or unnatural, indicating selective odour sensitivity:

"Ya, kalau saya bau yang macam busuk-busuk tu okey sikit tapi bila yang dia bercampur chemical. Yang tu bagi saya macam ada concern sikit lah." (Participant I-1)

["Yes, if I smell something that is smelly, it is okay a bit. But when it is mixed with chemicals… That is when I start to get a bit concerned."]

Interestingly, some participants noted fear of losing such sensitivity over time, reflecting meta-awareness on the potential overall habituation to the odour:

"Tapi kalau dah biasa, mungkin lah. Kita dah duduk bawah tu, pergi hari-hari. Mungkin nanti dia akan jadi dah terbiasa. Mungkin masih ada sikit. Lama-lama takut terbiasa." (Participant I-1)

["But if we get used to it, maybe. We have been downstairs, going there every day. Maybe we will eventually just get used to it. There might still be a little sensitivity. But over time, I am afraid of becoming too used to it."]

Similarly, intermittent risk awareness phenomenon further confirmed the behavioural conditioning:

'Saya masih fikir lah. Walaupun tak ada la hari-hari." (Participant I-4)

["I still think about it, even if it is not daily... "]

These findings indicate how behavioural conditioning shapes risk perception, by extending over habituation's effect of dulling the worker's awareness throughout time..

4.3.3 Social Conditioning of Risk Perception

Participants' risk perception was also shaped by their social environment. Many workers had internalised odour exposure and considered it as a part of normal job, reinforced by peer acceptance to the odours:

> *"Pada pendapat saya rasa, tak tahu dah apa ni kan. Kita macam biasa dah. Berbelas-belah tahun dah duduk sini, bau getah tu rasa macam bila duduk kat luar pun rasa macam orang boleh kenal kita kan."* (Participant D-3)
>
> ["In my opinion, I do not know it anymore. We are just used to it. After many years here, the smell of rubber becomes so usual that even outside the factory, people can recognize us by it"]

Participants also attributed their lack of concern associated to odours due to social normalization of rubber odour. For instance, the community experience and their background shaped how they perceive and responded to the odours:

> *"Saya tak fikir pula. Dalam suasana yang memang, daripada kecil sampai besar lah. Sebab terbiasa. Saya tak risau lah"* (Participant I-3)
>
> ["I did not really think about it. I have been in this environment since I was a child. Because I'm used to it. I am not worried."]

> *"Kalau bau tu biasa lah. Anak-anak peneroka, duduk bau getah dah lama. Pasal bau tak, tak fikir."* (Participant D-4)
>
> [We, the settler's children have been smelling rubber odours for a long time. Regarding the smell—no, I do not think about it"]

Additionally, social dynamics also contributed to hierarchical differences in risk perception based on workplace roles. Those from indirect exposure roles reported more concern despite infrequent contact with the odours:

> *"Kalau kami yang duduk dalam pejabat… tak ambil risiko. Tak ada la kisah sangat dah. sebab jarang-jarang jumpa. Tapi untuk pekerja bawah tu... Kasihan juga lah dekat bahagian bawah, risiko kepada kesihatan mereka."* (Participant I-4)
>
> ["Those of us working in the office… we do not really take risks. We do not really care much, since we rarely encounter it. But the ground workers... I do feel sorry for those on the ground (production) it is a health risk for them"]

These excerpts illustrate how social conditioning reinforced odour normalisation and affected how risk was perceived across different exposure groups.

4.3.4 Environmental and Perceptual Risk Cues

Although most participants had normalised the odour in their workplace, certain sensory and visual cues may reactivate risk awareness. For example, a participant described visible damage as a concern, indicating odour-related risk awareness:

> *"Kalau kita tengok, di besi, semua reput, kesan daripada asid. Asid kan daripada getah... Tapi jadi besi macam tu… kita bernafas pun macam tu"* (Participant I-3)
>
> ["If we looked at the metal, all corroded, the effect of acid. The acid that comes from the rubber...But just like the metal... we were also breathing that in."]

While participants with production knowledge associated specific smells with process, aiding judgement on what was normal or not:

> *"Kalau kita ada di bawah (bahagian pengeluaran) kita boleh beza bau sekerap, bau asap."* (Participant I-3)
>
> ["If we are on the ground (production), we can distinguish between the smell of rubber scrap and smoke."]

Some workers did report unfamiliar odour vigilance, where they became more alert:

> *"Ya boleh nilai lah, bila ada bau macam tu. Macam tahun lepas kita ada terima getah daripada Afrika, duduk dalam kontena tiga, empat bulan… so dia dah keluarkan bau bahan kimia."* (Participant I-4)
>
> ["Yes, you can judge based on the smell. Like last year we received rubber from Africa, stored in freight containers for three or four months… so it released chemical odours."]

While habituation reduced baseline risk awareness, certain environmental and sensory cues such as corrosion and odour attributes could override desensitisation and reinstate caution.

4.4 Role of Risk Perception in Safety Behaviour

This section presents the analysis on how risk perception distinctions that is linked to odour habituation influenced worker's safety behaviours. The analysis revealed that some participants were motivated to comply with safety protocols due to several factors classified as compliance drivers. While others demonstrated complacency due to interrupting factors categorised as non-compliance drivers and behavioural gaps. The drivers and gaps are presented in the following subsections.

4.4.1 Compliance Drivers

Participants who demonstrate higher risk awareness due to prior knowledge from formal protocols or training were more likely to engage in proactive safety behaviour. This is especially true for workers in high-risk areas like laboratories where there are various hazardous chemicals:

> *"Saya ikut (langkah keselamatan). Sebab kita takut bahaya. Sebab dekat lab, kita berhadapan dengan chemical macam-macam kan. Lepas tu kita pergi kursus pun dia orang cakap chemical ni macam mana reaksi dia."* (Participant D-4)
>
> ["I follow (the rules). Because we are afraid of the danger. Because at lab, we deal with various chemicals, right? And when we attend training, they explain how these chemicals react."]

While some participants reported compliance with safety precautions due to SOP, which was a form of habitual compliance:

> *"Rasa tak menjejas kan. Saya masih ikut SOP lagi."* (Participant D-2)
>
> ["I do not think it affects anything. I still follow the SOP."]

There were proofs that some workers overrode habituation by conscious risk prioritization:

> *"Kalau dia dah terbiasa ni kita tak boleh nak cakap. Tapi kalau dia fikir keselamatan dia, kesihatan dia, dia kena itu la… dia kena apa orang panggil? Kena pakai PPE.* (Participant D-1)
>
> ["If they have already gotten used to it, we cannot say anything. But if they think about their safety and health, they need to… what do you call it? They need to wear PPE."]

While others demonstrated proactive safety response when any abnormal incidents occurred:

> *"Kalau saya tengok kat mana... Kalau boleh cari sumber dulu kan kalau boleh? Tengok sumber dia kat mana... Kalau boleh take action atas sumber itu... Kita ambil action lah."* (Participant I-1).
>
> ["I would look at where it is coming from… If possible, identify the source first, right? Find out where the source is… and if action can be taken on the source… then we take action."]

Others described active risk vigilance in the work environment due to their work role:

> "Saya peka… Sebab saya duduk QC. Quality control." (Participant D-2)
>
> ["I am alert… because I work in QC, quality control."]

This was also linked to supervisory roles:

> *"Kalau bau, saya akan tanya, kenapa bau lain ni. Siasat dulu. Kemudian kita pergi beritahu majikan lah. Kira kata report lah."* (Participant I-3)
>
> ['As for odours, I will ask, why does this smell different? Investigate first. Then we inform the employer. Basically, we report it."]

These excerpts highlighted the factors that contributed to worker's safety compliance.

4.4.2 Non-compliance Drivers

Participants who had become desensitised to the odour reported no concern for following safety measures. For instance, upon asked about whether the workers tend to disregard PPE because they were used to the odour, one participant responded:

> *"Ya, selalu juga lah. Betul lah. Dia rasa, 'Tak payah lah, ini tak bahaya pun kan'".* (Participant D-3)
>
> ["Yes, it happens often. That's true. They feel like, 'No need, this isn't dangerous anyway'."]

Gradual habituation to the odour and social acceptance further reinforced this behaviour, especially among long-term workers:

> *"Sebab dah terbiasa... kita pun dah tak pakai mask. Kita dah biasa bau dah. Kadang tu dah sampai tak bau dah."* (Participant I-3)
>
> ["Because we are used to it... we do not even wear masks anymore. We have gotten used to the smell. Sometimes we do not even smell it anymore."]

While PPE was generally available at the workplace, some worker opted for self-improvised protection:

> *"Bau yang kuat selalu. Ambil kain la kut, tudung (tutup hidung)"* (Participant I-4)
>
> ["Usually if there is a strong smell. Just grab a cloth maybe, cover (to cover the nose)"]

Compliance to safety protocols was often conditional, determined based on task demands. This is known as task-dependent selective compliance:

> *"Dia tengok keadaan tempat. Kalau tempat itu kurang terdedah pada tu (bahan kimia), tak pakai mask. Tapi kalau yang terdedah pada benda, akan pakai. Untuk bau, tak pakai pun."* (Participant I-2)
>
> ["It depends on the area. If the area is less exposed to it (chemical), I do not wear masks. But if there is exposure to things, then I will wear them. As for odours, I do not wear them."]

When asked about conformity to safety precautions, some workers demonstrated a perceived irrelevance of odour to SOP, especially among those who views odour as nuisance but not dangerous:

> *"Rasanya macam bau ni tak memberi kesan dekat tempat kerja pun. Dia tak menjejaskan pada kerjalah untuk bau ni, walaupun ada bau."* (Participant D-1)
>
> ["I feel like the smell does not affect the workplace at all. It does not affect work, even though the smell is there."]

Non-compliance was also shaped by peer behaviour and social influence. For example, the bandwagon effect of normalisation was especially evident among new recruits at the workplace, who adopted the observed behaviour instead of independent reaction:

> *"Kalau ada pakai mask tu, saya tak pasti pula kan, hehe. Sebab saya mula-mula kerja pun tengok mereka pun tak ada pakai mask… Saya pun tak pakai lah."* (Participant D-2)
>
> ["If there were masks, I am not sure, haha. When I started working, I saw no one wearing masks… So, I did not wear it either."]

This excerpt illustrated how conformity to observed behaviour outweighed formal instructions, resulting in widespread non-compliance in the presence of known hazards.

4.4.3 Behaviour Gaps

Despite recognising risks, some workers demonstrated discrepancies between risk perception and their safety practices. For instance, some workers displayed resignation to risk, accepting that the odour is unavoidable and there is nothing can protect them:

> *"Sebab tak tahu dah nak buat apa-apa. Kalau nak lari pun tak boleh juga… Memang kena duduk situ kena buat juga tu."* (Participant I-4)
>
> ["“Because we do not know what else to do. Even if we want to run, we cannot. We have to stay and get the job done."]

There were also cases of externalisation of risk, where safety decisions were deferred to the management:

> *"Memang kalau ada macam tu (kejadian luar biasa), biasa kak akan berurusan dengan penyelia dulu"* (Participant D-1)
>
> ["Usually if something (unusual) like that happens, I would deal with the supervisor first."]

In several instances, workers relied on informal communication chains rather than formal reporting or safety protocols:

> *"Tak ada (siasat). Selalu mereka dah bagitahu kan. Macam duduk sini semua akan bau… Oh bau pelik ni. Nanti ada lah yang sampaikan."* (Participant I-4)
>
> ["No investigation. Usually someone will say something. Like, if we are here, everyone will smell it… 'Oh, that weird smell.' Then someone will inform others"]

The same participant also highlighted that there was often inaction due to role boundaries:

> *"Macam bau yang kuat, bau kimia, saya tak buat apa-apa. Saya maklumkan dulu la… dekat bahagian macam Makmal ke.. Mereka lagi kenal kan. Bahan kimia macam mana nak handle"* (Participant I-4)
>
> ['Like strong smells, chemical odours, I do not do anything. I will inform… maybe the lab department. They know better how to handle chemicals."]

The above excerpts reveal a gap between risk awareness and decision ownership, where workers tend to act as silent observers or messengers rather than acting upon any incidents. Preceding findings in this section also highlighted other behavioural gaps that contribute to limited individual accountability and detachment from proactive safety.

4.5 Control Measures Addressing Odour Habituation

This section presents the insights about how risks related to odour were currently managed in the rubber manufacturing context, specifically on control measures to mitigate effects of habituation due to the prolonged exposure. This includes an overview on existing control measures, identified gaps and the recommendations by the workers for improvement at the workplace.

4.5.1 Current Control Measures

The reported control measures for mitigating the odour exposure in the workplace included basic protective equipment particularly PPE. Although there were engineering controls such as ventilation system and scrubbers, most of the participants emphasised on the provision of face masks as the main control measure in place:

"Mask je... Kita dah buat sistem serombong (serombong asap)" (Participant I-3)

["Just masks. We have installed a chimney system. (smoke chimney)"

While for high-risk zones such as in laboratory mandated a more comprehensive controls, especially for procedures that contribute to more exposure:

> *"Macam exhaust fan pun bila kita melakukan proses untuk testing tu kita akan biasa buka fan tu. Pakai mask. Lepas tu kita pakai respirator. Sebab kita akan buat proses 'dirt'. 'Dirt' akan bau dia lebih kuat.* (Participant D-4)
>
> [We usually turn on the exhaust fan when doing testing processes. We wear a mask. Then we use a respirator, because the 'dirt' process has a stronger smell.]

Though some participants confirmed receiving training, most of them were on PPE usage and chemical handling:

> *"Untuk bau tu tiada tapi untuk chemical tu ada lah. Kalau handle pakai PPE betul-betul. Lepas tu cara semua handle kalau tumpah macam mana. Ada SOP dia lah."* (Participant I-1)
>
> ["For odour, there is nothing, but for chemicals, yes. If handling (chemicals) must wear proper PPE. And then the procedures, like if there are spills, ways to manage it. There is SOP for that."]

Reminders were sometimes provided:

> *"Selalu, kita punya bos yang kita akan beritahu (peringatan). Saya pun akan beritahu kepada pekerja."* (Participant I-3)
>
> ["Usually, our boss will tell (reminder). I also remind the workers."].

These findings suggested that the control measures implemented were primarily reliant on basic protection and ventilation systems. While some areas have enhanced controls, overall administrative measures were lacking. Other gaps will be explained in the following sections.

4.5.2 Gaps in Existing Controls

There were significant gaps identified in physical protection and administrative preparedness. For example, there were contradicting views regarding the presence of administrative controls for odour exposure. Some participant noted a lack of administrative oversight:

> *Tak ada (kawalan administrasi). Untuk berbau kurang. Untuk benda yang lain tu, ada lah keselamatan macam... Dari segi duduk ke... Rotation kan... Untuk bau macam tak ada sebab kurang.* (Participant I-4)
>
> ["There are no (administrative controls). For reducing smell. For other things, there are safety measures... like seating or rotation... but for smell, there is nothing because it is considered minimal."]

While others raised uncertainties regarding SOP associated to odours:

> *"Saya tak pasti… Saya tengok SOP ni banyak kepada keselamatan. Untuk bau ni, saya tak pasti pula ada SOP untuk tu."* (Participant D-2)
>
> ["I am not sure… From what I see, the SOPs mostly focus on safety. As for odours, I'm not sure if there is an SOP for that."]

Most participants highlighted that there was lack of odour-specific training:

> *"Kalau pasal bau memang tak ada, kalau pasal macam untuk mata ke... Yang itu ada lah kan. Untuk bau. Untuk bau memang tak ada lah.Sebab kami biasa dah. Kira dah lali dengan bau ni."* (Participant D-3)
>
> ["When it comes to odour, there is really nothing. But for things like the eyes, yes, there is. For odour, definitely nothing. Because we are used to it. You could say we have become desensitized to the smell."]

Some of them highlighted the lack of refreshment training:

> *"Tak ada lagi tu. sebab saya pun baru kerja.. 3 tahun. Yang kerja lama-lama tu mungkin ada pendedahan pasal ni. Mungkin ada lah."* (Participant D-2)
>
> ["There has not been any yet. Because I am still quite new… 3 years. Those who have worked longer might have had exposure to this. Maybe they have."]

Frequent, structured reminders were also noted as insufficient:

"Kurang peringatan. tapi ada… cuma tak ada lah kerap" (Participant I-4)

["Less reminders, but there are… just not frequent."]

There were also limitations in the provision of protective gear as workers doubt its relevance due to habituation:

"Kalau macam mask tu, macam tak ada apa (kesan). Sebab dia dah tak bau." (Participant I-3)

["As for the mask, it feels like it does not do anything. Because they do not smell anything"]

The standardised approach to personal protection did not suit all situation or individuals, revealing a one-size-fits-all approach is not practical:

> *"Kadang-kadang dia tengok pada individu. Pakai mask pun kadang-kadang ada individu yang tak boleh juga pakai mask. Sebab dia akan semput. Itu masalah juga."* (Participant D-1)
>
> ["Sometimes it depends on the individual. Some people cannot wear masks because it makes them breathless. That is also a problem."]

> *"Lagi satu, kerja yang mereka buat tu kadang... Bagi face mask tu, ada juga waktu tak sesuailah nak pakai kan…"* (Participant I-4)
>
> ["Another thing, their work sometimes... We give that face mask, but there are times it is not suitable to wear them."]

Generally, most of the participants pointed out that the current control measures were insufficient in controlling the effect of odour habituation among workers:

> *"Itulah kita dah bagi. Kalau dia pakai, berkesan lah. Kalau tak pakai, tak berkesan… Cuma dari segi kesediaan, kita dah lepas lah. Dari segi pekerja, tak berkesan."* (Participant I-2)
>
> ["We have already provided it. If they wear it, it is effective. If they do not, it is not effective… In terms of readiness, we have done our part… But in terms of the workers, it is not effective."]

Additionally, because of habituation, many odour-related concerns often go unreported:

> *"Macam kita. Sebab sebenarnya tak ada siapa mengadu benda-benda macam ni. Sebab semua orang dah terbiasa, tak ada siapa mengadu. Ini masalah baru ni."* (Participant I-3)
>
> ["For us, it is actually because no one complains about these things. Everyone iis already used to it, so no one reports it. This is a new issue."]

The findings indicate that existing controls were not enough in addressing the behavioural and perceptual challenges from habituation. These gaps called for interventions, as recommended by the participants in the following subsection.

4.5.3 Recommended Improvements

Participants acknowledged the insufficiency of the implemented controls at work and proposed several improvements. For instance, one participant highlighted the importance of understanding the reasons behind why protocols were made:

> *"Untuk saya lebih pada kita tackle dulu mengenai kesedaran…Lepas tu baru lah kita suruh orang tu ambil langkah apa. Kalau dia tak faham kenapa dia buat, dia takkan buat."* (Participant I-1)
>
> ["For me, we should tackle awareness first… Only then we tell people what steps to take. If they don't understand why they are doing it, they will not do it."]

While another participant highlighted the importance of reminders:

> *"Kita kena selalu peringat. Make sure seminggu kali tu kena mengingat. Barulah nak ingat. Sebab kadang-kadang takut terlupa kan...Kalau kita tak beritahu kadang-kadang boleh lupa. Kita sendiri terlupa."* (Participant I-3)
>
> ["We must always remind. At least once a week we should remind. Only then people will remember, because sometimes we forget… If we do not remind, people can forget. Even we ourselves forget."]

This reminder could be included in routine briefings. One participant shared why such briefings should be done because of its practicality:

> *"Kita bagi taklimat tu lah. Yang paling mudah pun, kita buat macam tu."* (Participant I-4)
>
> ["We give briefings. It is the easiest, that we can do"]

While some participants insisted on stricter enforcement or penalties:

> *"... Tak pakai kena ada tindakan. Tindakan yang berat sikit lah."* (Participant D-4)
>
> ["… If they do not wear it, got disciplinary action. A slightly stricter action"]

And others preferred positive reinforcement to encourage PPE usage:

> *"Bagi apa-apa pun. Insentif lah rasa. Bila pakai ni dapat ni kira-kira. Mungkin buat lah."* (Participant D-3)
>
> [Give anything. Incentives, I think. Like, if wearing it gets you something. Maybe people will do it."]

Workers did acknowledge that PPE alone might not enough to address odour exposure. Some participants suggested an enclosed or isolated processing areas but there were practicality constraints:

> *"Tapi tu kena buat macam bangunan yang tertutup. Tapi itu melibatkan kos. Dia bila tutup bahagian tu… Cuma isolated ni agak susah."* (Participant I-2)
>
> ["But that need to build like enclosed building. But that involves cost. When you close off the area…but isolation is quite difficult."]

Additionally, one participant stressed on the importance of reporting:

> *"Kalau ada orang cerita, buatlah. Pasal risiko macam mana, apa punca dia. Jadi, kalau ada efek apa pun… okey, kita beritahu kan"* (Participant I-3)
>
> [If someone brings it up, then action will be taken. About the risks, what causes it. So, if there is any effect, we will report it, okay"]

The recommendations highlighted the need to go beyond basic protective measures and consider individual differences for the interventions. These insights provided a base for a more integrated approach, which will be discussed by the researcher in the next chapter.

4.6 Triangulation Summary

To strengthen perspectives provided by the participants, direct observation was also conducted across several workplace zones as a part of data triangulation (Appendix G). The triangulation summary is outlined in the following table.

Table 4.2
Triangulation Summary

Subsections	Interview Insight	Observation Support	Interpretation
Odour Habituation (Section 4.2)	Workers reported getting used to odour time. Indirectly exposed workers tend to retain sensitivity to the odour.	Production staffs showed no response to the surrounding odour. Office workers retained sensitivity and showed reactions (covered nose) when worker from outside came into the place.	Habituation varied but not limited by exposure level. Indirect workers showed some sensitivity.
Risk Perception Biases (Section 4.3)	Odours perceived as harmless and not worth worrying for.	Mask usage was rare outside of the production site despite of the persistent odour in the whole area. Flies were seen as more annoying than the unpleasant smell.	Risks were normalised due to habit and social framing.
Safety Behaviour (Section 4.4)	PPE compliance varied across location.	Inconsistent mask usage outside labs. Workers improvised using scarves, perfume for covering the smell.	Safety practices relied on perceive comfort and practicality.
Control Measures (Section 4.5)	Participants claimed controls existed but often ignored or seen as ineffective.	Lack of enforcement observed. Associated rubber smell is strong despite of having scrubber installed. Odour nuisance rarely reported to management	Controls lacked enforcement. Workers perceived it as insufficient and irrelevant.

4.7 Summary of the Chapter

Chapter 4 presented the findings key findings, organised according to the research objectives. Drawing from interviews, the chapter explored workers' experiences of odour habituation, its influence on risk perception and safety behaviour. Direct observations were used to triangulate the findings, with the summary provided at the end of this chapter. These findings provide the empirical basis for the discussion in the next chapter, where they will be interpreted in relation to existing literatures and guiding analytical model.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter presents a comprehensive discussion on the study's findings that were outlined in the previous chapter. The key findings were interpreted through the lens of Risk Perception-Unsafe Behaviour Formation Model in this single-case study. The focus was to explore how odour habituation influenced risk perception and safety behaviour among workers in Malaysian rubber manufacturing context. Therefore, the discussion is structured around key themes and aligned with the theoretical pathways of the applied model. Special attention is given to details where the model was extended or nuanced by case-specific observations.

5.2 Summary of Key Findings and Thematic Recap

To provide a structured overview of the study's findings, Table 5.1 summarises the key themes and subthemes developed in Chapter 4, in alignment with the four research objectives. This table functions as a recap for the empirical results presented in Chapter 4 and lays the foundation for the interpretation to be presented in the next section. It offers a concise view on the worker's experience related to the dimensions of odour habituation, risk perception and safety behaviour.

Table 5.1
Summary of Key Findings and Thematic Recap

Research Objective	Themes	Subthemes	Key Findings
RO 1	1. Odour Experience and Habituation Spectrum	4.2.1 Initial Odour Reactions 4.2.2 Habituation Development 4.2.3 Reversible Sensitisation 4.2.4 Direct vs. Indirect Exposure Differences 4.2.5 Adaptation Catalyst	Initial reactions ranged from intense discomfort to emotional rationalisation. Most workers (both indirect and direct exposure) habituated over time, though some regained sensitivity after absence. Directly exposed workers tend to develop complete odour internalization. Habituation levels differed by job role and personal history.
RO 2	2. Odour-Driven Risk Perception	4.3.1 Cognitive Biases 4.3.2 Behavioural Biases 4.3.3 Social Conditioning 4.3.4 Environmental & Perceptual Risk Cues	Workers downplayed odour risks, often citing familiarity or lack of past harm. Behavioural conditioning and selective attention to odour cues emerged. Social norms reinforced risk minimisation. Cues like unfamiliar smells or corrosion reawakened concern.
RO 3	3. Risk Perception–Safety Behaviour Link	4.4.1 Compliance Drivers 4.4.2 Non-compliance Drivers 4.4.3 Behaviour Gaps	Compliance was driven by knowledge, task requirements, or vigilance. Noncompliance arose due to habituation, social conformity, or perceived irrelevance. Some workers acknowledged risks but deferred responsibility or took no action.
RO 4	4. Current Control Measures	4.5.1 Existing Controls 4.5.2 Gaps in Existing Controls 4.5.3 Improvement Strategies	While masks and ventilation existed, usage was inconsistent and perceived as ineffective. Training and SOPs lacked odour focus. Workers suggested awareness campaigns, reminders, tailored PPE, and incentive or disciplinary systems.

5.3 Discussion

This section presents the interpretation of the study's findings through the lens of the Risk Perception-Unsafe Behaviour Formation Model (Figure 3.1), highlighting novel insights into how odour habituation shapes risk perception and safety behaviour in the rubber manufacturing context. The discussion is organised around the core stages of the model, along with thematic findings from the analysis. In addition to confirming the key mechanisms proposed by the original model, the findings also suggest potential extensions to the framework such as the emerged concept of reversible desensitisation and targeted control improvements. These emergent elements contributed to a more nuanced understanding of risk and behavioural dynamics involved in odour management. The following subsections explore each key finding in alignment with the model to provide a more analytically grounded interpretation and discussion.

5.3.1 Odour Habituation Patterns Across Different Odour Exposure Groups

The findings revealed that the phenomenon of odour habituation among rubber manufacturing workers is not a straightforward process, but a rather multifaceted progression shaped by various interacting factors. This observation aligned with the previous research on olfactory habituation, which highlighted the complexity of the process (Fontana et al., 2023; Hintschich et al., 2024; Sinding et al., 2017). However, this study managed to uncover more important dimensions for understanding the process of odour adaptation that challenges conventional assumptions about workplace hazard. These aspects, with specific focus on the differences between workers in the different odour exposure groups are discussed as follows:

5.3.1.1 Odour Habituation Spectrum and Differential Patterns

Workers demonstrated various habituation timelines according to their level of exposure duration and odour characteristics. It was anticipated that workers from direct exposure group such as production staff will develop habituation faster than those from office roles (indirect exposure group). This expectation is due to Pellegrino et al. (2020) observations on effect of prolonged exposure. However, this study revealed a more complex observation. Upon exposure to odour, desensitization occurred regardless of the exposure group. Furthermore, the rapid desensitization was reported to happen within hours, and days of exposure. Even office workers such as Participant I-1 noted that she became 'used to the smell' after the interview session, indicating an onset of rapid desensitization within first few hours of exposure. This finding is aligned with the previous research on the early onset of odour habituation within minutes of exposure to odorant by Kim et al. (2020).

Despite this shared pattern, the extend and depth of adaptation was proved to be uneven across odour characteristics. Indirect workers retained longer sensitivity to intermittent, stronger smells (e.g., pungent chemicals) as compared to constant background odours (e.g., raw rubber odour). Participant I-4 highlighted how chemical smell released by extended storage of rubber was more noticeable compared to other odours, suggesting worker's sensitivity over a 'stronger' smell. This finding is consistent with Sinding et al. (2017) observations on the influence of physicochemical characteristics of the odours to the extent of habituation.

This variability of odour adaptation may result in a paradoxical risk alertness. This happens when workers remain sensitive and vigilant to unfamiliar smell while potentially overlooking the gradual increase in background odours due to perceptual blind spots. This is especially concerning or direct exposure workers who exhibit 'nose blindness' or had no reaction to baseline odours due to habituation. Such gap posed a serious issue in environment where chronic odour exposure is common and unavoidable. As noted by Piccardo et al. (2022), odorous compound is often dismissed as nuisances but the long-term exposure to such odours maybe associated to serious health risks such as chronic diseases. This highlights the importance of odour detection that does not rely solely on human sensory recognition for monitoring worker's exposure.

5.3.1.2 Dynamic Adaptation and Reversible Desensitisation

A particularly notable findings in this study was the phenomenon of reversible odour desensitization where workers regained odour sensitivity after breaks in exposure, such as during time off or department changes. While direct exposure workers experienced sustained olfactory fatigue, those from indirect or rotated roles (have breaks in in exposure) described regaining their sensitivity. For instance, Participant I-3 noted how he regained awareness about the odour after changing department and became less exposed to the odour. This suggests that habituation in industrial context may involve temporary sensory adjustment and not a permanent effect. These findings are supported by Shi et al. (2024) that observed interruptions to the exposure could restore subjective perceptions of odours. They also highlighted a contradiction where short recovery period eventually results in enhanced odour adaptation, greater than desensitisation

observed with continuous exposure. In contrast, longer recovery periods can reinstate odour perception, suggesting that the duration of exposure breaks is important in determining the effectiveness of odour sensitivity recovery.

The observed contradiction by Shi et al. (2024) also explained why some workers subjected to frequent but brief odour fluctuations (e.g., office workers) still developed habituation despite of less exposure. The demographic findings further add complexity to this insight. While previous research suggested that odour habituation can be affected by age-related differences (Hintschich et al., 2024; Mignot et al., 2021), the analysis revealed that the experienced workers (e.g., Participant I-3 with 20 years' experience) showed a better sensitivity restoration after a long period. This suggests that the long-term exposure may be linked to other adaptive mechanisms that improves odour awareness throughout time. For instance, this can be observed in workers in supervisory role (Participant I-3) and QC department (Participant D-2) which trained themselves to detect subtle or changes in rubber odour profile due to their working needs. This reflects on learned perceptual mechanism as an adaptive strategy.

5.3.1.3 Adaptation Catalysts of Odour Habituation

Habituation was affected not only by sensory fatigue but also by the psychological response of the workers which varied between different odour exposure groups. Workers in direct exposure roles often exhibit emotional resignation, reframing the odour as a necessary part of their job (e.g. Participant D-1). In contrast, indirect exposure group tend to demonstrate stronger negative emotions to the odours, especially when the smell intruded into their working area (e.g., Participant I-4).

Generally, unpleasant odours tend to evoke stronger emotional responses and affect the extent of habituation among workers. In general, adaptation to unpleasant smell is usually less pronounced due to their aversive nature. According to Li et al. (2023), desensitization for both pleasant and unpleasant odours occur relatively the same way, but affective habituation (emotional detachment to the stimulus) occurred readily for the pleasant odour. This means that although desensitization can occur rapidly, habituation to unpleasant odour develops more slowly or gradually.

Furthermore, the persistence of affective responses to the odour also affected the extent of odour habituation. Kontaris et al. (2020) emphasized that different affective state reflects on the interplay between brief emotional reactions and persistent mood. In rubber manufacturing context, prolonged exposure to odour may lead to emotional suppression where workers, regardless of exposure groups forced themselves to ignore the uncomfortable feelings due to perceived necessities. Over time, this may affect the worker's affective state potentially leading to detachment from risk cues.

Importantly, worker's tolerance to odour was not solely passive. It is also contributed by worker's coping mechanism due to the odour. Our findings highlighted emotional detachment to risk in some workers (e.g., Participant D-1) due to reframing of the thoughts due to necessities for livelihood. However, this may lead them to develop emotional detachment from risk, weakening their motivation to commit to safety behaviour. Additionally, Chong et al. (2022) highlighted that negative emotional state can cause reduction of hazard recognition accuracy and response speed. This suggests that affective detachment to odours can reinforce perceptual risks and behavioural complacency.

5.3.1.4 Synthesis of Findings

The comparison between direct and indirect exposure groups highlights that while both experiences odour habituation, the extent, stability and emotional framing of the habituation differed. Direct exposure workers showed a faster sensory dulling, often reinforced by the job's needs and emotional resignation. In contrast, indirect exposure workers retained more sensitivity and emotional discomfort due to fluctuating exposure to the odours. These differences imply that different exposure groups may require varied tailored interventions. For direct exposure groups, the findings highlight the needs to have odour cue reinforcement while for indirect roles, environmental isolation or improved ventilation may be more appropriate.

Overall, these findings suggest that odour habituation is not purely a sensory adaptation but also influenced by the worker's identity, experience and emotion. In other words, social and emotional framing contributed to the development of habituation (adaptation catalysts) in the occupational context. Collectively, these insights extended the Risk Perception-Unsafe Behaviour Formation Model by illustrating how odour habituation act as an antecedent to perceptual and behavioural changes. Although the model frames risk perception as a cognitive construct, this study extended the interpretation by illustrating how sensory adaptation interacts with psychosocial factors to shape risk perception. Additionally, the reversibility of habituation and presence of learned adaptive strategies suggest potential interventions opportunities can be made. These will be further explained in the next subsections.

5.3.2 Influence of Odour Habituation on Risk Perception

The findings demonstrated that in the context of odour exposure, risk perception of rubber manufacturing workers was shaped by a combination of cognitive factors, behavioural tendencies and social influences. This aligned with Özbakır (2024) who highlighted how risk perception is complex due to interactions of social and cultural factors. In this study, habituation to industrial odours not only dampened sensory sensitivity, but it also distorted worker's risk appraisal which resulted in both biased and unbiased psychological tendencies. Together with social influence, it affected the risk perception of workers. These combined influences on workers risk biases will be explored as follows:

5.3.2.1 Cognitive Biases and Heuristics

The findings revealed clear indications of cognitive biases among rubber manufacturing workers. Workers developed distorted risk appraisal over time, due to habitual exposure to the odours and lack of negative outcomes, reflecting normalcy bias or the belief that the odour posed no real harm. This was often observed with optimism bias, reflected in statements like "I am not worried, there is no cases yet" (Participant D-2). This suggests that there was underestimation of long-term health risks because there were no past incidents. Gassen et al. (2021) emphasized that such optimism may offer psychological comfort but can distort risk awareness particularly in prolonged hazard exposure.

Moreover, Riho (2024) noted how such cognitive biases often lead individuals to interpret reality based on expectations rather than solid evidence. This is also aligned with theory of affective heuristics described by Slovic and Peters (2006), in which risk

appraisal are shaped by feelings rather than critical evaluation. In other words, familiarity to the odours reduced workers' emotional salience of the associated hazards. Additionally, Wu et al. (2018) observed that affective heuristics can alter how risks are perceived due to 'format effect' which refers to the way the risks are contextualised. In rubber manufacturing setting, the persistent odour was often framed as unavoidable part of the job, rather than a safety concern, minimising the perceived risk.

However, these cognitive distortions may affect workers differently. This is because cognitive biases were also influenced by individual cognitive capacities. According to Skagerlund et al. (2020), individuals with higher cognitive reflection can easily override emotional intuitions and engage in analytical risk assessments. In this study, this was reflected in participants that did observations as a part of risk evaluation despite of a long working experience (e.g., Participant I-2). Meanwhile, most of the workers relied on their intuitions and feelings to evaluate risk, indicating the dominance of affective heuristics in their daily work life.

5.3.2.2 Behavioural Conditioning and Selective Attention

At behavioural level, the findings demonstrated the effect of conditioning alongside habituation process. As described by Rehman et al. (2024) classical conditioning which is an unconscious process associated with a stimulus, unfolds in several phases. In the study, workers initially exhibited natural aversion to the industrial odour, an unconditioned response to the stimuli. Through repeated exposure and odour habituation, the response gradually extinguished with workers describing as becoming 'numb' to the odour. This is an indicator of 'extinction phase' in classical conditioning,

where stimuli no longer rouse the initial response from the worker (Rehman et al., 2024).

However, the conditioning effect was not uniform. Some of the workers maintained stimulus discrimination capacity, where they remain sensitive to chemically distinct odours. For instance, Participant I-1 noted sensitivity for a stronger chemical smell. This points to selective attention to different cues. While this points at attentional bias or described by Azriel and Bar-Haim (2020) as the tendency to prioritize threads-related stimuli in the surrounding this observation also hinted at a form of inhibition learning process. Posited by Laing et al. (2025), this inhibition learning process or known as Pavlovian Safety Learning refers to associative process where repeated absence of expected danger creates an error in safety prediction.

In such cases, stimuli like persistent odour that initially triggered discomfort might be re-evaluated as a signal of safety. These odours eventually develop a positive safety association, reinforcing the learned sense of non-threat. This process also mirrors the concept of conditioned inhibition by Sosa and dos Santos (2019), where a stimulus supresses fear or avoidance response. In rubber manufacturing, workers may begin to associate rubber odours with routine, and psychological safety due to familiarity. This false sense of reassurance may dampen their response in real time.

5.3.2.3 Social Dynamics and Risk Normalisation

The study revealed that worker's risk perception was significantly shaped by their social and cultural setting. Over time, odour exposure became socially normalised within the workplace and surrounding community. As one participant noted "the smell

is so usual that even people outside the factory can recognize us by it" (Participant D-3). This demonstrated how the odour became a symbolic feature of a workplace shaping a collective tolerance through routine exposure and shared social meaning.

For some workers, they also attributed their lack of risk concern due to community-level habituation, rooted from childhood exposure. Participant D-4 highlighted how some workers have been familiar with the odours since childhood, especially the settler's children. This early exposure formed the concept of 'habitus' by Bourdieu (1977) in which the cultural disposition shaped how workers perceive and act in their environment. Within rubber manufacturing habitus, industrial odour is not just tolerated, it is regarded as a part of worker's identity. Over time, the associated risk of the odours is no longer perceived as threatening but transformed into a normalised community background.

Another reason for this observation was explained by Balžekienė et al. (2024) who found that people living close to the source of hazards tend to incorporate the risks into their daily life, distorting their perception. The phenomenon of community familiarisation was also explained by Chassang et al. (2025), who emphasised on how the cultural values forms the perceived characteristics of hazards. This includes whether the culture view something as harmful, tolerable or even beneficial. In this study, the odours were interpreted as a necessary part of life, especially among those with intergenerational ties to the rubber industry. Thus, it can be said that the cultural framing of odours may alter the individual's risk concern, regardless of the real risk.

Social learning also played a role in shaping new recruits' risk perceptual base at work. By observing the senior colleague's nonchalant behaviour towards the odour exposure, the newcomers might feel at ease and gradually develop a neutral reaction toward the odour. This aligned with Social Learning Theory by Bandura (1977) who asserted that people learned through modelling other's action. In workplace where safety norms are shaped by peer norms, social conformity became a major determinant of risk perception.

Notably, the findings also revealed a stratified risk perception among different exposure groups. For instance, office staff expressed more concern about the odour as compared to production workers, despite being less exposed to the hazards. This stratified perception suggests that habituation is not only physiological but mediated by sociocultural influences. As discussed by Chassang et al. (2025) risk was filtered through social status, shaped by what one's social context has taught. These findings suggest that odour habituation is not just a physical hazard but poses challenges to the existing social beliefs.

5.3.2.4 Environmental and Perceptual Risk Cues

While odour habituation generally diminishes worker's baseline sensitivity to industrial odours, the study found that certain environmental and perceptual cues could override desensitisation effect and reinstate risk awareness. Notably, these cues suggested that there might be unbiased or unaltered risk perception among workers. These cues include unusual odours and observable visual damage that acted as triggers that prompt re-evaluation of risks despite routine exposure. For instance, participant I-2 associated

corrosion of metal structures to odour risk by highlighting “we were breathing that in too”. This suggested how visual degradation, paired with olfactory input, served as multisensory cues that can prompt precautionary hazard detection. Such usage of cues aligns with the concept of ‘risk cognition’ in Lu’s (2025) risk model that involves conscious, analytical evaluation which can improve individuals’ risk appraisal.

Some workers, especially those with production experience also reported odour discrimination capacity where they can differentiate between expected smells. For example, Participant I-3 explained how workers can distinguish between rubber odours and smoke, indicating that they can remain vigilant to incidents despite of familiarity to various scents. This suggests that workers can learn contextual risk cues from prolonged odour exposure. Such cues are also important for workers as it can act as informal monitoring. However, cue reliability also played a role in determining whether workers can associate such cues with potential dangers. Su et al. (2024) explained how reliable cue will affect how risks are noticed by affecting workers’ response.

Stawarz et al. (2020) also highlighted how contextual cues must be consistent to effectively support behavioural changes. In this study, consistent cues like visible corrosion were considered as more reliable than mixture of odours in the background. This is supported by Lee et al. (2024) findings which stressed on the importance of visual cues in shaping worker’s situational awareness. Moreover, not all workers reacted to the same triggers. This contradiction can be seen among workers that claimed they can no longer differentiate odours due to strong odours at the production site. This is a classic sign of olfactory fatigue which is described by the inability to distinguish the odour after repeated exposure (Petersen, 2019). Despite of being a physical

response, this limitation caused a diminished odour awareness among the workers. This also suggests that although environmental cues may help counteract habituation, it is limited by individuals' differences. Therefore, reliance on odour cues as safety prompts may not be effective due to individual-perceptual capacity.

5.3.2.5 Synthesis of Findings

Together, the findings illustrate how odour habituation intersects with cognitive biases, behaviour and sociocultural construct to shape risk perception. Risk appraisal was not static throughout time, but it continuously evolved with repeated exposure, emotional and behavioural adaptation. In this way, the Risk Perception-Unsafe Behaviour Formation Model is extended beyond its original binary construct of biased and unbiased risk perception. The study indicates that risk perception is not just an individual cognitive process but affected by psychosocial and environmental construct. Additionally, the findings highlight the need to de-normalise odour exposure to increase cue validity and improve workers awareness. These insights suggest that interventions should address the multidimensional nature of risk perception while considering the cognitive, social, emotional and contextual factors discussed earlier.

5.3.3 Connecting Risk Perception to Safety Behaviour

The study reaffirmed the critical role of risk perception in shaping safety behaviour, which is consistent with the core structure of Risk Perception-Unsafe Behaviour Formation Model. While previous research has concluded on the positive correlation of risk perception to the worker's safety behaviour (Fialho et al., 2024; Priolo et al., 2025; Wang & Xu, 2022), this study offers deeper insights into how certain specific biases influenced works risk perception. As discussed in the previous subsection, risk perception is not static and shaped by various factors, which eventually affect behavioural decision making. These linkage between risk perception and safety behaviour will be further explored in detail as follows:

5.3.3.1 Compliance Drivers

Compliance was evident among workers who possessed relevant knowledge or worked in regulated environment such as in the laboratories due to learned vigilance and institutional training. For instance, Participant D-4 highlighted how workers followed strict SOPs during risky procedures due to the knowledge obtained from chemical handling training. This suggests that existing knowledge contributed to their proactive behaviour. This is consistent with Fialho et al. (2024) who found that workers with higher risk perception shaped by structured training were more likely to adopt proactive safety behaviour. Similarly, Al-Bsheish (2023) highlighted how safety training acted as a mediator between risk perception and safety compliance. In other words, it can be said that safety training improves workers risk perception that subsequently increases their safety compliance.

While some participants demonstrated compliance due to habitual or routine discipline. For instance, Participant D-2 mentioned about complying with the required PPEs because of SOPs. This highlighted how routine can support compliance even when risk perception is low. This is probably contributed by the apparent benefits of SOP that helped the workers to ensure alignment with their work, as described by Akyar (2012). This can also be observed among workers that wore PPE during high-risk tasks. This indicated that the workers had contextual awareness about the nature of the task demands.

Additionally, there were workers that actively counter the effects of habituation by conscious risk prioritization as noted by Participant D-1 about how workers should still wear PPE despite habituation. This is supported by Skagerlund et al. (2020) findings on the effect of individual's cognitive reflection that can override intuitive shortcuts. This effect was also observed in the active risk vigilance by workers (e.g. Participant I-3, D-2) that described how their job necessitated extra attention to changes in the environment. Similarly, Participant I-1 noted how she took proactive measure to determine the nature of risks in case of abnormal incident. This is probably contributed by the higher educational level and experience that can enhance worker's risk appraisal ability (Handoko et al., 2022).

5.3.3.2 Non-compliance Factors

Non-compliance to safety rules and precautions was frequently associated to perceptual biases linked to odour habituation. Workers often framed odour as a nuisance, and not a threat. For instance, Participant D-3 quoted how workers tend not to wear respiratory

protection because of perceived insignificance of the odours. This reflects on Qiu et al. (2024) concept of self-generated anchors and low-risk anchors based on past incident experiences that increases the workers rate of engaging unsafe behaviour. In this study context, repeated exposure to odours without consequences creates an anchoring effect that decreases the worker's motivation for undertaking safe behaviour.

Another issue was due to perceived irrelevance of protective measure and safety protocols associated with odours. Even when PPE was readily available, it was often disregarded due to worker's doubts in its efficacy. As explained by Hu et al. (2018), worker's effort for achieving procedural compliance is contributed by their perceived usefulness of the related procedures. In other words, those viewing SOPs as irrelevant will highly be susceptible to non-compliance behaviour. Another observation strengthens this notion, where workers opt for self-improvised protection such as using clothes to cover their nose instead of using provided face masks. This observation illustrated how workers tend to undermine the need for wearing PPE.

Task-dependent selective compliance was common among workers. For instance, they would only wear face masks when getting into the main production zone but skip them during routine odour exposure, as explained by Participant I-1. This illustrates the influence of risk framing, where certain conditions are considered as less critical, resulting in partial compliance to formal protective protocols. Wang and Xu (2022) observed the similar pattern in their study, suggesting that risk perception influences compliance under specific conditions such as supervisor presence at work.

One of the most notable non-compliance drivers was social conformity. New workers mimic peer behaviours, especially their senior colleagues. Participant D-2 shared how he initially started to not wear facial masks simply because others did not. This bandwagon effect of non-compliance conformed with the established Social Learning Theory (Bandura, 1977) and findings by Xia et al. (2020) regarding the moderating effect coworker's safety climate on worker's unsafe behaviour. In an environment where non-compliance was normalised among workers, new workers will adapt to the core workplace norms, thus reducing effectiveness of any safety interventions.

5.3.3.3 Safety Behaviour Gaps and Deferred Responsibility

Although some workers had the ability to recognise odour-related risks and hazards, they demonstrated discrepancies between their risk perception and the actual safety practices. These gaps were reflected in the worker's tendency toward risk resignation, where the person passively accepted exposure as inevitable, as highlighted by Participant I-4. Workers showed perceived constraints to react to the risks due to a sense of helplessness. This sentiment aligned with concept of 'learned helplessness' by Seligman and Maier (1967), where individuals lose motivation to do anything due to perceived inevitability of the associated events. Such resignation to risk challenges behavioural agency even when risk is acknowledged.

The study also revealed deferred responsibilities where workers hesitated to act and waited for safety decisions from higher-ups or other departments. This reflects a lack of empowerment where front-line workers do not feel qualified to make initial risk mitigating decision. This aligns with Yang and Kim (2025) argument on the moderating

effect of worker's status in the organization to the safety behaviour. Lower-ranked workers relied on inclusive supervision to be more empowered and voice out their safety-related concerns.

Similarly, workers also relied on informal communication rather than structured formal reporting to pass along concerns. According to previous studies, worker's engagement in safety decisions is significantly influenced by the sense of psychological safety at the workplace (Creon & Schermuly, 2025; Quansah et al., 2023). In environment where voicing concerns is not a norm, even risk-aware workers will default to silence or passivity. This suggests how safety becomes shared observation rather than actionable responsibility. These patterns reveal a gap between risk awareness and decision ownership where workers often positioned themselves as passive observers rather than reacting proactively.

5.3.3.4 Synthesis of Findings

The findings extend the Risk Perception-Unsafe Behaviour Model by revealing that the relationship of risk perception and safety behaviour is not linear. The relationship is mediated by a combination of cognitive biases, situational framing and social dynamics. Compliance was primarily supported by knowledge and task salience, also by individual's trait such as workers self-reflection and vigilance. In contrast, non-compliance stemmed from perceptual desensitisation and social adaptation particularly due to normalisation of risk cues. Notably, even risk-aware individuals developed behavioural detachment due to learned helplessness and deferred responsibilities. This insight highlights that reinforcing safety behaviour requires more than raising

awareness, it also demands stronger emphasis on worker's sense of responsibility and empowerment at work.

5.3.4 Control Measures for Addressing Odour Habituation

The findings revealed critical gaps between existing organisational control measures and the practical implementations at the rubber manufacturing facility. While physical controls such as PPE and general ventilation were formally in place, their actual effectiveness were limited by several factors. The nature of these gaps and potential areas for improvements in managing industrial odour exposure are discussed in detail as follows:

5.3.4.1 Gaps in Existing Controls

The control measures implemented to address odour exposure at the rubber manufacturing facility followed the conventional Hierarchy of Controls (HOC), beginning with the more effective (engineering intervention) to the least (personal protective equipment, PPE). However, the findings revealed that the effectiveness of the controls was undermined by several gaps, as outlined below.

A. Engineering Controls

At the engineering level, the facility relied on wet scrubber system for capturing odorous compounds during drying process. According to Kamarulzaman et al. (2019) and Sari et al. (2019), this is due to the release of volatile compounds responsible for odour nuisance during the process. However, this also means that industrial odour

generated during other processes received less attention in risk mitigation. Moreover, Idris et al. (2022) found that the usage of wet scrubber for odour reduction at rubber manufacturing plants was inadequate in controlling odour issue. This highlights that the engineering controls in place were limited in both usage scope and effectiveness.

B. Administrative Controls

In terms of administrative measures, the study found gaps in training content, procedural clarity and supervisory reminders. While participant report that there were trainings on chemicals and PPE usage, there was lack of focus on odour-related hazards and potential effect of long-term exposure. Most of them could not recall training that address about prolonged exposure to industrial odour or olfactory desensitization. This gap impacted the level of knowledge and awareness of workers, especially among direct exposure group.

As noted by Buratti and Allwood (2019), individuals tend to underestimate risks they do not understand, meaning that this knowledge gap may contribute to their unsafe behaviour. Furthermore, there were concerns about limited refresher training and infrequent reminders by supervisors that worsen the workers knowledge base over time. Additionally, the workers highlighted that there were no clear instructions for odour exposure management in SOPs, leading to confusion and inconsistency in the application.

C. Personal Protective Equipment (PPE)

In practice, the dominant strategy for mitigating odour exposure remained to be provision of basic PPE, particularly face masks. However, there was widespread unconformity to the usage of face masks due to some issues. First, workers reported on the perceived irrelevance of PPE and widespread normalisation of not wearing masks. In addition, some participant quote on the subjective comfort issues that limited PPE favourability. These comments echoed with arguments by Samosir et al. (2020) in which the availability of PPE was argued to be insufficient to ensure compliance, as factors such as comfort, behavioural norms and supervision will significantly its usage in rubber manufacturing context.

Other than those factors, Febriyanti and Widajati (2025) highlighted other crucial influential pattern on PPE compliance such as knowledge, safety awareness and policy enforcement. Without targeted awareness, odour was perceived as sensory nuisance rather than hazards, which was also why some workers perceived PPE as irrelevant as a safety measure. Some workers pointed out that there was lack of enforcement for PPE usage. Compliance to protective measures was mostly left to personal discretion, which allowed risk normalisation to take place, especially in production zone.

5.3.4.2 Apparent Need for Improvements by Workers

In response to identified shortcomings of the control measures, participants proposed several improvement strategies that they feel will most likely lead to successful implementation. A recurring recommendation highlighted the emphasis on improving worker's awareness about the industrial odour. For instance, Participant I-1 suggested that awareness should be prioritized before implementing any protocols, highlighting that compliance without understanding will be meaningless. This supported by Hu et al. (2022) that asserted on the critical knowledge needed to ensure safety compliance. Educating workers on the health implications of odour exposure and habituation due to desensitization could help improve workers internal motivation towards compliance.

Participants also advocated for frequent and structured reminders. Participant I-3 highlighted how the workers were susceptible to forgetfulness without routine reinforcement. This is supported by Xu and Wang (2020) findings on benefit of timely reminders in reducing the frequency of unsafe acts. To achieve this, routine briefings were suggested as the most inexpensive and practical measure to convey odour-related safety messages. Workers also called for more individualised PPE, noting that the provided face masks were not always suitable with the tasks and conditions. This reflects the need of participatory ergonomics where workers will be actively involved in any considerations of workplace changes that improves their comfort and reduce safety risks (Rodrigues & Rocha, 2023). However, such interventions require awareness and active contributions by the workers. Yarahmadi et al. (2022) mentioned about how promoting awareness regarding the ergonomics should be prioritized by the management for supporting participatory interventions.

Another consideration was on incident reporting, as most odour-related concerns often go unreported due to habituation. A culture of tolerance has emerged as workers choose not to speak up unless prompted. Yang and Kim (2025) cited on how improvement of communication such as by encouraging the workers to openly speak up can help in improving feedback loop and improve their perceived risk. While there were mixed views on enforcement policies where some workers advocated for disciplinary action to enhance compliance (Participant D-4) and others proposed incentives as a positive reinforcement (Participant D-3). The suggested incentives referred to rewards for workers who consistently complied with protective measures, particularly proper PPE usage and SOPs. Lee and Kim (2024) observed the difference in giving both penalties and safety incentives to the workers. They found that workers will feel more pressures upon receiving penalties for non-compliance and would eventually give up on the following safety rules, while incentivizing improved their motivation to comply with the rules. The result indicated that strict policies implementation might not be the best option for the rubber manufacturing workers as it may lower their safety adherence motivation.

At a broader level, there was a suggestion to do isolation control for the processing areas, suggesting that the workers recognized the limitations of PPE and existing administrative controls. However, the practicality of the infrastructure was questioned. Isolation is considered as one of a better alternative, but it is impractical and costly. One of the main issues is that the odorous emissions concentration is affected by environmental factors, such as wind. Lee et al. (2023) observed how ambient environmental factors complicate odour characterising for risk monitoring while Huang

et al. (2022) noted how such compounds were not properly characterized, making targeted engineering interventions quite challenging. These technical limitations reinforced the practical constraints of engineering control in odour exposure control. This underscores the need for a more adaptable and feasible control interventions.

5.3.4.3 Areas for Improvement of Control Interventions

The study findings revealed that although the current rubber manufacturing adhered to the traditional Hierarchy of Controls (HOC), the approach has significant limitations in addressing risks associated with odour habituation. This is because habituation poses as both sensory and psychosocial hazards, making it more complex to address using conventional engineering controls or PPE alone. Furthermore, complete elimination or substitution of industrial odours is unrealistic in rubber processing, where odorous emissions are a part of the core operations.

Given these constraints, the study highlights the need for an updated approach that accommodates workplace constraints while targeting both systemic and behavioural risks. To address this, the study recommends aligning future interventions with Work Systems Hierarchy of Control (WS-HOC) proposed by Davies et al. (2025). The model expands the traditional HOC by offering a flexible, non-linear framework comprising elimination, work system redesign, and individual actions. Unlike rigid ranks in traditional HOC, WS-HOC allows for context-specific strategies across levels. This offers more realistic and sustainable solutions especially for intangible hazards. This is consistent with Kjærgaard et al. (2025) who highlighted that higher-level system-

focused interventions are more effective than administrative or behavioural controls alone in managing complex risks like psychosocial hazards.

In the context of odour habituation in rubber manufacturing, an integrated strategy is needed. Therefore, recommendations are outlined within the layers of WS-HOC for a clearer view:

A. Elimination

While total elimination of odour sources is not feasible, partial elimination through targeted emission control, especially for high-concentration or intermittent odour points should be pursued where possible. As Davies et al. (2025) highlight, optimization and partial reduction are valid strategies when full elimination is unrealistic. Partial elimination through material substitution aligns with WS-HOC's highest tier while acknowledging industrial constraints in rubber processing. For example, the usage of sepiolite as additives to minimize volatile odour released in natural rubber has been researched and proven its efficacy (Bing et al., 2022).

B. System Redesign

Several system-level improvements are recommended. First, the design of the current scrubber system should be reviewed. A study by Sari et al. (2019) found that modifying the scrubber with electrochemical-based ammonia sensors improved the scrubber performance in crumb rubber processing. Therefore, redesigning the scrubber with such alterations may be useful to control the emission. Additionally, other emission points outside the drying phase, such as mixing or compounding, should be equipped with local exhaust ventilation or isolation structures to contain the odour from spreading.

This is supported by Liu et al. (2020) who found that the usage of push-pull airflow along with draft hoods in local exhaust works effectively to capture pollutant during rubber vulcanization. Moreover, Lee et al. (2023) noted how easily odour diffuses to surrounding area. To mitigate this, odour zoning or separation of high-emission and low-exposure workspace should be considered to help reduce incidental inhalation by indirect exposure groups.

Another critical upgrade is the integrating odour sensors or electronic noses for real-time odour concentration monitoring. According to Jońca et al. (2022), electrical nose has the ability analyse and learn new odour pattern through training. Thus, this technology can help in providing more accurate detection and trigger early precautionary measures. Alongside technological solutions, participatory ergonomics should also be incorporated when upgrading PPE designs, especially for workers in high-exposure zones. As Rodrigues and Rocha (2023) emphasized, participatory design enhances user comfort and promotes adherence, particularly when workers are involved in selecting or testing protective gear. To ensure success, Yarahmadi et al. (2022) stressed that management should prioritize promotion of awareness regarding the participatory interventions.

C. Individual Level Strategy

At the individual action level, several key improvements are highlighted. First, training content must be enhanced to include odour exposure and desensitisation mechanisms. This aligns with Buratti and Allwood (2019) who emphasized that workers tend to underestimate hazards they do not understand it. Since the lack of odour-specific training has led to significant gaps in risk perception, future training should include topics on odour desensitisation and habituation. To reinforce this, information campaigns and visual cues such as posters can help sustain awareness and intrinsic motivation (Hu et al., 2022). Such materials can be used to highlight the health risks of chronic odour exposure and habituation phenomenon. In addition to training, clear procedures or SOPs should be established to guide workers on appropriate response when encountering unusual incidents. For instance, how to respond to increased odour intensity, even if the odour has become normalised through habituation. Workers' uncertainty due to the absence of such guidelines reinforces inconsistent behaviour. This concern was raised by Windarko et al. (2023) who linked SOPs to improved work discipline and performance. Supervisors also play an important role. They must deliver frequent, structured briefings, especially as reinforcement for high-risk groups. As highlighted by Xu and Wang (2020), appropriate reminders can significantly reduce worker's unsafe behaviours.

Regarding PPE, more task-specific equipment with higher filtration and ergonomic comfort is needed. Okrasa et al. (2021) found that the filtering facepiece respirators with activated carbon has the highest odour reduction capacity among other respirators. Such masks are also easily adjustable to fit the user. Thus, such respirators can be more

appropriate in managing odour exposure of workers. To further support behavioural change, a Behaviour-Based Safety (BBS) program is recommended. BBS strategies help identify, and correct unsafe habits rooted in desensitisation by focusing on observed behaviour and feedback loops (Niciejewska & Obrecht, 2020). Complementing this, positive reinforcement mechanisms, such as incentive schemes for consistent PPE use or odour reporting, can foster sustained compliance. Lee and Kim (2024) demonstrated that such incentives are more effective than punitive approaches, which may reduce morale or compliance motivation.

Collectively, these recommendations address both systemic and individual factors influencing odour habituation, and their classification under the WS-HOC model provides a structured pathway for organisations to implement context-appropriate interventions. The summary of this recommendation is outlined in the following table.

Table 5.2
Recommendations Summary Based on Work System-Hierarchy of Controls (WS-HOC)

WS-HOC Level	Focus Area	Recommendations
1. Elimination	Partial Odour Elimination	- Target high-concentration or intermittent odour sources for emission control. - Use material substitution where feasible (e.g., sepiolite additives in rubber formulation).
2. Work System Redesign	Engineering Controls	- Upgrade existing scrubber with enhanced sensor technologies. - Install local exhaust ventilation at odour-emitting stages like mixing or compounding. - Apply odour zoning to separate high and low exposure workspaces.
	Monitoring Technologies	- Implement electronic noses for real-time odour detection and early warning.
	PPE and Ergonomics	- Redesign PPE through participatory ergonomics. - Provide task-specific respirators with high filtration and comfort (e.g., activated carbon masks).
	Organisational Awareness	- Promote odour awareness and participatory initiatives across the organisation.
3. Individual Actions	Training and Information	- Include odour habituation and risk desensitisation in training. - Use posters and visuals to maintain risk awareness. - Ensure clear SOPs for responding to odour events.
	Supervision and Briefings	- Increase structured and timely supervisory reminders, especially in high-risk zones.
	Behavioural Reinforcement	- Implement Behaviour-Based Safety (BBS) programs to address desensitisation. - Use positive reinforcement (e.g., incentives for PPE use and reporting).

5.3.4.4 Synthesis of Findings

The findings reveal that practical effectiveness of the implemented organisational control measures was undermined by perceptual, behavioural and structural barriers. Workers' compliance with protective measures was constrained by discomfort, perceived irrelevance, habituation and weakness in enforcement. The absence of odour-specific guidance and reminder also allowed risk normalisation to strengthen over time. These limitations highlight the inadequacy of one-size-fits-all strategies, particularly those based on the traditional Hierarchy of Controls (HOC), in addressing complex risks like odour habituation.

Importantly, the study highlights the effective control strategies must consider beyond one-size-fits all policies and adopt a more participatory approach. Worker's suggestions reflect both recognition of the existing limitations and their readiness for a change. Collectively, the proposed improvements highlight the need for a multi-layered, worker-centred approach. Therefore, this study adopts the Work Systems Hierarchy of Control (WS-HOC) as a proposed framework, offering a flexible structure that integrates system redesign, behavioural strategies, and where possible, partial elimination. This framework better reflects the contextual realities of odour-intensive environments and provides a clearer pathway for targeted, sustainable improvements.

5.3.5 Integration with The Risk Perception-Unsafe Behaviour Formation Model

Figure 5.1 presents the visual synthesis of the study's thematic findings to illustrate how odour habituation, perception biases, behavioural and societal norms also environmental cues interact to shape worker's safety behaviour in the rubber manufacturing context. Guided by the Risk-Perception-Unsafe Behaviour Formation Model, the visual synthesis highlights the complexities involved in perceptual and safety outcomes associated with odour habituation phenomenon. Thematic findings are mapped within the model with linkage to subsections from Chapter 4 for enhancing transparency and traceability,

At the core of the model lies the risk source, which originates from the worker's repeated exposure to industrial odour. The findings suggested several extensions to the original frameworks by including the spectrum of odour habituation as the antecedent of risk source and the concept of reversible desensitisation. Surrounding the core is the layer of risk perception biases. Workers who maintained a normal risk perception, aided by environmental and perceptual cues (4.3.4) and others developed biases in risk perception. These are grouped in three major categories: cognitive biases (4.3.1), behavioural biases (4.3.2) and social conditioning (4.3.3). These biases influence how workers interpret their environment, leading to either accurate appraisal or flawed judgment.

Surrounding this is the layer of safety behaviour, which is the worker's behavioural expression of the preceding perceptual layer. This includes factor that drive compliance (4.41), non-compliance driver (4.4.2) and behavioural gaps (4.4.3). However, the direction of these behaviours, whether it is safe or unsafe, were governed by another layer of organisational context. If the biases are recognised, organisational control measures (4.5.1) may help to manage the odour habituation impact, resulting in controlled biases and promoting safe behaviour. Alternately, unidentified biases and ineffective controls (4.5.2) increase the likelihood of unsafe behaviour.

Importantly, the synthesis incorporates an improvement loop where recommended improvements proposed by worker (4.5.3) act as feedback for enhancing the control measures. When acted upon, these interventions offer the potential to mitigate the uncontrolled biases in risk perception, further extending the original model. Overall, Figure 5.1 presents a dynamic, multi-layered conceptualisation on the interplay between odour adaptation, perceptual linkage, behavioural patterns and organisational responses. It contributes to a more holistic understanding on how safety behaviour evolves in an odour-intensive environment such as in rubber manufacturing and provides a base for targeted intervention.

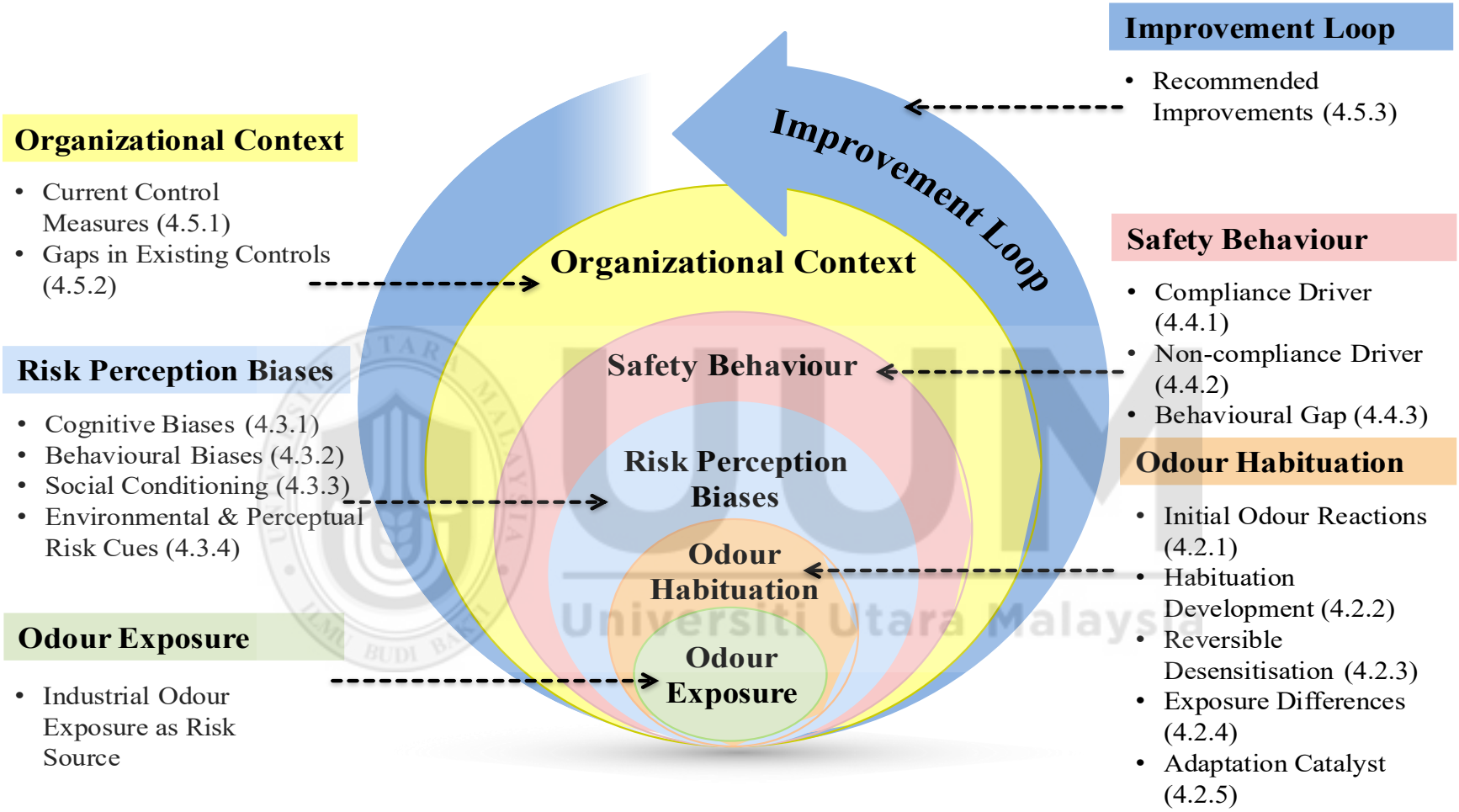

Figure 5.1

Visual Synthesis of Key Themes Illustrating Extended Risk Perception Conceptualisation with an Integrated Improvement Loop.

5.4 Implications of the study

This study contributes to the field of occupational safety and health management by offering deeper understanding on the phenomenon of odour habituation and its effects on risk perception and safety behaviour. While the broader explanation on the significance of this study has been outlined in Chapter 1, there are several notable implications that will be highlighted. Theoretically, this study tested the applicability of the Risk Perception-Unsafe Behaviour Formation model and extended the concept by incorporating new constructs and improvement loop (Figure 5.1). The synthesised model reflects the complexity of the nature of risk formation and offers a detailed understanding of on the other considerations for choosing a framework for studying behavioural safety in odour-intensive industrial environment.

Practically, the study identifies the limitations in existing control measures including perceived infectiveness of PPE, lack of odour-specific training and passive compliance norms. By incorporating worker's voice, this study offers practical strategies to improve safety practices such as using tailored training and structured reminders. These insights are valuable for enhancing safety protocols in rubber manufacturing industries and may be replicated for other sectors with odour-related nuisances. Methodologically, the study demonstrates the value of a model-informed qualitative case study approach for exploring an underexplored phenomenon such as odour habituation. It also highlights how thematic analysis can reveal reach insights from latent interpretations that may be missed in quantitative assessments. Together, these contributions highlight

the study as a meaningful addition to the knowledge and practical field of safety management in Malaysia's manufacturing context.

5.5 Limitation of the study

Despite the contributions and novel insights offered, this study has several limitations that has been acknowledged. Firstly, the sample size was limited to a small group of rubber manufacturing workers in Sungai Petani, Kedah, Malaysia. While this is appropriate for a qualitative case study design, it may limit the diversity of perspectives from the workers and reduced the transferability of the findings for other industries or cultural settings. Additionally, the use of purposive sampling, although was intentional for targeting specific exposure roles, it may also introduced selection bias from the researcher.

Secondly, the study was conducted in a single case study involving only one rubber manufacturing company. A multi-case study approach could have offered comparative context across different organisational settings that may be helpful in adding depth to the understanding of the phenomenon. Besides, the timeline of the study offered a cross-sectional overview to the studied phenomenon. As there were restricted data collection period, very little observations can be made. A longitudinal study can help adding more depth to the data collected. Prolonged and follow-up observations regarding workplace variations could provide more insights into the dynamics of odour habituation.

Another constraint was the limited prior qualitative studies regarding this topic that limited supportive evidence that can be used. The lack of existing studies constrained the comparative analysis and theoretical triangulation, requiring the study to rely more on adjacent and interdisciplinary literatures. One more thing to highlight is that other environmental factor such as noise, light or temperature that may influence safety behaviour were not explored due to the emphasis on industrial odour as the central focus of this study. These omitted variables may interact with odour exposure and affect risk perception in a more complex ways than this study could account for.

Despite of these limitations, the study offers rich insights that contribute to the understanding of how sensory adaptation influences work safety.

5.6 Recommendation for the Future Research

Based on the findings and limitations of this study there are several recommendations for future research to further improve the understanding of odour habituation, risk perception and safety behaviour in industrial settings. Firstly, future studies could adopt a multi-case study approach involving multiple companies across different sector. In the context of rubber manufacturing, future studies could involve both synthetic and natural rubber manufacturers as both facilities is affected by different odour profiles that can affect workers in a different way. Furthermore, by choosing several companies, the research could do comparison across organizational structure, exposure types and

demographic groups. This will improve the generalisability of the findings and validating the extended model in a diverse context.

The timeline of the study should be long enough, and a longitudinal design should be considered. This will allow for more observations to be made and possibility of gaining more supplementary data to triangulate the findings. Further research may integrate quantitative approaches or a mixed method to assess the strength of the relationships between variables such as risk perception biases, habituation level and compliance behaviour. For instance, physiological assessment such as olfactory thresholds and behavioural checklist could complement qualitative insights from the workers, enabling cross-validation to be made.

Additionally, future studies should consider other environmental factors such as noise, temperature and lighting that may interact and affect risk perception. Understanding how these stimuli affect worker's overall working experience could lead to a more comprehensive workplace hazard assessment. It is also recommended that the role of organizational factors in shaping workplace safety should be integrated into the research. For instance, the safety climate, leadership and communication may influence how workers comply with safety measures. This may reveal more important considerations for behavioural safety interventions. Lastly, the researchers may consider using and further refined the model used in this study. This is especially because the model can be expanded and integrated to fit to other industries such as chemical processing and waste management.

5.7 Conclusion

This study explored how prolonged exposure to industrial odours influences worker's risk perception and safety behaviour in the context of Malaysian rubber manufacturing. Using the Risk Perception-Unsafe Behaviour Formation Model as a guiding lens, the study revealed that odour habituation is not just a physical response but a complex psychosocial process that shapes how workers perceive and respond to actual hazards. By integrating the thematic findings with the guiding model, the research provided a deeper understanding on how sensory adaptation interacts with cognitive, behavioural and organisational factors to influence safety outcomes. The findings underscore the importance of addressing odour habituation as a systemic risk factor that promotes perceptual biases. These biases, reinforced with unsafe social norms and ineffective organisational controls create perceptual blind spot among the workers. Risk awareness was found to be fluid and situational, affected by peer influence, emotional framing and the lack of odour-specific interventions. Significantly, the study demonstrated how behavioural gaps and risk minimisation tendencies persist despite having formal safety measures due to unaddressed sensory desensitisation.

To enhance safety in odour-intensive environments, organizations must go beyond the basic protective provisions and consider a more adaptive and context-structured strategies. These may include awareness training, participatory safety, improvement of communication and regular reinforcement to counter the effects of habituation. Aligned with these insights, the study proposed a multi-tiered control approach based on the Work Systems Hierarchy of Control (WS-HOC) to more effectively manage both

systemic and behavioural risks. By recognising sensory adaptation as a dynamic factor that influences workplace safety, this study contributes to the growing bodies of knowledge that bridges environmental psychology, behavioural safety and industrial practice. It offers an empirical and practical foundation for intellectual discerning regarding how invisible risks such as odour exposure are managed in the consistently changing industrial landscape. It is hoped that this study can inform more effective interventions and inspire further research into the undermined role of sensory adaptation and habituation tendencies among workers in occupational safety management.

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Appendix A

Interview Protocol

EXPLORING THE INFLUENCE OF ODOUR HABITUATION ON RISK PERCEPTION AND SAFETY BEHAVIOUR IN RUBBER MANUFACTURING	
Participant Information	
To be collected prior to interview	1. Participant Code / Id: _____ 2. Gender: _____ 3. Age: _____ 4. Job Role/Title: _____ 5. Department/Work Location: _____ 6. Years Of Experience in Current Role: _____ 7. Total Years in Rubber Manufacturing Industry: _____ 8. Shift Pattern (Day/Night/Rotating): _____ 9. Main Tasks/Responsibilities: _____
Introduction	
To be read to the participant: Key Components: 1. Express thanks 2. Introducing interviewer 3. Purpose 4. Confidentiality 5. Duration	Hello, and thank you for agreeing to participate in this interview. My name is Nor Insyirah Binti Daud and I am conducting a research study as part of my postgraduate work at Universiti Utara Malaysia. The aim of this study is to explore how industrial odour habituation influences workers' risk perception and safety behaviour in the rubber manufacturing industry. This interview will roughly take about 20-30 minutes. I will ask you some questions about your experience working in the rubber industry, particularly related to your exposure to industrial odours, how you perceive

6. How interview will be conducted 7. Opportunity for questions 8. Signature of consent	risks in your workplace, and your views on safety practices. Your participation is voluntary, and all responses will remain confidential. You may choose not to answer any question or stop the interview at any time. With your permission, I would like to audio-record our conversation to ensure accuracy in capturing your insights. Here is the consent form for you to sign. Do you have any questions before we begin?
Key Questions	
RO 1: *To investigate how the occurrence of odour habituation varies among workers from different exposure groups to industrial odour in the rubber manufacturing industry.*	1. Can you describe the types of smells or odours you commonly encounter during your work? 2. How would you describe your initial reaction to these odours when you first started working here? 3. Over time, have you noticed any changes in sensitivity or how you respond to these odours? 4. Do you think workers who are regularly exposed become more used to the odour compared to those who are not? Why or why not
RO2: *To explore the impact of odour habituation on workers' risk perception biases in the rubber manufacturing industry.*	5. Have you ever felt concerned about safety or health risks related to the odours? Why or why not? 6. How do you usually assess whether an odour is dangerous or normal part of the process? 7. Do you think becoming used to the odour affects how seriously you take odour-related risks? 8. In your opinion, do workers in different roles (e.g., production vs. office) have different levels of risk awareness or concerns about workplace odours? Why?
RO3: *To examine the role of risk perception in influencing worker's safety behaviour with reference to Risk Perception-Unsafe Behaviour Formation Model.*	9. Can you describe how you normally respond when you notice something unusual in the workplace (such as a strong or unfamiliar smell)? 10. Do you think your familiarity with workplace odours has affected how you follow safety rules or precautions? 11. Have there been times when you or your colleagues overlooked or ignore safety precautions because the odour seemed 'normal' or not harmful?

RO4: *To identify and recommend control measures for improving safety practices that address effects of habituation.*	12. What safety procedures or equipment are in place to deal with odour-related hazards? 13. Do you think existing control measures are still effective for workers who are used to the odours? Why or why not? 14. Have you received reminders or training to counteract the effects of habituation in relation to chemical or odour exposure? 15. What improvements or additional support would you recommend to help ensure safety measures are taken seriously, even when odours seem familiar?
Closing	
Additional comment	16. Is there anything else you would like to share about your experience with workplace odours or safety practices?
To be read to the participant	Key Components: 1. Next Step 2. Express thanks

Appendix B

Participant Information Sheet

RESEARCH INFORMATION/ *MAKLUMAT KAJIAN*

Research Title *Tajuk Kajian:*	**Exploring The Influence of Odour Habituation on Risk Perception and Safety Behaviour in Rubber Manufacturing** ***Penerokaan Pengaruh Kebiasaan Terhadap Bau terhadap Persepsi Risiko dan Tingkah Laku Keselamatan dalam Industri Pembuatan Getah***
Principal Investigator: *Penyelidik Utama:*	Nor Insyirah Binti Daud, Master of Science (Occupational Safety and Health Management) *Sarjana Sains (Pengurusan Keselamatan dan Kesihatan Pekerjaan)*
Supervisor: *Penyelia:*	Dr. Syazwan Syah Zulkifly, Dr. Siti Hawa binti Harith, School of Business Management, Universiti Utara Malaysia *Pusat Pengurusan Perniagaan, Universiti Utara Malaysia*

INTRODUCTION/*PENGENALAN*

You are invited to take part voluntarily in a research study. The scope of this study encompasses the exploration on how becoming used to odours (odour habituation) might influence how workers in rubber manufacturing perceive safety risks and how they behave at work.

It is important that you read and understand this research information before agreeing to participate. You will receive a copy of this form for your own records if you choose to participate. Your participation is expected to take about 30 minutes in total. This study will involve around 10 to 15 participants.

Anda dijemput untuk menyertai kajian ini secara sukarela. Skop kajian ini meliputi penerokaan bagaimana kebiasaan terhadap bau (odour habituation) mungkin mempengaruhi cara pekerja dalam industri pembuatan getah menilai risiko keselamatan dan tingkah laku keselamatan mereka.

Adalah penting untuk anda membaca dan memahami maklumat kajian ini sebelum bersetuju untuk menyertai. Anda akan menerima satu salinan borang ini untuk simpanan anda sekiranya anda bersetuju untuk menyertai. Penyertaan anda dijangka mengambil masa lebih kurang 30 minit secara keseluruhan. Kajian ini akan melibatkan sekitar 10 hingga 15 peserta.

PURPOSE OF STUDY/ *TUJUAN KAJIAN*

The purpose of this study is to better understand how repeated exposure to strong or unpleasant odours in rubber manufacturing may affect how workers perceive risk and how they behave in terms of safety.

Tujuan kajian ini adalah untuk memahami bagaimana pendedahan berulang kepada bau yang kuat atau tidak menyenangkan dalam industri pembuatan getah boleh mempengaruhi persepsi risiko dan tingkah laku keselamatan pekerja.

PARTICIPANT'S CRITERIA/*KRITERIA PESERTA*

The research team will confirm your eligibility before participation. It is important that you are honest with the researcher about your work background and experiences.

You are eligible to participate if:

- You are currently working in a rubber manufacturing facility in Malaysia.
- Your job involves direct or indirect exposure to industrial odours (e.g., production or admin roles on-site).
- You have worked in the industry for at least 6 months to 1 year.

You are not eligible if:

- You have problems with your sense of smell.
- You are a temporary or part-time worker.
- You work off-site or remotely (e.g., upper management not based at the facility).

Pasukan penyelidik akan mengesahkan kelayakan anda sebelum penyertaan. Adalah penting untuk anda jujur tentang latar belakang kerja dan pengalaman anda.

Anda layak menyertai kajian ini jika:

- *Anda bekerja di fasiliti pembuatan getah di Malaysia.*

- *Tugas anda melibatkan pendedahan langsung atau tidak langsung kepada bau industri (contohnya pekerja produksi atau pentadbiran di tapak).*
- *Anda mempunyai pengalaman kerja sekurang-kurangnya 6 bulan hingga 1 tahun dalam industri ini.*

Anda tidak layak jika:

- *Anda mengalami masalah deria bau.*
- *Anda pekerja sementara atau sambilan*
- *Anda bekerja di luar tapak atau secara jarak jauh (contohnya pengurusan atasan yang tidak bekerja di fasiliti).*

STUDY PROCEDURES/*PROSEDUR KAJIAN*

If you agree to participate, you will take part in a one-on-one interview. The interview will last around 30 minutes and will be audio-recorded with your permission. You will be asked questions about your work experience, how you notice or stop noticing odours at work, and how that affects your awareness of safety risks. You can skip any question or stop the interview at any time.

Jika anda bersetuju untuk menyertai, anda akan mengambil bahagian dalam temubual secara individu. Temubual ini akan berlangsung dalam 30 minit dan akan dirakam dengan kebenaran anda. Anda akan ditanya tentang pengalaman kerja anda, bagaimana anda menyedari atau terbiasa dengan bau di tempat kerja, dan bagaimana ia mempengaruhi kesedaran anda terhadap risiko keselamatan. Anda boleh memilih untuk tidak menjawab mana-mana soalan atau menghentikan temubual pada bila-bila masa.

RISKS/*RISIKO*

This study has minimal risk. However, you might feel uncomfortable when discussing certain topics. If this happens, you can stop the interview or skip any question.

Kajian ini mempunyai risiko yang sangat rendah. Namun begitu, anda mungkin merasa tidak selesa apabila membincangkan beberapa perkara. Jika ini berlaku, anda boleh menghentikan temubual atau tidak menjawab soalan tersebut.

PARTICIPATION IN THE STUDY/*PENYERTAAN DALAM KAJIAN*

Your participation is completely voluntary. You may withdraw at any time without giving any reason. There will be no negative consequences if you choose to stop.

Penyertaan anda adalah secara sukarela sepenuhnya. Anda boleh menarik diri pada bila-bila masa tanpa memberikan sebarang sebab. Tiada akibat buruk sekiranya anda memilih untuk berhenti.

The investigator will serve solely as a researcher in this study and will not be inflicted as a service provider to the participants.

Penyelidik hanya akan bertindak sebagai penyelidik dalam kajian ini dan tidak akan berperanan sebagai penyedia perkhidmatan kepada peserta.

POSSIBLE BENEFITS/*MANFAAT YANG MUNGKIN*

Your participation can help increase understanding of the impact of odour on risk perception and safety behaviour, which can contribute to better workplace safety practices in the future.

Penyertaan anda boleh membantu meningkatkan pemahaman tentang kesan bau terhadap persepsi risiko dan tingkah laku keselamatan, yang dapat menyumbang kepada amalan keselamatan tempat kerja yang lebih baik pada masa hadapan.

QUESTIONS/*PERTANYAAN*

If you have any questions or concerns about this study, please contact:

Jika anda mempunyai sebarang pertanyaan atau kebimbangan mengenai kajian ini, sila hubungi:

Researcher/*Penyelidik*: Nor Insyirah binti Daud
Phone Number/*Nombor Telefon*: 011-39488447
E-mail/ *Emel*: n.insyirahdaud@gmail.com

If you have any questions regarding the Ethical Approval or any issue / problem related to this study, please contact;

Jika anda mempunyai sebarang pertanyaan atau kebimbangan mengenai kebenaran etika atau sebarang permasalahan mengenai kajian ini, sila hubungi:

Research Management Center (RMC)/ *Sekretariat UUM JKEP:*
Puan Nurul Nadiah binti Rusle
Phone Number*/Nombor Telefon: 04-928 4780*
E-mail*/ Emel: nurul.nadiah@uum.edu.my*

CONFIDENTIALITY/*KERAHSIAAN*

All information will be kept strictly confidential. Your name will not appear in any report. The audio recordings and transcripts will be securely stored and destroyed five years after the study ends, unless required by law.

Semua maklumat akan dirahsiakan sepenuhnya. Nama anda tidak akan disebut dalam mana-mana laporan. Rakaman audio dan transkrip akan disimpan dengan selamat dan dimusnahkan lima tahun selepas kajian tamat, kecuali sekiranya diperlukan oleh perundangan.

The interview protocol and study procedures was reviewed and by JKEP-UUM Research Ethics Committee. The JKEP-UUM Review Panel and relevant regulatory authorities may review the study data as part of their oversight responsibilities.

Prosedur kajian dan protokol temubual untuk kajian ini telah disemak dan diluluskan oleh Jawatankuasa Etika Penyelidikan (JKEP-UUM). Panel Penilaian JKEP-UUM dan pihak berkuasa berkaitan mungkin akan menyemak data kajian ini sebagai sebahagian daripada tanggungjawab penyeliaan mereka.

SIGNATURES/*TANDATANGAN*

To become participant of this study, you must sign the consent form (on the signature page) provided by the researcher.

Untuk menjadi peserta kajian ini, anda mesti menandatangani borang kebenaran (dalam muka surat tandatangan) yang disediakan oleh penyelidik.

Appendix C

Consent Form

SUBJECT INFORMATION AND CONSENT FORM/ *MAKLUMAT PESERTA DAN BORANG PERSETUJUAN*

Research Title *Tajuk Kajian:*	**Exploring The Influence of Odour Habituation on Risk Perception and Safety Behaviour in Rubber Manufacturing** ***Penerokaan Pengaruh Kebiasaan Terhadap Bau terhadap Persepsi Risiko dan Tingkah Laku Keselamatan dalam Industri Pembuatan Getah***
Principal Investigator: *Penyelidik Utama:*	Nor Insyirah Binti Daud, Master of Science (Occupational Safety and Health Management) *Sarjana Sains (Pengurusan Keselamatan dan Kesihatan Pekerjaan)*
Supervisor: *Penyelia:*	Dr. Syazwan Syah Zulkifly, Dr. Siti Hawa binti Harith, School of Business Management, Universiti Utara Malaysia *Pusat Pengurusan Perniagaan, Universiti Utara Malaysia*

CONSENT STATEMENT/*PENYATAAN KEBENARAN*

Please tick the boxes to confirm. *Sila tandakan kotak untuk mengesahkan.*

I have read and understood the Participant's Research Information *Saya telah membaca dan memahami Maklumat Kajian Untuk Peserta.*	
I have had the opportunity to ask questions. *Saya telah diberi peluang untuk bertanya soalan.*	
I understand that participation is voluntary. *Saya faham bahawa penyertaan adalah secara sukarela.*	
I agree to take part in the study. *Saya bersetuju untuk menyertai kajian ini.*	
I agree to be audio recorded. *Saya bersetuju untuk dirakam secara audio.*	

Participant's Name: ***Nama Peserta:***
Identification No. : ***No. Kad Pengenalan:***
Signature/*Tandatangan*: _____ **Date/*Tarikh*:** _____
Consent obtained by: ***Kebenaran diambil oleh:*** **Name/*Nama*:** **Signature/*Tandatangan*:** _____ **Date/*Tarikh*:** _____

Appendix D

Raw Transcript for Participant D-4

Penyelidik
[00:01:22.000 --> 00:01:28.000] Boleh tak puan terangkan jenis-jenis bau yang puan biasa bau masa mula bekerja?
Peserta
[00:01:28.000 --> 00:01:30.000] Bau dekat sini lah?
Penyelidik
[00:01:30.000 --> 00:01:34.000] Macam mana puan nak terangkan bau tu?
Peserta
[00:01:34.000 --> 00:01:38.000] Dia macam ni. Kalaulah kita masuk.
[00:01:38.000 --> 00:01:42.000] Getah tu terlampau. Kalaulah baru datang tu dia tak berapa nak ni.
[00:01:44.000 --> 00:01:47.000] Bila dia baru datang tu dia tak bau
[00:01:47.000 --> 00:01:52.000] Macam tengik dia tu lagi. Bau masam-masam tu kan.
Penyelidik
[00:01:52.000 --> 00:01:56.000] Bagi puan bau tu dia tak menyenangkan ke,
[00:01:56.000 --> 00:01:58.000] Bau sedap ke?
Peserta
[00:01:58.000 --> 00:02:00.000] Tak menyenangkan lah kan.
Penyelidik
[00:02:00.000 --> 00:02:06.000] Senang kata puan terangkan bau tu sebab bau yang tidak menyenangkan.
[00:02:06.000 --> 00:02:08.000] Masa awal kerja tu.
Penyelidik
[00:02:08.000 --> 00:02:12.000] Lepas tu, apa reaksi kepada bau-bau tu?
[00:02:12.000 --> 00:02:14.000] Dah tak menyenangkan.
[00:02:14.000 --> 00:02:16.000] Masa mula-mula kerja tu, apakah reaksi kepada bau-bau tu?
Peserta
[00:02:16.000 --> 00:02:18.000] Macam kena sakit kepala sikit lah.
Penyelidik
[00:02:18.000 --> 00:02:20.000] Oh ada reaksi juga lah.
Peserta
[00:02:20.000 --> 00:02:24.000] Lepas tu lama-lama tu kita dah biasa lah.
Penyelidik
[00:02:24.000 --> 00:02:27.000] Ada reaksi pada bau?
Peserta
[00:02:27.000 --> 00:02:29.000] Ada lah juga sikit-sikit.
Penyelidik
[00:02:29.000 --> 00:02:32.000] Kemudian setelah beberapa lama tu dah terbiasa lah kan?
[00:02:32.000 --> 00:02:34.000] Maknanya ada perubahan?
Peserta
[00:02:34.000 --> 00:02:38.000] Ada perubahan la, lama dah biasa lah. Mangli dah lah.

Penyelidik
[00:02:38.000 --> 00:02:43.000] Terbiasa lah. Cara reaksi bau tu.
Peserta
[00:02:43.000 --> 00:02:45.000] Tak ada apa dah lah.
Penyelidik
[00:02:45.000 --> 00:02:51.000] Tapi adakah puan rasa, pekerja yang selalu terdedah dengan orang yang tak terdedah
[00:02:51.000 --> 00:02:53.000] Contohnya yang duduk di pejabat kan.
[00:02:53.000 --> 00:02:55.000] Tak kena pun, getah pun.
[00:02:55.000 --> 00:02:57.000] Tak berbau direct lah kan.
[00:02:57.000 --> 00:03:02.000] Adakah mereka ni, akan lebih mudah terbiasa?
[00:03:02.000 --> 00:03:03.000] Atau tidak?
[00:03:03.000 --> 00:03:05.000] Ada beza tak?
Peserta
[00:03:05.000 --> 00:03:07.000] Ada beza.
Penyelidik
[00:03:07.000 --> 00:03:12.000] Maksudnya macam kalau duduk di pejabat tu kurang terbiasa?
Peserta
[00:03:12.000 --> 00:03:15.000] Ya kurang terbiasa.
Penyelidik
[00:03:15.000 --> 00:03:17.000] Kalau dekat pejabat?
Peserta

[00:03:17.000 --> 00:03:20.000] Kalau dekat pejabat lah. Kalau turun bawah, bau lah.
Penyelidik
[00:03:20.000 --> 00:03:25.000] Kalau turun, baru bau lah.
[00:03:25.000 --> 00:03:27.000] Jadi kurang terbiasa..
Penyelidik
[00:03:27.000 --> 00:03:35.000] Pernah tak puan risau tentang risiko keselamatan berkaitan dengan bau-bau?
[00:03:35.000 --> 00:03:39.000] Tak kisah lah bau getah atau bahan kimia. Ada tak?
[00:03:39.000 --> 00:03:40.000] Kerisauan?
Peserta
[00:03:40.000 --> 00:03:44.000] Kerisauan macam chemical-chemical tu risaulah juga.
Penyelidik
[00:03:44.000 --> 00:03:45.000] Oh risaulah juga.
[00:03:45.000 --> 00:03:46.000] Pasal bau?
Peserta
[00:03:46.000 --> 00:03:48.000] Bau tu biasa lah.
[00:03:48.000 --> 00:03:51.000] Anak-anak peneroka duduk bau getah lama.
Penyelidik
[00:03:51.000 --> 00:03:54.000] Kiranya berkaitan dengan bau tak ada la.
Peserta
[00:03:54.000 --> 00:03:56.000] Tak berapa ada masalah sangat.
[00:03:56.000 --> 00:03:58.000] Masalahnya dekat chemicall-chemical tu.
Penyelidik
[00:03:58.000 --> 00:04:01.000] Berkaitan bau tak fikir langsung tentang risiko keselamatan?

Peserta
[00:04:01.000 --> 00:04:04.000] Tak. Tak fikir.
Penyelidik
[00:04:04.000 --> 00:04:09.000] Kemudian, macam mana puan nilai sama ada
[00:04:09.000 --> 00:04:11.000] Bau-bau yang ada ni kan?
[00:04:11.000 --> 00:04:14.000] Dari proses kerja biasa ataupun benda yang luar biasa?
[00:04:14.000 --> 00:04:16.000] Maksudnya bau yang tak normal..
Peserta
[00:04:17.000 --> 00:04:19.000] Biasa yang tu.
[00:04:19.000 --> 00:04:25.000] Macam proses-proses tu kalau ada orang masukkan chemical tu dia pelik sikit.
[00:04:25.000 --> 00:04:30.000] Macam-macam buat asid, penambahan asid untuk bagi getah tu ni.
Penyelidik
[00:04:30.000 --> 00:04:38.000] Jadi macam mana puan tahu benda tu memang itu yang biasa orang buat atau tiba-tiba sebenarnya ada kebecoran ke?
[00:04:38.000 --> 00:04:41.000] Luar biasa. Susah tak nak jangka?
Peserta
[00:04:41.000 --> 00:04:42.000] Susah juga.
Penyelidik
[00:04:42.000 --> 00:04:44.000] Susah sebab bau terlalu banyak?
[00:04:44.000 --> 00:04:46.000] Susah nak nilai?
Peserta
[00:04:46.000 --> 00:04:47.000] Susah nak nilai.
Penyelidik
[00:04:49.000 --> 00:04:59.000] Tapi adakah puan rasa kebiasaan kepada bau-bau ni menjejaskan sejauh mana orang ambil berat tentang risiko?
[00:04:59.000 --> 00:05:01.000] Risiko bau-bau ni.
[00:05:01.000 --> 00:05:03.000] Pada pendapat lah.
Peserta
[00:05:03.000 --> 00:05:04.000] Pendapat macam mana?
Penyelidik
[00:05:04.000 --> 00:05:11.000] Adakah orang yang terbiasa dengan bau? Adakah sebab terbiasa dia akan kurang ambil berat tentang risiko-risiko?
Peserta
[00:05:11.000 --> 00:05:12.000] Mereka tak ambil berat.
Penyelidik
[00:05:12.000 --> 00:05:13.000] Tak ambil berat.
[00:05:13.000 --> 00:05:15.000] Kiranya, ya.
[00:05:15.000 --> 00:05:18.000] Tidak ambil berat.
Penyelidik
[00:05:22.000 --> 00:05:34.000] Pada pendapat puan, adakah pekerja yang daripada pengeluaran mempunyai tahap kesedaran risiko atau kebimbangan yang berbeza dengan yang duduk di pejabat?
[00:05:36.000 --> 00:05:37.000] Senang kata kesedaran lah.
[00:05:38.000 --> 00:05:42.000] Kesedaran mereka yang duduk sana dengan yang di sini. Berbeza tak?
Peserta

[00:05:42.000 --> 00:05:43.000] Berbeza.
Penyelidik
[00:05:43.000 --> 00:05:47.000] Berbeza tu. Sebab apa puan rasa berbeza? Sebab mereka ada bau?
Peserta
[00:05:47.000 --> 00:05:53.000] Perbezaan dia macam dalam sini dia jarang bau secara..
[00:05:53.000 --> 00:05:55.000] Oh secara ini, secara..
[00:05:55.000 --> 00:05:56.000] Secara ini lah.
[00:05:56.000 --> 00:05:58.000] Spontan macam kita duduk.
Penyelidik
[00:05:58.000 --> 00:06:02.000] Kurang bau secara terus?
Peserta
[00:06:02.000 --> 00:06:03.000] Terus ya. Direct?
[00:06:03.000 --> 00:06:07.000] Ya sini nak bau macam mana. Bukan buat proses tu. Cuma..
[00:06:07.000 --> 00:06:09.000] Ini saja.
Penyelidik
[00:06:10.000 --> 00:06:18.000] Faham. Kiranya berbeza lah mereka yang dekat sana dengan yang di sini.
Peserta
[00:06:18.000 --> 00:06:19.000] Sebab lain-lain kerja kan.
Penyelidik
[00:06:19.000 --> 00:06:20.000] Oh betul.
[00:06:20.000 --> 00:06:26.000] Bolehkah puan terang. Kalau puan ada nampak benda yang luar biasa. Contoh bau yang terlampau kuat.
[00:06:26.000 --> 00:06:29.000] Ataupun ada benda tumpah.
[00:06:29.000 --> 00:06:32.000] Macam mana puan bertindak?
Peserta
[00:06:32.000 --> 00:06:35.000] Bukan kita bersediakan PPE kan.
[00:06:35.000 --> 00:06:41.000] Kita sediakan PPE. Kita kena ambil langkah memakai PPE tu lah.
[00:06:42.000 --> 00:06:49.000] Macam mereka kalau buat macam tertumpah. Dia ada bahan-bahannya.
[00:06:49.000 --> 00:06:51.000] Bahan-bahannya untuk ni lah.
[00:06:51.000 --> 00:06:53.000] Kalau tertumpah.
Peserta
[00:06:53.000 --> 00:06:56.000] Kalau tertumpuh dia ada chemical
Penyelidik
[00:06:56.000 --> 00:06:58.000] Prosedur dia?
Peserta
[00:06:58.000 --> 00:07:01.000] Cara nak cuci dia macam mana.
Penyelidik
[00:07:01.000 --> 00:07:07.000] Kalau bau yang tak normal macam asap ke?
Peserta
[00:07:07.000 --> 00:07:09.000] Dia ada penapis dia semua tu.
[00:07:09.000 --> 00:07:11.000] Kalau ada orang tak buka.
Penyelidik
[00:07:11.000 --> 00:07:13.000] Kalau contoh dia macam dekat lab.

[00:07:13.000 --> 00:07:16.000] Ada bau yang tak normal…buka?
Peserta
[00:07:16.000 --> 00:07:19.000] Buka pintu, buka tingkap.
[00:07:22.000 --> 00:07:25.000] Sebab kita bilik macam tertutup.
[00:07:25.000 --> 00:07:26.000] Sliding, semua
Penyelidik
[00:07:26.000 --> 00:07:31.000] Dekat lab dia ada exhaust fan kan? Ventilation system lah kan.
Peserta
[00:07:31.000 --> 00:07:35.000] Ada-ada.
Penyelidik
[00:07:35.000 --> 00:07:36.000] Dekat sini pintu Tingkap lah cukup..
[00:07:36.000 --> 00:07:40.000] Berbeza lah sebab puan bahagian lab.
[00:07:40.000 --> 00:07:43.000] Sebab tu saya tanya spesifik sikit bahagian lab.
Penyelidik
[00:07:43.000 --> 00:07:48.000] Adakah puan rasa, sebab puan dah terbiasa dengan bau ni…
[00:07:48.000 --> 00:07:53.000] Puan ikut lagi SOP yang sebenar-benar nya atau tak ikut?
Peserta
[00:07:53.000 --> 00:07:54.000] Ikut.
[00:07:54.000 --> 00:07:56.000] Sebab kita takut bahaya.
[00:07:56.000 --> 00:07:57.000] Sebab lab.
[00:07:58.000 --> 00:08:01.000] Kita berhadapan dengan chemical macam-macam kan.
[00:08:01.000 --> 00:08:08.000] Lepas tu kita pergi kursus pun dia orang cakap chemical ni macam mana reaksi dia.
Penyelidik
[00:08:08.000 --> 00:08:10.000] Kiranya tu puan..
[00:08:10.000 --> 00:08:15.000] Kalau daripada segi bau pula kan …sebab puan dah terbiasa dengan bau kan…
[00:08:15.000 --> 00:08:18.000] Kalau PPE berkaitan dengan bau, adakah puan masih pakai?
Peserta
[00:08:18.000 --> 00:08:19.000] Pakai.
Penyelidik
[00:08:19.000 --> 00:08:20.000] Pakai lagi.
[00:08:20.000 --> 00:08:21.000] Okey.
[00:08:23.000 --> 00:08:28.000] Tapi lah ada ke puan tengok lah rakan kerja
[00:08:28.000 --> 00:08:31.000] Terlepas pandang ataupun abaikan langkah keselamatan.
[00:08:31.000 --> 00:08:35.000] Contohnya macam tak pakai mask lah sebab dah terbiasa dengan bau ni?
Peserta
[00:08:36.000 --> 00:08:38.000] Tak ada lah semua kebanyakan pakai lah.
[00:08:38.000 --> 00:08:40.000] Dekat lab pakai lah.
[00:08:40.000 --> 00:08:44.000] Sebab kita dah pergi kursus pun semua tu.
[00:08:44.000 --> 00:08:46.000] Kena ikut langkah-langkah tu lah.
Penyelidik

[00:08:46.000 --> 00:08:53.000] Kiranya walaupun bau tu dah terbiasa ataupun normal tapi tetap ikut langkah keselamatan.
[00:08:53.000 --> 00:08:55.000] Okey faham.
Penyelidik
[00:08:55.000 --> 00:09:03.000] Apakah prosedur yang disediakan untuk kurangkan risiko berkaitan dengan bau? dekat lab tadi dah beritahu lah.
[00:09:03.000 --> 00:09:06.000] Tapi takpalah boleh ulang sikit?
Peserta
[00:09:06.000 --> 00:09:14.000] Macam exhaust fan pun bila kita melakukan proses untuk testing tu kita akan biasa buka fan tu.
Penyelidik
[00:09:14.000 --> 00:09:15.000] Dalam kebuk wasap tu?
Peserta
[00:09:15.000 --> 00:09:18.000] Dalam kebuk wasap tu ada punya kebuk wasap dah tu.
[00:09:18.000 --> 00:09:20.000] Ada buat test apa tu…
[00:09:20.000 --> 00:09:22.000] Nitrogen?

Penyelidik
[00:09:23.000 --> 00:09:28.000] Kebuk wasap lah tu yang tutup masa testing tu?
[00:09:28.000 --> 00:09:30.000] Ataupun dia terbuka ke?
Peserta
[00:09:30.000 --> 00:09:31.000] Dia ada.
[00:09:31.000 --> 00:09:32.000] Tempat dia.
Penyelidik
[00:09:32.000 --> 00:09:33.000] Tempat dia tu macam mana?
[00:09:33.000 --> 00:09:34.000] Macam cabinet?
Peserta
[00:09:34.000 --> 00:09:35.000] Oh kabinet.
[00:09:35.000 --> 00:09:36.000] Ada.

Penyelidik
[00:09:36.000 --> 00:09:40.000] Yang tu nama dia kebuk wasap?
[00:09:46.000 --> 00:09:47.000] Ada ya.
[00:09:47.000 --> 00:09:52.000] Jadi dia digunakan untuk kurangkan risiko berkaitan bau lah di samping pakai mask?
Peserta
[00:09:52.000 --> 00:09:55.000] Mask. Lepas tu kita pakai respirator.
Penyelidik
[00:09:55.000 --> 00:09:56.000] Oh respirator dia pakai juga?
Peserta
[00:09:56.000 --> 00:09:59.000] Ya sebab kita akan buat proses ‘dirt’
[00:09:59.000 --> 00:10:02.000] ‘dirt’ akan bau dia lebih kuat.
Penyelidik
[00:10:02.000 --> 00:10:04.000] Kiranya dekat lab ni lebih ketat.
Peserta
[00:10:04.000 --> 00:10:05.000] Ya lebih ketat.
Penyelidik
[00:10:05.000 --> 00:10:06.000] Faham.

[00:10:07.000 --> 00:10:10.000] Adakah puan rasa …ni pendapat lah.
[00:10:10.000 --> 00:10:13.000] Langkah kawalan yang sedia ada.
[00:10:13.000 --> 00:10:16.000] Berkesan tak untuk pekerja yang dah terbiasa dengan bau.
[00:10:16.000 --> 00:10:18.000] Tempat-tempat lain lah tak semestinya lab lah.
[00:10:18.000 --> 00:10:20.000] Dia pun dah terbiasa dengan bau kan.
[00:10:20.000 --> 00:10:23.000] Adakah cukup langkah kawalan yang sedia ada?
Peserta
[00:10:23.000 --> 00:10:24.000] Tak ada.
[00:10:24.000 --> 00:10:25.000] Tak cukup.
Penyelidik
[00:10:25.000 --> 00:10:26.000] Tak cukup kan?
Peserta
[00:10:26.000 --> 00:10:27.000] Dia kena lebih lagi.
Penyelidik
[00:10:27.000 --> 00:10:29.000] Sebab dekat makmal dia lain.
[00:10:29.000 --> 00:10:30.000] Dia lebih ketat?
Peserta
[00:10:30.000 --> 00:10:31.000] Sebab tempat proses dia lain.
[00:10:31.000 --> 00:10:33.000] Tak cukup ya.
Penyelidik
[00:10:33.000 --> 00:10:42.000] Pernah tak puan ada pendapat peringatan ataupun latihan berkaitan dengan kesan bahan kimia ataupun bau?
[00:10:42.000 --> 00:10:43.000] Ada lah kan?
Peserta
[00:10:43.000 --> 00:10:44.000] Ada lah.
Penyelidik
[00:10:44.000 --> 00:10:46.000] Peringatan ataupun latihan?
Peserta
[00:10:46.000 --> 00:10:47.000] Latihan.
Penyelidik
[00:10:47.000 --> 00:10:50.000] Latihan ni macam kursus lah?
Peserta
[00:10:50.000 --> 00:10:51.000] Kursus.
Penyelidik
[00:10:51.000 --> 00:11:00.000] Ada sebarang cadangan penyambut baikan untuk pastikan orang tak ambil mudah pasal bau?
Peserta
[00:11:00.000 --> 00:11:04.000] Ini yang macam kita sediakan PPE tu.
[00:11:04.000 --> 00:11:09.000] Kita macam kalau tak pakai ke, kita kena ambil langkah lah macam….
[00:11:09.000 --> 00:11:13.000] Tak pakai kena ada tindakan.
Penyelidik
[00:11:13.000 --> 00:11:14.000] Tindakan.
[00:11:14.000 --> 00:11:17.000] Tindakan ketat sikit lah?
Peserta
[00:11:17.000 --> 00:11:19.000] Tindakan yang berat sikit lah.
[00:11:19.000 --> 00:11:20.000] Berat sikit lah.
[00:11:20.000 --> 00:11:24.000] Sebab untuk menjamin keselamatan kesihatan mereka

Penyelidik
[00:11:24.000 --> 00:11:25.000] Betul.
Peserta
[00:11:25.000 --> 00:11:28.000] Kalau tak. mereka ambil langkah mudah lah tak pakai, ambil bau macam tu lah lah.
Penyelidik
[00:11:31.000 --> 00:11:32.000] Jadi selain pada tu.
[00:11:32.000 --> 00:11:35.000] memang kena keras sikit lah?
Peserta
[00:11:35.000 --> 00:11:36.000] Keras sikit lah kan.
Penyelidik
[00:11:37.000 --> 00:11:47.000] Ada apa-apa lagi yang puan nak kongsi berkenaan dengan pengalaman berkaitan dengan getah ni secara umum?
Peserta
[00:11:47.000 --> 00:11:48.000] Pengalaman.
[00:11:50.000 --> 00:11:51.000] Tak ada la.

Appendix E

Sample of Coding of Interviews

RO 1: To investigate how the occurrence of odour habituation varies among workers from different exposure groups to industrial odour in the rubber manufacturing industry.

Question 1: Can you describe the types of smells or odours you commonly encounter during your work?

ID	Quote (BM)	Supporting Quotes (Translated)	Initial Code
D-1	*Bila dia masa mula-mula masuk kerja tu, memang tak sangka lah kita kerja kilang getah bau busuk kan?*	*"Did not expect to work at stinky rubber factory"*	Unpleasant odour
D-1	*Lepas tu sampai balik pun anak kata, "Woi ibu bau busuk, ibu pergi mandi dulu.", macam tu sekali. Dia melekat ke baju kita.*	*Then when I went home, my kids said, "Wow, mom, you smell bad, mom, go take a shower first.", that's how it is. It sticks to our clothes.*	Odours offensive to outsiders
D-1	*Dia kuat, dia akan melekat pada baju.*	*"It's strong, it'll stick to our clothes."*	Strong, lingering odour
D-2	*Baiklah, bau getah lah..Bau getah yang mentah dengan masak, bau dia lain.*	*"Alright, it's rubber odour. The smell of raw and processed rubber is different.*	Rubber odours

Appendix F

Thematic Table

Research Objective	Themes	Subthemes	Codes
RO 1	**1. Odour Experience and Habituation Spectrum**	1.1 Initial Odour Reactions	**A. Sensory Impact** 1. Unpleasant odour 2. Rubber odours 3. Strong lingering odour 4. Stinging odours 5. Acid smell 6. Burnt smell 7. Rancid/sour smell
			B. Physical and Psychological Responses 1. Initial odour intolerance 2. Emotional detachment 3. General discomfort 4. Physical discomfort 5. Odour offensive to outsiders
			C. Odour Awareness 1. Odour awareness through social feedback 2. Recognition of odour intensity differences
		1.2 Habituation Development	**A. Temporal Patterns** 1. Rapid odour habituation 2. Gradual odour habituation 3. Partial odour habituation 4. Habituation through repeated exposure
			B. Adaptive States 1. Complete odour internalization 2. Routine comfort in odorous setting 3. Emotional detachment from odour 4. Physical tolerance to odour
		1.3 Reversible Sensitisation	**A. Post-Exposure Effects** 1. Regained odour sensitivity outside work 2. Regained sensitivity after less exposure 3. Intermittent risk awareness
	2. Exposure group Variation	1.4 Direct vs. Indirect Exposure Differences	**A. Direct Exposure** 1. Role-based exposure variation (production) 2. Localised odour exposure

			B. Indirect Exposure 1. Cross-environment odour exposure 2. Occupational awareness disparity
			C. Individual Factors 1. Subjective individual tolerance 2. Across-role odour habituation
		1.5 Adaptation Catalyst	**A. Environmental** 1. Environmental odour variations 2. Daily exposure prior to work
			B. Social 1. Community-level habituation 2. Social reinforcement of tolerance 3. Past experience anchoring effect
RO 2	**3. Odour-Driven Risk Perception**	3.1 Cognitive Biases	**A. Heuristics** 1. Normalcy bias 2. Optimism bias 3. Anchoring effects of smells
			B. Risk Minimization 1. Perceived harmlessness of odours 2. False consensus of risk perception 3. Paradoxical awareness
		3.2 Behavioural Biases	**A. Selective Processing** 1. Proximity-attenuated awareness 2. Reduced responsiveness to odour cues 3. Selective odour sensitivity
			B. Habitual Responses 1. Concern over potential risk 2. Routine acceptance of odours 3. Dismissal of health risks 4. Selective concern over chemical odours
		3.3 Social Conditioning	**A. Group Dynamics** 1. Social normalization of odour 2. Bandwagon effect of non-compliance 3. Occupational awareness disparity 4. Second-hand risk hyperawareness
		3.4 Environmental & Perceptual Risk Cues	**A. Risk Cues** 1. Environmental damage as risk cue 2. Odour characteristics as risk estimation

			3. Unfamiliar odour vigilance 4. Process-based odour familiarity
RO 3	**4. Risk Perception–Safety Behaviour Link**	4.1 Compliance Drivers	**A. Knowledge-Based** 1. Knowledge-based awareness 2. Firsthand risk familiarity 3. Training-driven compliance
			B. Proactive Actions 1. Proactive safety response 2. Active risk vigilance 3. Role-driven odour vigilance 4. Reflective safety behaviour 5. Hierarchical risk awareness
		4.2 Non-compliance Drivers	**A. Behavioural** 1. Safety complacency due to odour normalisation 2. Long-term habituation and social acceptance 3. Incomplete habituation with concern. 4. Improvised self-protection
			B. Systemic 1. Task-dependent selective compliance 2. Perceived irrelevance of odour to SOP 3. Perceived uncertainty in safety practices 4. Perceived control measure sufficiency due to routine
		4.3 Behaviour Gaps	**A. Psychological** 1. Resignation to risk 2. Externalization of risks 3. Contradicting awareness vs risk underestimation 4. Cognitive detachment from risk
			B. Practical 1. Convenience over compliance 2. Deferral of action to others 3. Inaction due to role boundaries 4. Reliance on authority 5. Forgetfulness without reinforcement
RO 4	**5. Current Control Measures**	5.1 Existing Controls	**A. Physical** 1. Basic protective strategies (masks) 2. Engineering controls (scrubbers) 3. Specified protective strategies 4. Enhanced controls for high-risk zones
			B. Administrative

			1. Training on PPE 2. Training on chemical effects 3. Supervisory reminder 4. Informal communication chain
		5.2 Gaps in Existing Controls	**A. Training** 1. Training gap on odour hazards 2. Lack of reminder regarding odour
			B. Systemic 1. Limitation of physical protection 2. One-size-fits-all limitation 3. Cost-related barriers 4. Underreporting 5. Context-dependent ineffectiveness of controls 6. Lack of administrative controls
		5.3 Improvement Strategies	**A. Awareness & Training** 1. Need for technical explanation 2. Importance of reminders 3. Briefings as default safety measure
			B. Policy & Enforcement 1. Stricter enforcement (penalties) to counteract complacency 2. Incentives for improving compliance
			C. Adaptive Controls 1. Adaptive PPE protocols 2. Limitation of physical protection 3. Isolation control
			D. Reporting Systems 1. Habituation-resistant complaint reporting

Appendix G

Summary of Direct Observation Notes

Direct Observation Note – [11 June 2025]

Location: [Rubber Manufacturing Plant]

Areas Visited:

- Outside Area (surrounding premises)
- Canteen (dining/break area for workers)
- Guard Posts (security checkpoints)
- Production Area (main manufacturing floor)
- Office (administrative/workspace areas)

Key Observations:

1. Mask Usage & Odor Exposure:
    - General Areas (Production, Canteen, Outside, Guard Posts): No workers wore masks despite persistent foul odour.
    - Task-Specific Use: Masks were worn for certain high-exposure tasks.
    - Peer Influence: Some workers acknowledged discomfort with the smell but avoided masks because colleagues did not wear them.
2. Worker Concerns:
    - Primary Irritant: Flies were a more frequently cited annoyance than odour.
    - Odor Mitigation Tactics:
        - Workers covered noses with clothing, hands, or perfumed items (e.g., tissues with fragrance) near office areas.
        - Odor Infiltration: The smell entered office spaces when doors were opened or when production staff entered, as their clothing retained the strong odour.
3. Mask Provision Claims vs. Reality:
    - Management stated masks were "widely available," yet:
        - Usage was inconsistent outside labs.
        - Workers improvised alternatives (perfume, fabric) instead of using masks.
        - Lingering odours on clothing suggested prolonged exposure risks.

Notable Risks:

- Secondary Exposure: Office staff indirectly exposed when production workers entered, or doors were left open.
- Residual Odor: Smell clung to clothing, potentially extending exposure beyond workspaces.