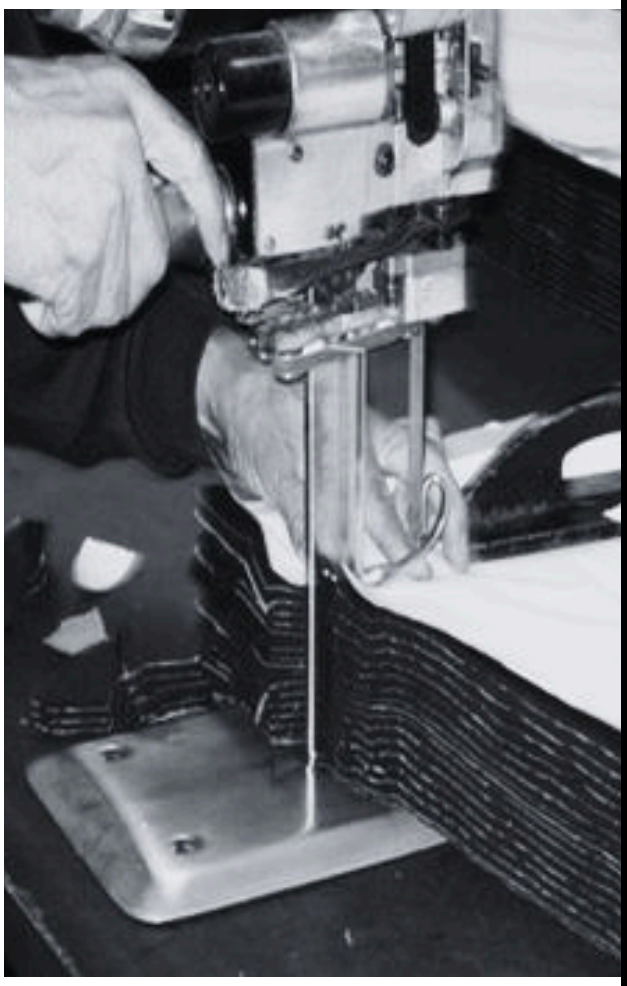


2025

# Research Report

# Enhancing Fashion Production Spaces to Address Respiratory Health and Safety Challenges


Prepared By :

**Chelsea Duong**


7th September 2025

ID 7 Capstone
Word Count : 4083

## Authenticity Statement

This is to certify that to the best of my knowledge; the content of this report is my own work. This report has not been submitted for any subject or for other purposes. I certify that the intellectual content of this report is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

Your Name : Chelsea Duong
Date : 7th September 2025

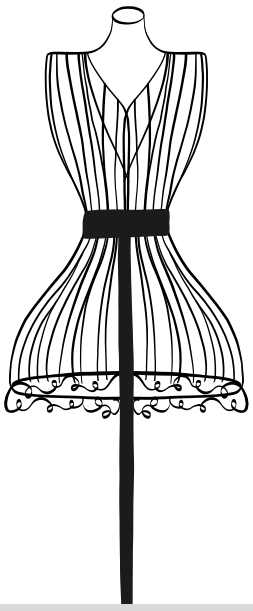
## AI Use Statement

For the purpose of this report, I have utilised the Generative AI program ChatGBT to support my work in several ways. Specifically, I used it to edit the fluency of my sentences, reduce word count, calculate percentages in my data, and verify that the frequency counts of themes and sub themes from survey responses were correct.

Your name : Chelsea Duong
Date : 7th September 2025

# EXECUTIVE SUMMARY

This report examines respiratory health and safety risks in fashion production workplaces, focusing on dust and microfibre exposure in both Australian and international contexts. It combines secondary research, benchmarking, and primary data to identify key challenges, contributing factors, and avenues for improvement. The study begins by establishing a foundation of knowledge on industry practices, including the impact of these challenges across different production contexts, associated health effects, and relevant data. Benchmarking of preventative measures on the market revealed that current solutions struggle to balance ergonomic design with affordability and accessibility, resulting in inconsistent equipment adoption and disruptions to workflow. Primary research, conducted though surveys and observations, reinforced these findings, highlighting the gap between current measures and workplace realities. The findings from the secondary and primary research are summarised in this report, forming a basis for developing concepts that encourage safer and more sustainable practices in the fashion industry.



Chelsea Duong
ID7 Assessment 1

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# 01

# INTRODUCTION

# Introduction

With 60 million people employed in the fashion manufacturing industry globally (Lai & Christiani, 2013), approximately 27 million are affected by occupational health concerns (The Editorial Unit, 2021). Respiratory conditions are especially prevalent, largely driven by ongoing exposure to airborne irritants released during fabric handling. This underscores the significant prevalence of work-related risk (WorkSafe Queensland, 2020).

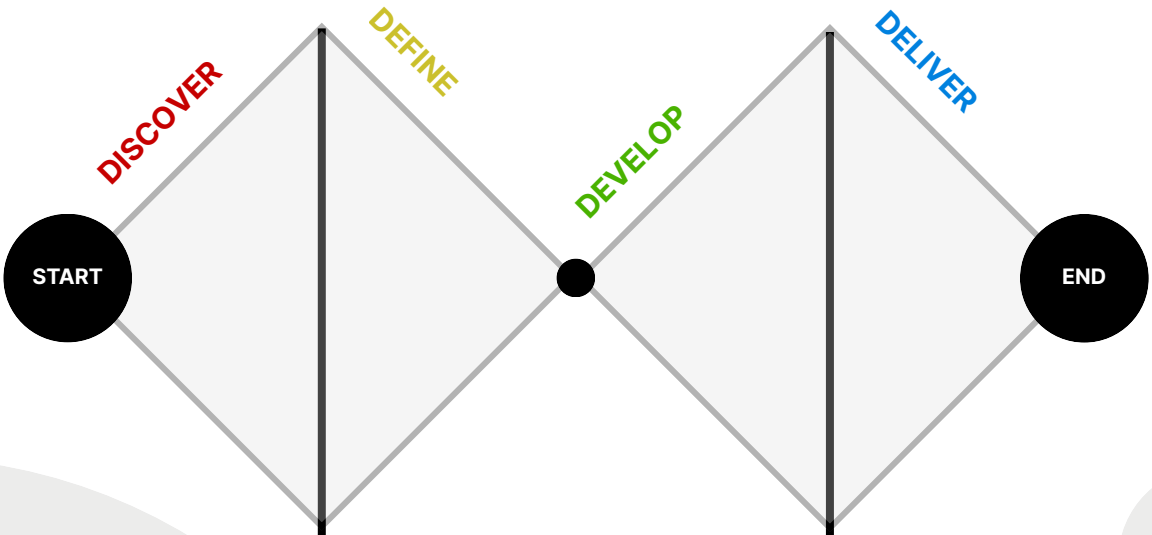
The aim of this project is to understand the detrimental effects airborne fibres and dust have on fashion workers. Subsequently, recognising that symptoms can manifest both immediately and over time, it investigates whether current protective tools and systems are sufficient in mitigating risks and reducing the severity of its cumulative impact.

Inhalation or ingestion of these particles can trigger immediate inflammatory responses such as coughing or throat irritation, while prolonged exposure may lead to chronic pulmonary dysfunction (Ha et al., 2021). Beyond physical symptoms, exposure also has significant implications for mental wellbeing. Workers may experience psychological distress as performance capacity, job sustainability, and health concerns arise from workflow disruptions, manifesting as discomfort, accelerated fatigue and increased task difficulty (Department of Health, 2025). Hence, the importance of protective measures as a preventative strategy cannot be overstated. Current interventions, such as ventilation systems and personal protective equipment (PPE), aim to minimise worker exposure to occupational hazards. Yet, very few products on the market are simultaneously ergonomic, affordable, and accessible. Thus, safeguards are often disregarded or inconsistently used, with comfort, convenience, and productivity prioritised over safety. These practices further increase the likelihood of respiratory harm (Tamene et al., 2020).

This elucidates a design opportunity for a protective system that reduces exposure, enhances workplace safety, improve quality of life, and encourage consistent use as a natural, sustainable part of daily practice.

# Project Visualisation

**RESEARCH** > **DESIGN**




### Secondary Research

Conduct research using medical journals, reports and industry safety publications to understand respiratory health risks in fashion manufacturing.

**Product Benchmarking**

Examine current protective measures for mitigating COPD risks in both industrial and home environments.

### Primary Research

Use insights from research to create an anonymous, targeted survey. Deploy to obtain data and insight. Conduct two observational studies.

### Quantitative Analysis

Analyse survey responses to uncover recurring themes and sub themes.

### Quantitative Analysis

Analyse worker environments and routines to understand protective equipment use and exposure management.

**Concept Ideation**

**Prototyping & User Testing**

**Refinement Of Idea**

### Design Implications

Translate research insights into actionable design considerations.

Brainstorm and define design opportunity.

**Report Developed And Delivered**

**Resolved Final Product**

# Background

Chronic obstructive pulmonary disease (COPD), encompassing multiple respiratory syndromes, can be caused or exacerbated by prolonged exposure to textile derived contaminants (Mayo Clinic, 2024). Figure 1 shows the pathways through which microfibres enter the body and the health issues that may follow, including byssinosis, occupational asthma, and bronchitis, among others (Livingston et al., 2025). Within this context, fashion workers are especially vulnerable, as tools such as and sewing machines or overlockers are significant producers of dust and particles, many of which contain harmful chemicals and additives (Jakšić & Yabanlı, 2022).

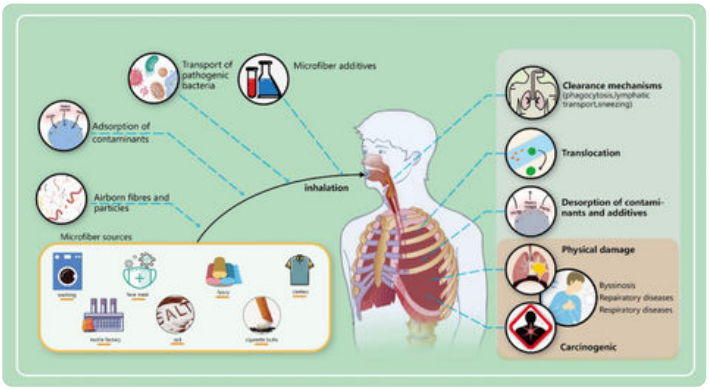



Figure 1. Microfibre Exposure Pathways
and Resulting Health Effects (Liu et al., 2022)

The fashion industry encompasses a variety of production contexts, ranging from factories to small-scale operations and home-based work (Common Objective, 2018). Notably, COPD cases are frequently underreported in smaller facilities, and access to factories is often challenging, limiting the availability of data across sectors (Chumchai et al., 2015). Despite these constraints, all contexts share the same occupational, respiratory risk, with severity influenced by working conditions and task demands. Therefore, this study considers workers across all contexts to ensure design opportunities account for the diverse realities inherent to garment production at multiple scales.

Despite mitigating hazards, adoption of personal protective equipment (PPE) is often inconsistent, influenced by product accessibility, perceived low risk and practical challenges, collectively shaping workplace culture and personal habits (George et al., 2023). Poorly fitting facial PPE (respirators and masks) is shown to significantly affect performance, with 88 % of 16 studies reporting discomfort during prolonged use, reduced mobility, and decreased pulmonary function, all of which disrupt workflow (Brisbine et al., 2022).

While technological advancements have improved the customisation, functionality, and efficiency of ventilation systems and respirators, economic and logistical barriers persist. In Australia, dust and fibre ventilation range from $ 500 for small collectors to over $ 1 million for large installations (Plant Engineering, 2021).

Furthermore, respirator costs range from $3.80 - $8.00 for disposable P2 models, $50 - $180 for half masks, and $350 - $800 for full face reusables. These prices reflect the market spectrum of entry level to high end models, excluding filters, packs, supplementary features and accessory costs. Such expenses entail a notable financial strain, particularly for workers in small-scale contexts. When combined with spatial constraints, it further contributes to inconsistent usage, thereby limiting the effectiveness of these measures.

In the Australian context, regulatory frameworks set standards for both equipment and infrastructure. Work Health and Safety (WHS) legislation require manufacturers to supply PPE that complies with Australian Standards for design, material, and performance. Furthermore, ventilation systems must meet AS 1668.2 and the AS / NZS 3666 series to ensure workplace infrastructure meets safety and performance benchmarks (Safe Work Australia, n.d.). These standards are essential, providing a framework for safety across industries to ensure users have access to reliable equipment that meets needs.

# 02

# BENCHMARKING

# Benchmarking

To understand current market solutions, benchmarking was conducted to evaluate existing measures for reducing exposure to airborne irritants. While only a few core solution categories exist, consumers have access to hundreds of variations differing in design, price, accessibility, and context specific applications. To gain a more holistic overview, the analysis goes beyond fashion based implementations to include protective systems from related fields such as construction, woodworking, and home environments. This will help reveal gaps, transferable elements and strategies, limitations, and opportunities beyond the current framework.

The most common solutions identified include **respirators, face masks, air purifiers, dust extractors, extraction hoods, and industrial ventilation systems.**

The protective systems outlined above are evaluated against five criteria.

**1 . Accessibility**. Are the solutions easily obtainable and accessible to workers?
**2 . Adaptability.** Can the product be applied across different contexts and user needs?
**3 . Durability.** Does the product retain its effectiveness and durability over time?
**4 . Ease Of Use.** Is the equipment capable of being used correctly and efficiently?
**5 . Ergonomics & Comfort.** Is the solution comfortable and suitable for prolonged use?

This approach enables a comparative analysis of how existing measures currently address needs across various scales and contexts of garment production.

### 1 . RESPIRATORS

Commonly used in medical, construction, and manufacturing sectors, respirators are moderately accessible through suppliers and online retailers. High protection is provided by a secure seal, while reusable models support sustained use and adaptability through interchangeable filters. However, they present notable ergonomic limitations: their size, weight, and restricted airflow can cause breathing difficulty, discomfort, and fatigue during extended use, hindering compliance and consistent wear (Biomed Central, 2016; PMC, 2020). Additionally, ongoing filter replacements make reusable respirators costly and maintenance-intensive, particularly for small-scale workers.

### 2 . DUST MASKS

Dust masks provide affordable, lightweight protection against airborne matter and are widely available both online and in stores (Big Safety, 2024). While easy to use and appropriate for short-term or low-risk tasks, their loose fit limits protection against hazardous particles. Repeated use also reduces structural integrity and filtration efficiency, and reuse introduces contamination risks (EHS Leaders, 2018). Although their affordability and convenience encourage uptake, limited adaptability and protective capacity reduce their suitability in high-exposure environments.

### 3 . AIR PURIFIERS

HEPA filter air purifiers can capture up to 99.97% of airborne particles, including dust, fibres, bacteria, and viruses (Lonmax, 2024). They provide notable ergonomic advantages, enabling free movement and ease of use. Portable models are particularly suitable for homes and small workshops. Nonetheless, air purifiers are relatively expensive to purchase and maintain, with replacement filters averaging around AUD $200 per year (Choice, 2024). Their effectiveness is also context-dependent, as performance varies with room size and airflow conditions.

### 4 . DUST EXTRACTORS

Dust extractors are designed to capture particulates directly at the source, preventing dispersion across workspaces. They typically feature HEPA filters and are adaptable with a wide range of accessories (Festool, 2024), such as standard hose sizes, head attachments, and adapters. Their durability and efficiency make them reliable; however, they are less accessible due to high initial costs (AUD $799–$1,125) and ongoing maintenance requirements. Ergonomic limitations are also present, as many units are bulky and noisy. Additionally, high energy consumption reduces their practicality in smaller spaces.

### 5 . EXTRACTION HOODS

Extraction hoods effectively capture airborne contaminants directly at the point of release to minimise worker exposure and the spread of particulates. They are durable and highly efficient in fixed setups, but lack flexibility once installed, as movement is limited to a few rotational joints for directional adjustments and height changes. Accessibility is generally restricted outside of industrial or educational environments, and high costs and space requirements pose additional barriers, particularly for home-based workshops (WorkSafe Queensland, 2019).

### 6 . INDUSTRIAL VENTILATION SYSTEMS

Industrial ventilation systems improve air quality across large areas by removing contaminated air and maintaining continuous airflow, which disperses and dilutes particulates, fumes, and vapours. They are highly durable and capable of managing pollutant loads and environmental conditions. However, due to extensive installation, high maintenance costs, professional oversight requirements, and limited adaptability, they are unsuitable for smaller workplaces, though essential for maintaining safe working conditions in industrial environments (RVT Group, 2025).

# Radar Diagram

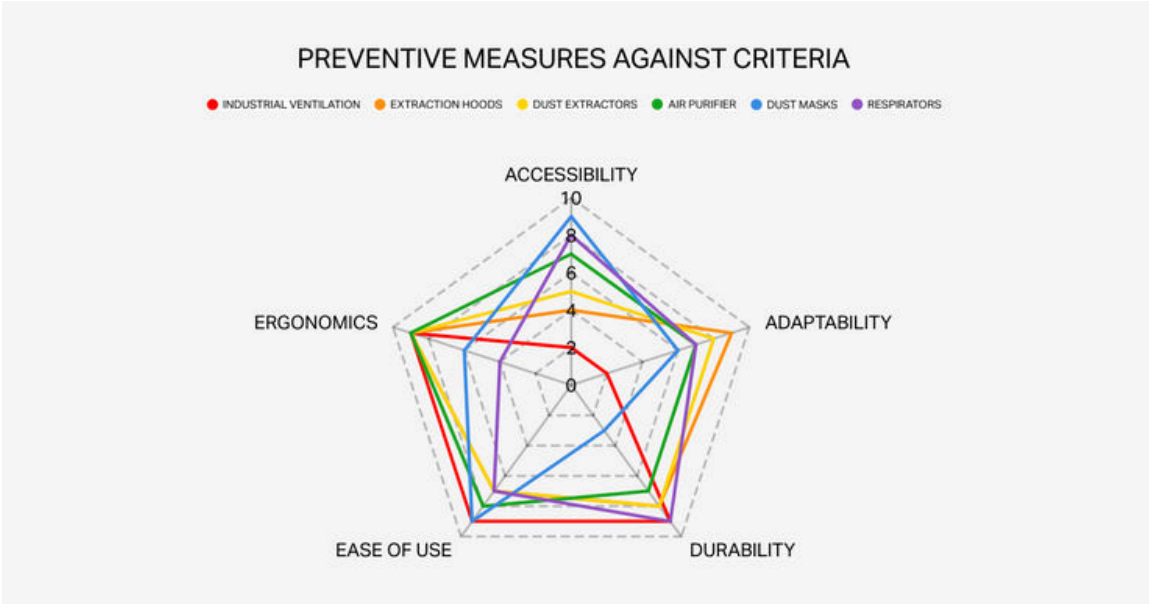



Figure 3. Preventative Measures Against Criteria for Comparison (by author, 2025)

As shown in the radar diagram in Figure 2, large environment based systems such as extraction hoods, dust extractors, and industrial ventilation, rank highly in durability, ergonomics, and ease of use. However, their high installation costs and limited flexibility restrict their applicability across different workplace sizes, resulting to lower scores for adaptability and affordability.

PPE exhibits a contrasting trend. While dust masks rate highly in accessibility and ease of use, they perform poorly in terms of durability, adaptability, and ergonomics.

Respirators provide greater protection due to their build quality and high efficiency filters. Their moderate adaptability rank is attributed to features such as adjustable straps and the potential for customisation when not using off shelf models. However, wearer discomfort, the need for regular filter replacements, and limited sizing, reduce its performance in both ergonomic and adaptability categories.

Similar to larger systems, air purifiers occupy the middle ground, excelling in ergonomics and ease of use, being moderately affordable, but ranking lower in adaptability due to their reduced efficiency in large scale environments.

The radar diagram indicates that **no single protective system outperforms others across all five criteria.** A trend was found in which environmental systems provide superior long-term safety but are less accessible and adaptable, while PPE is highly accessible yet often compromises comfort and durability. This gap highlights an opportunity for designs that blend the ease of use of personal devices with ergonomic and durable features of environmental systems, ensuring sustainable protection across various work settings.

# 03

# RESEARCH AND ANALYSIS

# Research

To better understand the impacts of airborne irritants on respiratory health in garment production and their contributing factors, I conducted secondary research, reviewing medical journals, industry reports, occupational safety publications, and assessing existing protective measures. This foundational study informed the focus and design of my primary investigation methods.

**Survey Methodology**

Surveys were selected for their ability to be easily shared, reach a broad online audience, and collect both quantitative and qualitative data. 22 questions were distributed via Google Forms to fashion students, industry workers, and small business owners, primarily in Australia. The questions addressed demographics, protective practices, experienced symptoms, limitations, and priorities when selecting protective measures.

Both multiple-choice and open-ended responses were used to capture measurable trends and personal insights. Participants were recruited through personal and professional networks, including Instagram direct messages, QUT fashion and industrial design students, and established contacts with garment manufacturing / tailoring businesses.

**The survey questions attempted to answer the following main research questions :**

1 . Which tools, machines, equipment, or fabrics do you notice release the most particles?
2 . Under which conditions do you usually experience discomfort?
3 . What steps do you currently take to reduce your exposure to fibres and dust?
4 . Are there any challenges associated with the protective methods you currently use?
5 . What aspects do you prioritise when choosing your form of protection

**Observation Methodology**

Observations complemented survey findings by providing visual, real-world insights into how individuals manage exposure in practice, capturing behaviours and contextual factors that may not be fully reflected in self-reported data. The study was carried out at a small, home-based fashion business.

Survey participants were invited to volunteer for the observation session by providing their email adress at the end of the questionnaire. Information sheets were subsequently distributed via email, and consent forms were collected prior to the session.

The observation aimed to examine how individuals engaged with protective equipment, and the influence of environmental conditions. A naturalistic approach was employed to minimise researcher influence and capture authentic behaviours (Kawulich, 2005).

**Ethical Considerations**

All participants were informed of their rights, including the option to withdraw at any time. Care was taken to minimise disruption to normal workflows. Surveys were conducted anonymously, while observation participants signed consent forms and were assured of confidentiality. Data was anonymised, with responses coded and visual material edited to remove personal identifiers.

**Research Constraints & Limitations**

**1 . Demographic Representation.** Majority of responses came from younger participants, underrepresenting older workers who may experience more severe chronic respiratory challenges. Reliance on existing networks also limited the survey's reach.

**2 . Access Challenges.** Although symptoms are more prevalent in overseas factories and sweatshops, where production is largely unmonitored and working conditions are poor, ethical, geographic, and legal barriers prevent data collection on a broader scope.

**3 . Methodological Considerations.** As surveys rely on self-reported data, there is a risk of misreported symptoms. Similarly, observations conducted in small-scale settings may not fully reflect the conditions and practices present in larger industry contexts.

Despite these limitations, the study still provides insights into respiratory health challenges in fashion work among the participant groups that were most accessible.

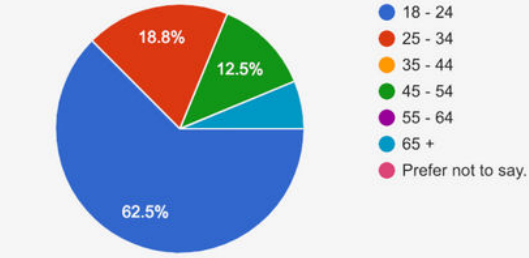
# Analysis

## Quantitative Analysis : Survey Findings

Quantitative data was analysed using Microsoft Excel, with graphs created to highlight key findings. Both the number and percentage of responses were reported, as shown in the pie charts, bar graphs, and tables.

Multiple-choice responses were automatically displayed as diagrams in Google Forms, while long-answer responses were exported into Excel for organisation and systematic coding. From there, frequencies were calculated to determine how often particular themes or items were mentioned, highlighting commonalities and outliers in participant responses. This process provided robust insights into respiratory-related challenges in the workforce. The data was clear and straightforward to interpret, leading to easily identifiable and actionable design findings. See Appendices 1 and 3 for survey visuals and analysis tables.

**SURVEY DATA**




**Participant Demographics (n=16)**

Of 16 respondents, most were aged 18 to 25 (62.5%), with smaller groups being 25 to 34 (18.8%), 45 to 54 (12.5%), and 65 + (6.3%). While older workers may be underrepresented, the results indicate that respiratory concerns are recognised and relevant across various life stages and levels of industry experience.

**Refer to Appendix 3 for analysis tables of the following data :**

**Recognition and Use of Safety Measures**

- Responses were evenly split between positive and negative mentions across the three main themes : recognition & discussion, PPE provision and existing ventilation systems.
- Over 40% reported discomfort or inadequate provision of masks or respirators.
- 43% noted ventilation that was inconsistent, unavailable, or ineffective.
- 2 indicated that awareness stemmed solely from industry experience.

The data shows mixed recognition and inconsistent use of safety measures, with challenges arising from both the design of protection and their provision in workspaces.

**Tools and Particle Generation**

Analysis revealed clear links between equipment and airborne fibre production :

- Overlockers were cited as the highest fibre generating tool (50% of respondents).
- Sewing machines were commonly use (75%) but less often linked to fibres (31%).
- Rotary cutters were identified by 19%
- Other tools were not associated with the generation of airborne particles.

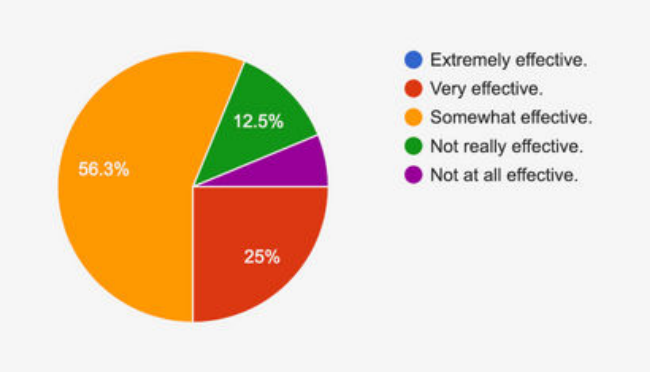
Rotary cutters, overlockers, and sewing machines are key targets for design interventions.

**Environmental and Task Dependent Symptoms**

- 66.7% reported symptoms when using equipment.
- Symptoms occurred in 41.7% of specific tasks and 33.3% of workspace areas.
- Reported symptoms were mostly mild.
- Itchy eyes (25%), sneezing (19%), and slight cough or throat irritation (19%).

Respiratory effects are linked to tasks and workspace conditions, not just tool use.

**Effectiveness of Current Methods**



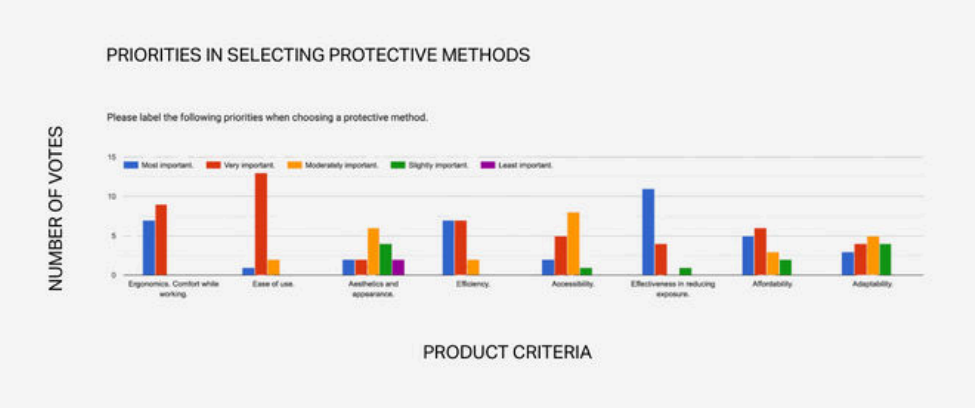

**Identification of Common Barriers through Themes**

- Mask discomfort (50%) reported, including ear pain, sweating, itching, and breathability.
- Ventilation concerns (37.5%) included doubts about effectiveness.
- Environmental limitations (18.75%) included lack of space.
- Resource barriers (12.5%) included limited access to extractors or costly systems.

Despite these challenges, a small number of participants (12.5%) reported satisfaction with basic PPE, showing that simple tools can be effective if accessible and comfortable.

**User Priorities**

As shown in the graph below, participants prioritised factors at varying levels; however, ergonomics, ease of use, efficiency, effectiveness, affordability, and adaptability consistently ranked from very important to slightly important. The least important factor appeared only twice, in the aesthetics category. Some participants also highlighted sustainability, durability, and ease of cleaning, underscoring the value of protective solutions that address these priorities and integrate seamlessly into daily work routines.



**Survey Summary**

**The analysis highlights five overarching themes :**

1 . PPE is inconsistently used, primarily due to ergonomic challenges.

2 . Powered equipment is strongly linked to fibre generation.
This makes it a key focus for design solutions.

3 . Environmental management helps but remains imperfect.
This is due to ventilation systems being costly, inaccessible and varying in effectiveness.

4 . Respiratory effects are linked to tasks and workspace conditions, not just tool use.

5 . User priorities encompass several key factors.
Ergonomics, ease of use, efficiency, affordability, adaptability, durability, and sustainability.

Overall, the findings indicate that while awareness exists, current tools and systems do not provide consistent protection, highlighting a clear design opportunity for a solution that addresses user needs and constraints.

# Qualitative Analysis : Observation Findings

**Observation 1 : Action Focused**

This observation examined how workers handled
textiles and applied protective measures during tasks.

**Key behaviours and themes included :**

**1 . Mask Use.** Participant wore a mask when cutting thicker piles of fabric,
making multiple adjustments to the nose bridge and sides throughout the session.
The mask was removed immediately upon completion of task.
For smaller volumes or faster tasks with the rotary cutter, participant did not wear a mask.

**2 . Workflow Sequence.** PPE was secured prior to entering the workspace
and activating machines, demonstrating adherence to a consistent safety routine.

**3 . Debris Management.** Sweeping scraps into bins and using tables with disposal holes helped reduce microfibre spread, though residue remained on machines, sustaining potential inhalation risks. Refer to Fig 4 for images.

**4 . Movement.** Reaching over machines during cutting introduced minor risks and may increase exposure to airborne fibres due to user proximity to machine surfaces.

**5 . Pack Up & Cleaning.** Sweeping floors and emptying bins when full, contributed to reducing fibre concentrations; however, machine are infrequently cleaned. Aprons are worn over clothing, with participants changing clothes after work to limit fibre transfer.

**6 . Surface Contact.** Frequent contact with machines, tables, and fabric piles.

**Rotary Cutter : Sequence Of Use**

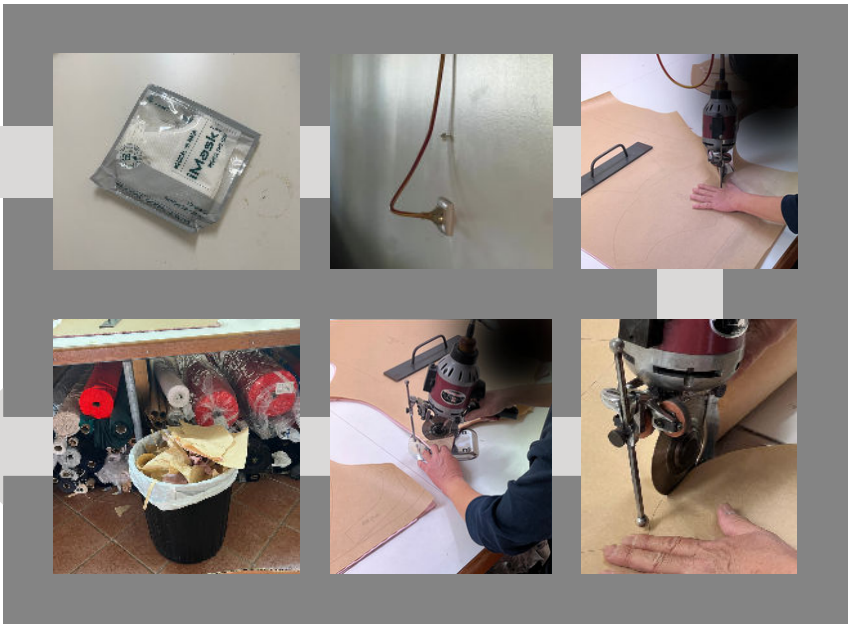


Figure 3. Photographs from Action Centric Observation of Textile Handling, Processes, and Use of Protective Measures (Duong, 2025)

**Observation 2 : Environment Focused**

The second observation focused on their environment, including the positioning of equipment, ventilation, and disposal points. It aimed to assess how spatial arrangements influence fibre dispersal, and help identify potential areas for intervention.

**Key themes included :**

**1 . Equipment Placement.** Machines are positioned near windows for natural ventilation and away from fans and aircon. Tables with overlockers feature disposal holes for collecting excess materials and fibres. Portable equipment is stored in a designated area.

**2 . Fibre Management Practices.** Plastic door covers are used to limit debris spread into the main house, while ventilation strategies, including open windows and unobstructed spaces, facilitate airflow and reduce fibre concentrations. An open and clean space.

**2 . Fibre & Dust Accumulation.** Machine surfaces and workshop corners accumulate the highest levels of fibres and dust, making them more difficult to clean than open areas. Microfibre buildup persisted on machine surfaces despite environmental controls.

**3. Ventilation strategies.** Open doors with nets, fans, and air conditioning are used to enhance airflow; however, their use varies depending on weather conditions and material type eg. active ventilation is not used when handling cotton.

These themes indicate that environmental strategies can help reduce the severity of fibre exposure, with outcomes strongly influenced by machine placement, accessory use, and cleaning frequency. Nonetheless, even well-managed workspaces may experience fibre accumulation if these measures are not consistently implemented or maintained.

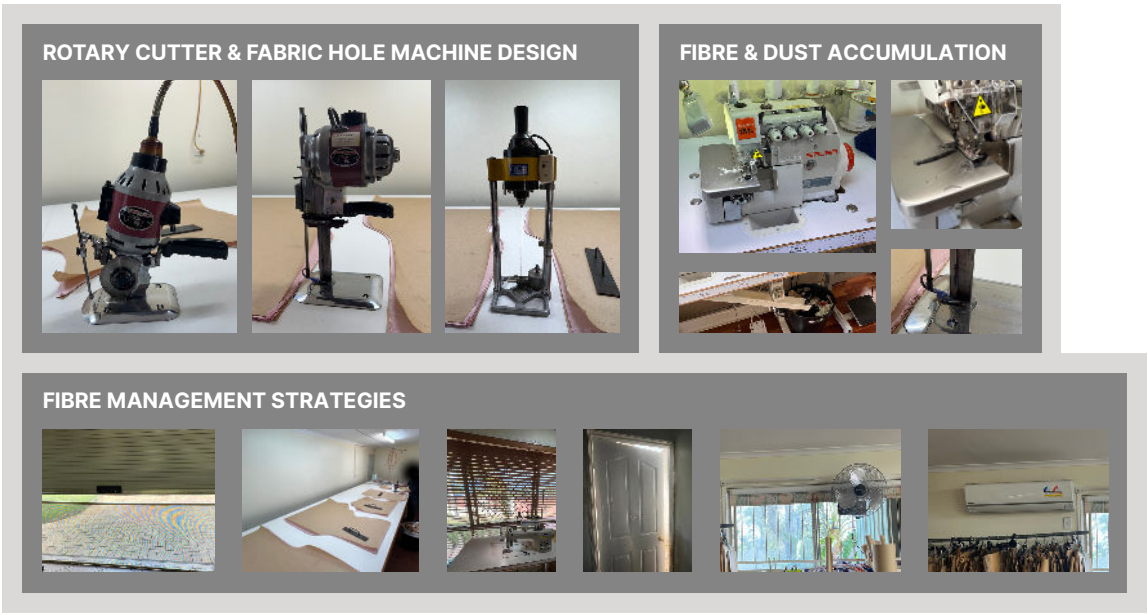



Figure 4. Treemap of Work Environment and Equipment (Duong, 2025)

# 04

# DISCUSSION AND DESIGN IMPLICATIONS

# Discussion

This research highlights the ongoing gap between the availability of protective systems for airborne fibres and dust in the fashion industry and their actual use. Literature (Ha et al., 2021; Brisbine et al., 2022) emphasises the respiratory risks of fibre inhalation and the discomfort associated with PPE, with primary data confirming that these barriers affect workplace behaviour. Over 40% of respondents reported discomfort or a lack of suitable masks and respirators, aligning with findings that, although protective, respirators are often ergonomically limiting and unsuitable for extended wear. Similarly, while ventilation and extraction systems are proven effective, respondents noted they are often inaccessible due to costs and infrastructure challenges.

The findings broaden current understanding by showing that respiratory risks impact not only long-term workers but also younger members. Survey data indicated that symptoms such as coughing, throat irritation, and fatigue can appear early in careers, suggesting that cumulative effects begin sooner than traditionally thought. This expands concern from traditionally high-risk groups to workers at all stages of their careers.

Observation data provides details missing from much of the literature, showing that ergonomics, environmental factors, and workflow integration substantially influence use. Workers often began tasks wearing masks but gradually reduced their use during small, quick jobs or when discomfort interfered with productivity. Environmental modifications, such as fibre-disposal table holes or natural ventilation, lowered visible dust but did not prevent microfibre buildup, showing the inadequacy of partial fixes.

These findings confirm that no single measure fully addresses the risks of airborne irritants. Masks and respirators offer affordable protection but lack comfort and prolonged wearability, while environmental systems provide superior long-term benefits yet remain inaccessible to many. This mismatch between accessibility and effectiveness reveals a design opportunity for hybrid systems that combine the portability of PPE with the environmental benefits of filtration or purification.

Overall, this research demonstrates that effective protective design must prioritise ergonomics, accessibility, and seamless integration into workflow. Addressing these factors can help close the gap between protective intentions and actual practices, leading to safer, more sustainable outcomes for fashion workers.

# Design Implications

The research highlights key issues with current protective systems for airborne fibres and dust, revealing direct design opportunities. Existing solutions tend to focus on either accessibility or effectiveness, but rarely both.

Firstly, PPE is often uncomfortable and impractical for long-term use. Research and respondents both reported ear pain, sweating, restricted breathing, and discomfort, leading to inconsistent adoption. This highlights the opportunity to develop lightweight, adaptable facial PPE that provides protection while minimising discomfort.

Secondly, environmental systems, although highly effective, are often financially and spatially inaccessible for smaller workplaces. Additionally, large-scale units require significant investment and infrastructure. There is scope for affordable, portable environmental solutions, such as compact or portable filtration devices or modular extraction units, which provide effective fibre control without excessive cost.

Protective measures also frequently disrupt workflow. Observations and survey results revealed that workers limited their use of masks as ergonomic strain slowed productivity. This underscores the need for protective systems that are quick to set up and allow uninterrupted work. Streamlined, integrated solutions, such as workstation vacuums, could ensure continuous protection without compromising efficiency.

Current methods are divided into either personal or environmental solutions, however, workers need both. There is an opportunity to design a hybrid system that combine mobility with environmental effectiveness, such as attachable filtration accessories, desk mounted extractors, or furniture with built-in air-purification systems.

Finally, designs must be practical for everyday use. Even effective devices may be rejected if they are too complex, uncomfortable, or expensive. Simplicity, affordability, and usability should therefore guide design development, ensuring consistent use.

**These findings suggest these design principles :**

**1 . Ergonomics.** Comfortable, lightweight, and adjustable to minimise fatigue.

**2 . Affordable.** Suitable across various economic contexts.

**3 . Hybrid.** Combining the strengths of personal and environmental protection.

**4 . Workflow.** Streamlined, simple to use, and compatible with job demands.

By addressing these factors, future protective designs can surpass the limitations of current systems and develop solutions that are not only effective in theory but also consistently adopted in practice. This positions design as a vital pathway towards safer, healthier, and more sustainable working conditions within the fashion industry.

# Conclusion

This research has explored the ongoing challenges faced by fashion workers in protecting themselves from airborne fibres and dust. While masks and respirators are widely accessible, they are often uncomfortable for extended use, causing ear pain, sweating, and breathing difficulties that deter consistent use. Conversely, ventilation and extraction systems provide more effective protection but remain financially and spatially out of reach for many small-scale or home-based workers. These limitations leave users caught between devices that are cheap and accessible but compromise comfort and durability, and environmental systems that are effective yet difficult to access. Consequently, protective measures are used inconsistently, increasing the risk of COPD. By highlighting these challenges, this study reveals a clear opportunity for designs that balance identified needs. Findings suggest that future solutions should combine the comfort and portability of PPE with the ergonomic benefits of filtration systems, while remaining affordable and practical for diverse environments. A user-centred, hybrid approach therefore offers the most promising path forward for enhancing working conditions in the fashion industry.

# 05

# REFERENCES AND APPENDICES

# References


Better Health Channel. (n.d.). Work-related stress. State Government of Victoria. https://www.betterhealth.vic.gov.au/health/healthyliving/work-related-stress

Big Safety. (n.d.). Masks & respirators. https://bigsafety.com.au/collections/masks-respirators#:~:text=Viruses%2C%20metal%20shavings%20or%20chemical,in%20and%20around%20the%20eyes

Canadian Centre for Occupational Health and Safety (CCOHS). (2018). Lungs – dusts and chemicals. https://www.ccohs.ca/oshanswers/chemicals/lungs_dust.html

Common Objective. (n.d.). Mapping the fashion industry: Executive summary. https://www.commonobjective.co/article/mapping-the-fashion-industry-executive-summary#:~:text=A%20vast%20industry%20Fashion%20is%20a%20complex%2C,one%20player%20to%20create%20enough%20impact%20alone

EHS Leaders. (2018, April). Dust masks: Reuse or toss? https://ehsleaders.org/2018/04/dust-masks-reuse-toss/#:~:text=In%20dusty%20workplaces%20that%20could,Tags:%20PPE

Fanmaster. (n.d.). 3 types of ventilation systems for warehouses and factories. https://www.fanmaster.com.au/3-types-of-ventilation-systems-for-warehouses-and-factories/

Festool. (n.d.). Dust extractors. https://www.festool.com.au/dust-extractors.html?srsltid=AfmBOop0r1cQZphq6WuRTuhq3KeoA5s6IVNgsrt-UxLRbLSfhBqTmJus

Garments Merchandising. (2018, May 10). Methods of fabric cutting. https://garmentsmerchandising.com/methods-of-fabric-cutting/

Ionmax. (n.d.). HEPA air filters. https://ionmax.com.au/blogs/resources/hepa-air-filters#:~:text=High%2Defficiency%20particulate%20air%20filters,grades%20based%20on%20their%20efficiency

InovaAir Purifiers. (n.d.). Airclean E8. https://inovaairpurifiers.com.au/products/airclean-e8?variant=43430352945388

J Biol Eng. (2016). Respirator effects. Journal of Biological Engineering, 10, Article 25. https://jbioleng.biomedcentral.com/articles/10.1186/s13036-016-0025-4#:~:text=Respirator%20effects:%20bulk,or%20finger%20movements%20nearly%20impossible

Mayo Clinic. (2023, May 18). COPD (chronic obstructive pulmonary disease). https://www.mayoclinic.org/diseases-conditions/copd/symptoms-causes/syc-20353679

Mgear. (n.d.). Double diamond model. https://mgearon.com/ux/double-diamond-model/

Moldex. (n.d.). 7800 series reusable silicone half-mask respirator. https://www.moldex.com/en-au/product/7800-series-reusable-silicone-half-mask-respirator/

# References


National Center for Biotechnology Information (NCBI). (2013). Occupational lung disease: The role of exposure and host factors. Current Opinion in Pulmonary Medicine, 19(2), 144–148. https://pmc.ncbi.nlm.nih.gov/articles/PMC3725301/

National Center for Biotechnology Information (NCBI). (2020). Barriers to the use of respiratory protective equipment. Journal of Occupational Medicine and Toxicology, 15, Article 20. https://pmc.ncbi.nlm.nih.gov/articles/PMC7528124/

National Center for Biotechnology Information (NCBI). (2024). Dust exposure and health effects. Environmental Health Perspectives, 132(1), Article 123456. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10964409/

Neurological Research and Practice. (2020). Participant observation methods. Neurological Research and Practice, 2, Article 59. https://neurolrespract.biomedcentral.com/articles/10.1186/s42466-020-00059-z

Plant Engineering. (2017, June 20). How much does a dust collector really cost? https://www.plantengineering.com/how-much-does-a-dust-collector-really-cost/#:~:text=CFM%20measures%20the%20amount%20of%20air%20a,would%20otherwise%20be%20available%20for%20production%20lines

PK Safety. (n.d.). Respirators & filters. https://pksafety.com/collections/respirators-filters#:~:text=Depending%20on%20the%20features%20and,spend%20between%20%24100%20and%20%24300

PubMed. (2014). Occupational exposure and respiratory symptoms. Annals of Occupational Hygiene, 58(7), 859–872. https://pubmed.ncbi.nlm.nih.gov/25122551/

PubMed. (2022). Dust inhalation and health outcomes. International Journal of Environmental Research and Public Health, 19(24), 16789. https://pubmed.ncbi.nlm.nih.gov/36449531/

ResearchGate. (2012). Participant observation as a data collection method. https://www.researchgate.net/publication/221875465_Participant_Observation_as_a_Data_Collection_Method

RVT Group. (2021, February 5). What is an industrial ventilation system? https://rvtgroup.com.au/insights-resources/news/what-is-an-industrial-ventilation-system/#:~:text=An%20industrial%20ventilation%20system%20is,but%20also%20a%20legal%20requirement

Safe Work Australia. (2020a). Personal protective equipment (PPE). https://www.safeworkaustralia.gov.au/safety-topic/managing-health-and-safety/personal-protective-equipment-ppe

Safe Work Australia. (2020b). Exposure standards for airborne contaminants. https://www.safeworkaustralia.gov.au/safety-topic/managing-health-and-safety/exposure-standards-airborne-contaminants#:~:text=Worker's%20exposure%20is%20measured%20by,exposure%20standards%20for%20airborne%20contaminants

# References


Spray Chief. (n.d.). Dust mask 5 pack. https://www.spraychief.com.au/dust-mask-5-pack

SpringerLink. (2022). Occupational exposure figure. Current Pulmonology Reports, 11, Article 15. https://link.springer.com/article/10.1007/s44169-022-00015-9

The Upcoming. (2021, December 24). Safety and health risks in the fashion and textile industry: Here's how to protect workers. https://www.theupcoming.co.uk/2021/12/24/safety-and-health-risks-in-the-fashion-and-textile-industry-heres-how-to-protect-workers/

Tru Brands. (n.d.). Difference between disposable and reusable respiratory protection. https://www.trubrands.com.au/difference-between-disposable-and-reusable-respiratory

Wikipedia. (2023, October 19). Chronic obstructive pulmonary disease. In Wikipedia. https://en.wikipedia.org/wiki/Chronic_obstructive_pulmonary_disease

WorkSafe Queensland. (2019). Hazardous dusts. https://www.worksafe.qld.gov.au/safety-and-prevention/hazards/hazardous-exposures/hazardous-dusts

WorkSafe Queensland. (2021). Local exhaust ventilation (LEV). https://www.worksafe.qld.gov.au/safety-and-prevention/creating-safe-work/managing-risks/local-exhaust-ventilation-lev#:~:text=capture%20contaminants%20at%20the%20source,or%20cool%20in%20indoor%20workplaces

World Health Organization. (2021). Respiratory risks in the workplace. International Journal of Environmental Research and Public Health, 18(18), 9813. https://www.mdpi.com/1660-4601/18/18/9813#:~:text=The%20strongest%20risk%20factors%20for,to%20their%20workplace%20%5B12%5D

World Health Organization. (2022). Microfibers and synthetic fibers in workplaces. Water, 14(23), 3797. https://www.mdpi.com/2073-4441/14/23/3797#:~:text=Microfibers%20can%20vary%20in%20the,Synthetic%20Fibers

WorkSafe Queensland. (2019). Extraction hoods. [Google search result]. https://www.google.com/search?sca_esv=ea952d4a728bb5fe&rlz=1C5CHFA_enAU914AU914&sxsrf=AE3TifM9TghM299by8Ep7pp631YIBQBWfg:1757206476309&udm=2&fbs=AIIjpHxU7SXXniUZfeShr2fp4giZ1Y6MJ25_tmWITc7uy4KIemkjk18Cn72Gp24fGkjjh6zx5r9-tqg6OrBVOwHghPIhtu8T6H-yTeKM9tevsnQuYIlfwxzA9nzrkF4dHDW1xHwa4oHFJG4_KyJ1SFZoMQeObSmeNes5Ie5roNaKN2Cw2ps9FEQ5-3_bkMLfFpHaKmN4IZNknfdXFrAe-ir3FyZCRMUOnQ&q=Extraction+hoods

WorkSafe Queensland. (n.d.). Managing health risks: Dust and ventilation. https://ebaircontrol.com/blog/advantages-installing-demand-controlled-ventilation-systems/

# Appendices

**ALL RAW DATA AND IDENTIFIABLE INFORMATION HAS BEEN REMOVED**

# Appendices

## Coded Analysis Tables

**Are these health risks recognised, prepared for or discussed in your workplace?**

| Theme | Positive Mentions | Negative Mentions | Neutral Mentions | Frequency | % Positive | % Negative | % Neutral | Keywords / Subthemes |
|---|---|---|---|---|---|---|---|---|
| Recognition & Discussion | 7 | 5 | 0 | 12 | 58% | 42% | 0% | Recognised & discussed, Not recognised |
| Masks / Equipment | 6 | 5 | 0 | 11 | 55% | 45% | 0% | Provided, Not provided, Rarely worn |
| Ventilation Systems | 4 | 3 | 0 | 7 | 57% | 43% | 0% | Installed/airflow, Absent/poor |
| Cleaning Practices | 0 | 0 | 3 | 3 | 0% | 0% | 100% | Cleaning measures mentioned |
| Awareness via Experience | 0 | 0 | 2 | 2 | 0% | 0% | 100% | Industry/personal awareness |

**Which tools, machines, or equipment do you notice produce the most airborne particles?**

| Theme / Category | Equipment | Frequency Used | Particle Mentions | % of Respondents (16) Reporting Particles | Risk Level | Linked / Not Linked | Qualitative Insight |
|---|---|---|---|---|---|---|---|
| Sewing & Stitching Machines | Overlocker / Serger | 9 | 8 | 50% | High | Linked | Most frequently cited as producing airborne fibres, especially with cotton |
| Sewing & Stitching Machines | Sewing machine(s) | 12 | 5 | 31% | Medium | Linked | Produces some fibres, less than overlocker |
| Sewing & Stitching Machines | Cover stitch machine | 1 | 1 | 6% | Medium | Linked | Mentioned alongside hemming/locking processes |
| Cutting Tools & Machines | Rotary cutter (manual/electric) | 5 | 3 | 19% | Medium | Linked | Cutting fabric releases fibres and particles |
| Cutting Tools & Machines | Fabric scissors | 7 | 0 | 0% | Low | Not Linked | Not typically linked to airborne fibres |
| Sewing & Stitching Machines | Straight sewer | 1 | 0 | 0% | Low | Not Linked | Not directly linked |
| Cutting Tools & Machines | Cutting table / cutting machine | 3 | 0 | 0% | Low | Not Linked | No direct mentions |
| Cutting Tools & Machines | Fabric laser cutter | 1 | 0 | 0% | Low | Not Linked | Not mentioned |
| Miscellaneous | Hot wires / sanders / bandsaw | 1 | 0 | 0% | Low | Not Linked | Outlier, not linked |
| Pressing & Heat Equipment | Iron / pressing iron | 6 | 0 | 0% | Low | Not Linked | Not linked |
| Pressing & Heat Equipment | Steam press / steamer | 4 | 0 | 0% | Low | Not Linked | Not linked |
| Pressing & Heat Equipment | Heat press / sublimation press | 3 | 0 | 0% | Low | Not Linked | Not linked |
| Pressing & Heat Equipment | Fusing machine | 2 | 0 | 0% | Low | Not Linked | Not linked |
| Pattern-Making & Measurement | Pins & needles | 4 | 0 | 0% | Low | Not Linked | Not linked |
| Pattern-Making & Measurement | Mannequins | 3 | 0 | 0% | Low | Not Linked | Not linked |
| Pattern-Making & Measurement | Measuring tape / rulers | 2 | 0 | 0% | Low | Not Linked | Not linked |
| Pattern-Making & Measurement | Chalk / white chalk | 2 | 0 | 0% | Low | Not Linked | Not linked |
| Pattern-Making & Measurement | Tracing wheel / pattern tools | 1 | 0 | 0% | Low | Not Linked | Not linked |
| Specialty / Embellishment | Button / buttonhole machine | 3 | 0 | 0% | Low | Not Linked | Not linked |
| Specialty / Embellishment | Fabric dyes | 2 | 0 | 0% | Low | Not Linked | Mentioned for skin absorption, not airborne fibres |
| Specialty / Embellishment | Fabric printers | 1 | 0 | 0% | Low | Not Linked | Not linked |
| Specialty / Embellishment | Embroidery machines | 1 | 0 | 0% | Low | Not Linked | Not linked |
| Specialty / Embellishment | Polyester fill stuffing | 1 | 0 | 0% | Low | Not Linked | Not linked |

**Symptoms you experience and their severity.**

| Theme / Category | Symptom | Frequency | Severity | Linked / Not Linked | EXAMPLES |
|---|---|---|---|---|---|
| Eye irritation | Itchy eyes | 4 | Mild | Linked | Often after longer sessions, exposure to dust/fibres |
| Eye irritation | Watery eyes | 1 | Mild | Linked | Usually short-term, goes away after leaving workspace |
| Nose irritation | Itchy nose | 3 | Mild | Linked | Triggered by dust or fibres |
| Sneezing | Sneezing | 3 | Mild | Linked | Triggered by airborne particles |
| Throat irritation | Tickling throat / mild cough | 3 | Mild | Linked | Often after longer sessions, exposure to cotton/synthetics |
| Throat irritation | Persistent cough / wheezing | 1 | Moderate | Linked | Sometimes linked to prolonged exposure |
| General concern | Sore throat / concern | 1 | Mild | Linked | Concern about long-term effects |
| Observation / contextual | Production scale issues | 1 | N/A | Not directly linked | Notes that high-volume production lines pose higher risk |

**Protective Measures taken in detail**

| Theme / Category | Protective Measure / Action | Frequency | % of Respondents Re | Linked / Not Linked | EXAMPLES |
|---|---|---|---|---|---|
| Masks / Respiratory Protection | Wearing mask at uni/home | 2 | 25% | Linked | Some forget or don't bother at home |
| Masks / Respiratory Protection | Wearing mask when handling high-fib | 2 | 25% | Linked | Disposable or fabric masks, used as needed |
| Eye Protection | Wearing goggles | 1 | 12.50% | Linked | Used when cutting or handling delicate fabrics |
| Ventilation / Airflow | Using installed ventilation / keeping w | 4 | 50% | Linked | Ensures airflow, reduces airborne fibres |
| Clothing / Personal Hygiene | Changing clothes after work / wearing | 2 | 25% | Linked | Prevents fibres from sticking to skin/clothing |
| Cleaning / Dust Management | Using lint rollers / cleaning workspace | 2 | 25% | Linked | Reduces fibres flying and sticking |
| Behavioral / Avoidance | Stepping away / avoiding exposure wh | 1 | 12.50% | Linked | Self-regulation strategy |
| Resource / Accessibility Barriers | Lack of provided equipment / cost co | 2 | 25% | Linked | Limits ability to consistently protect themselves |

**Do you experience any difficulties or limitations with the ways you currently protect yourself from fibres and dust?**

| Theme / Category | Subtheme / Issue | Frequency | % of Respondents Re | Severity / Impact | EXAMPLES |
|---|---|---|---|---|---|
| Masks / Respiratory Protection | Discomfort (ear pain, heat, sweat, itcl | 8 | 50% | Moderate to High | Hot in summer, long sessions, material irritates skin |
| Masks / Respiratory Protection | Limited wear due to discomfort or forg | 3 | 18.75% | Moderate | Avoided for long sessions or at home; only worn during certain tasks/fabrics |
| Ventilation / Airflow | Skepticism / Ineffectiveness of ventil | 6 | 37.50% | Moderate | Fans or vents may just move dust around; unsure if effective |
| Ventilation / Airflow | Hard to use / unclear operation | 2 | 12.50% | Low to Moderate | No signifiers, need prior knowledge to operate |
| Ventilation / Airflow | Noisy ventilation | 2 | 12.50% | Low to Moderate | Cheap fans or vents create noise |
| Ventilation / Airflow | Airflow complications from AC / fans | 1 | 6.25% | Low | Aircon can blow dust/fibres into face at home or workspace |
| Space / Environmental Limits | Crowded / messy workspace | 3 | 18.75% | Moderate | Fabric scraps everywhere, lots of machines running at once |
| Space / Environmental Limits | Accumulation of fibres / delayed clea | 2 | 12.50% | Moderate | Dust and scraps can remain for days if not cleaned immediately |
| Space / Workflow / Task Conditions | High-volume / task-related exposure | 1 | 6.25% | Moderate | More exposure when cutting multiple layers or during long sessions |
| Resource / Accessibility | Equipment inaccessible or expensive | 2 | 12.50% | Moderate | Cannot afford dust extractors or large ventilation at home |
| Positive / No Issues | No difficulties experienced | 2 | 12.50% | N/A | Respondent finds PPE easy to wear (glasses, shoes, basic masks) |

**If there were no limits, what ideal product, tool, system, or change would you introduce or design to reduce exposure to airborne particles and improve work experiences?**

| Theme / Category | Subtheme / Solution | Frequency | % of Respondents | Note | EXAMPLES |
|---|---|---|---|---|---|
| Ideal Solutions | Comfortable / ergonomic / adaptable | 5 | 38.50% | Fits different head/face shapes; encourages t | "Maybe more comfortable safety goggles or masks - adaptable to different head/face shapes; also aesthetically pleasing." "Something ergonomic, reusable, and easy to use." "PPE feels ugly; I feel awkward wearing it." |
| | Lightweight / breathable mask | 3 | 23.10% | Filters fibres effectively; avoids overheating | "Lightweight, breathable mask that filters fibers comfortably; avoids overheating." |
| | Reusable / sustainable PPE | 2 | 15.40% | Avoids waste from disposable masks; easy to | "Disposable masks feel wasteful; reusable solution to avoid waste." |
| | Easy access / convenient to wear | 3 | 23.10% | Avoids walking across workspace for short ta | "Workers often skip wearing masks on quick tasks if inconvenient to leave work station." "Avoids walking across workspace for short tasks." |
| | Air purifier / constant dust extraction | 3 | 23.10% | Quiet, built-in, keeps workspace clean withou | "Quiet, built-in workstation air purifier." "Something constantly sucking in dust/pollution before it can be breathed in." "Vacuum fan to increase ventilation." |
| | Increase ventilation / accessible vent | 2 | 15.40% | Improve airflow at home or in workshops | "Fashion workshops at QUT don't have ventilation systems." "Improve airflow at home or in workshops." |
| | Easy to use / quick setup | 3 | 23.10% | Simple to operate; doesn't interfere with work | "Won't interfere with work, hard setup would prevent use." "Solutions easy to maintain; don't slow workflow." |
| | Fibre collection / reuse | 1 | 7.70% | Reuse fibres as stuffing or other materials | "Something that could collect fibres to be reused (potentially as stuffing)." |
| | Compact / fits small/shared spaces | 2 | 15.40% | Suitable for small or shared workspaces | "Many students work in small/shared spaces; compact designs help." |