Research Report

DNB311 ID Studio 7: Capstone

Out of Sight, Within Reach: A User-Centred Storage System for Handheld Vacuums in High Density Australian Housing

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Executive Summary

This report looks to examine how storage systems for adaptable modular vacuum cleaners can improve the user experience for individuals in compact high density living environments in Australia. High density living refers to where many people occupy a given residential space that is close together. For instance, apartments that are comprised of 9 or more storeys (Hanrahan & Ibrahim, 2022). Moreover, these spaces are often compact or restricted with a one-bedroom apartment allocated $6m^3$ of storage of which only about $3m^3$ needs to be inside the apartment as highlighted by the NSW Apartment Design Guide (NSW Department of Planning & Environment, 2015). The project aims to identify the many challenges that individuals currently face in vacuuming these environments, more specifically their studio apartments or caravans. Secondary research including a background literature review and benchmarking, along with primary research through observations and surveys were undertaken as illustrated in Figure 1.

The secondary research conducted emphasised that existing consumer market vacuums consistently ranked strongly in areas such as ease of use, suction performance, portability and overall convenience for quick cleaning. Whereas they are weak in terms of their maintenance, ergonomics, modularity, and noise levels. This indicates a clear market gap, that there is currently no single vacuum that satisfies all user-centric needs. Some of the key findings in the discussion expressed that the most frequent problems reported were physical strain like bending and reaching, difficulty during routine maintenance, and the effort of swapping attachments.

These pain points raised design implications for the storage system. They included a free-standing unit that does not depend on wall fixing, charging that occurs while the machine is stored, attachment storages within reach of the machine, ventilation for a device returning to storage damp, and a footprint that fits the internal storage allocation of a one-bedroom apartment.

As a result, these suggested improvements would cater for a more easy, efficient, and user-friendly experience during vacuum cleaning sessions in Australian compact high density living environments.

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.

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AI Use Statement

I have utilised Generative AI in this report, specifically Copilot to provide as a means for inspiration, refining phrasing, and structuring sections including the introduction, background, benchmarking, research, analysis, and discussion. All written content presented is my own work.

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Section One – The Topic

Introduction

There has been an increasing shift towards compact high density living in Australia (Hanrahan & Ibrahim, 2022). Restricted environments have created new challenges that occur during the vacuum cleaning process. These span across a wide array of factors such as limited space, diverse surface types, dust accumulation, allergen levels, and time saving convenience, which has spurred the widespread need to design new vacuum cleaners (Beheshti et al., 2024; Zhao et al., 2022). Traditional vacuums may not be suitable in these settings as they often fail to address storage limitations, ergonomic requirements, and adaptable modular cleaning solutions (Albiz & Glaerum, 2019; Kang et al., 2020; Kwon & Shin, 2022). By understanding a user's basic cleaning behaviours, constraints and frustrations, highly intuitive designs that respond to their needs can be achieved.

This report focuses on the key research question - how can the design of a storage system for an adaptive modular vacuum improve the user experience for individuals in compact high density living environments of Australia? This project specifically targets individuals in compact high density living environments for example, high rise studio apartments or caravans. Modern vacuum cleaners present opportunities for improvement in areas such as portability, multifunctionality, and user experience (Zhao et al., 2022). To enable the sufficient use of handheld vacuums in these types of environments, ways to store them in a more compact manner are required. By applying a user centred design approach, this project will develop a compact storage system that can house a handheld adaptable modular vacuum cleaner (i.e. a Dyson V15).



Figure 1. Project Overview

Background

Overview

High density living often refers to areas of accommodation that house many occupants. Apartments that are comprised of 9 or more storeys are amongst high density living (Hanrahan & Ibrahim, 2022). Moreover, these spaces are often compact or restricted. According to the NSW Apartment Design Guide the minimum storage allocation for a one-bedroom apartment is specified as $6m^3$ however up to half of this may be located outside, leaving approximately $3m^3$ of storage inside (NSW Department of Planning & Environment, 2015).

This shift is predominately in Sydney, Melbourne and Brisbane (Hanrahan & Ibrahim, 2022; Veal & Piracha, 2024). The 2021 ABS census recorded apartments as 16% of Australia's dwelling stock, with 500,000 Australians living in high density apartment buildings and 45% of those in Sydney (ABS, 2021). Household products are consequently being used in compact living environments rather than the detached homes they were designed around (Albiz & Glaerum, 2019; Zhao et al., 2022).

Challenges of Vacuuming in Compact High Density Living Environments

The limited floor spaces in these apartments make it difficult to effectively manoeuvre bulky vacuums. This is particularly true when navigating around furniture, narrow walkways and confined rooms (Albiz & Glaerum, 2019). These spaces typically have different types of floor surfaces for instance carpet, timber, tiles, and rugs requiring either manually switching attachments or cleaning modes (Zhao et al., 2022). Apartments also have restricted storage capacity with many Australians struggling to stow their vacuums, accessories and charging stations (NSW Department of Planning & Environment, 2015; Harmer et al., 2019).

By referring to Figures 2, 3, 4, and 5 vacuum cleaners are hidden to both minimise visual clutter and maximise floor space by storing them in cupboards, narrow utility spaces, furniture compartments or other unused areas as these have become popular storage choices. Users not only actively look to hide their vacuums in these types of available spaces, but they also ensure to maintain a well cleaned and visually unobtrusive living environment (Inselife, 2023; Clayton, 2025).

Statistics on vacuum cleaner storage show that 62% of users conceal their machines in cupboards, and 17% behind furniture (Harmer et al., 2019). This creates a tension between accessibility and invisibility. Users want their vacuums to be “available and easily accessible, but not visible” (Albiz & Glaerum, 2019, p 18).



Figure 2. Example of a compact high density living apartment (Inselife, 2023).



Figure 3. Easily accessible wall mounted stick vacuums (Inselife, 2023).



Figure 4. Hidden storage cupboard for stick vacuum - closed (Clayton, 2025).



Figure 5. Hidden storage cupboard for stick vacuum - open (Clayton, 2025).

Evidence That the Problem Is Real

As apartment living continues to grow in Australia more residents are experiencing cleaning problems (Hanrahan & Ibrahim, 2022; Albiz & Glaerum, 2019). Compact dwellings accumulate dust and allergens faster and require more frequent cleaning, and indoor allergens are established contributors to allergic conditions and asthma (Beheshti et al., 2024; Maciag & Phipatanakul, 2022). High frequent cleaning makes storage a real design problem, because if a machine is used several times a week it cannot simply be packed away.

Surveys performed by Harmer and colleagues uncovered that 66% of discarded vacuum cleaners were still functioning, with disposal driven by perceived inefficiency, maintenance barriers and psychological obsolescence rather than mechanical failure (Harmer et al., 2019). These findings from Harmer and colleagues are key considerations as they show that other influences such as user perceptions, convenience, and usability asides from cleaning performance can affect the overall lifespan of the vacuum machine.

User Groups

The primary user group is young adults between the age bracket of 20-40 and the secondary user group is mature adults aged 55 years and over (Hanrahan & Ibrahim, 2022; James et al., 2020). Within are two distinct demographics: young first-time buyers and the downsizing empty nesters (Mortimer, 2018). These groups were selected because they are increasingly represented in Australia's compact high density housing market and because they occupy the environments that this project is investigating, where storage constraints, portability and space efficiency directly shape how a vacuum is used (Hanrahan & Ibrahim, 2022; Mortimer, 2018; Albiz & Glaerum, 2019).

Benchmarking

Overview

The purpose of this section is to perform evaluations, comparisons and analysis on already available products that exist on the market. This is performed to better understand a products limitations, performance levels and industry expectations.

Existing Consumer Market Vacuums

Six different vacuums were chosen to be analysed and compared against from a diverse market range, refer to Appendix 1, Table 1. These were the Hoto AutoCare Plus Air Duster & Vacuum, the Black & Decker Wet & Dry Dustbuster, the Shark MessMaster Portable Wet & Dry Vacuum, the Dyson V9 Submarine, the Bosch Rechargeable 2-in-1 Mop, and the Fraction.

Five main attributes were derived from the factor tables in Appendix 1: cost, compactness, low maintenance, adaptability and modularity. Each was ranked out of 10 and converted to a percentage for presentation in six radar charts built in RadarChart.io (Figures 6 to 11).

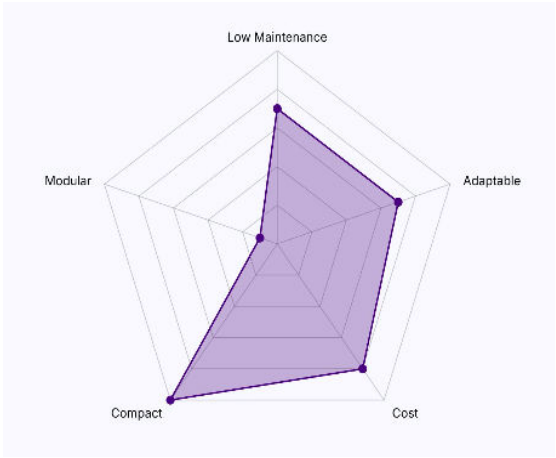


Figure 6. Hoto AutoCare Plus Air Duster & Vacuum Factor Scores

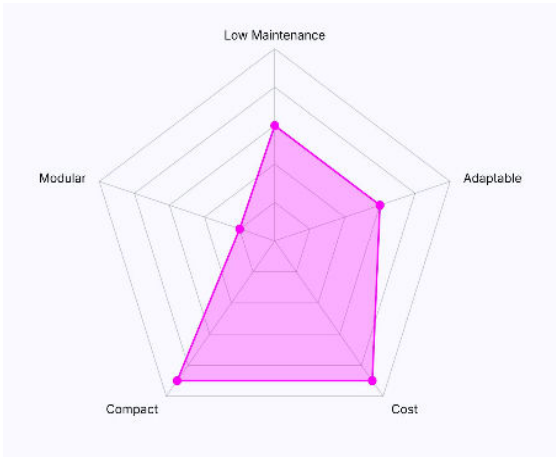


Figure 7. Black & Decker Wet & Dry Dustbuster Factor Scores



Figure 8. Shark MessMaster Portable Wet & Dry Vacuum Factor Scores



Figure 9. Dyson V9 Submarine Factor Scores



Figure 10. Bosch Rechargeable 2 in 1 Mop Factor Scores



Figure 11. Fraction Vacuum Cleaner Factor Scores

The Hoto AutoCare Plus Air Duster in Figure 6 and Black & Decker Wet & Dry Dustbuster in Figure 7 performed well in the categories compact (100% and 90%) and cost (80% and 90%) due to their overall size and simple construction. Conversely, they scored lower in the areas of adaptability (70% and 60%), modularity (only 10% and only 20%) and low maintenance (70% and 60%) compared to other existing consumer market vacuums. They have limited attachment options and replaceable pieces leading to reduced functional flexibility and frequent emptying of small dustbins.

Other larger systems like the Shark in Figure 8, Dyson in Figure 9, and Bosch in Figure 10 vacuums had generally achieved much higher rankings for adaptability (70%, 100%, and 90%) and modularity (70%, 50%, and 40%) as they included countless functions for multipurpose cleaning, and several modular parts. However, these greatly decrease each vacuums compactness for storage (40%, 60%, 50%) whilst their cleaning maintenance was similar (60%, 60% and 60%). The Fraction vacuum in Figure 11 slightly differed from this norm by not only being high adaptability, high modularity it

also had low maintenance requirement, however compactness rated low as it's a full handheld unit.

Identified Market Gaps

The storage allowances for each vacuum system were also compared, as the research question concerns storage rather than cleaning performance. Only the Dyson and the Bosch are supplied with a dedicated storage accessory, and both are wall mounted docks that require drilling into the wall. Under most Australian strata by-laws approvals are required, and it is not an option at all for renters or for caravan users. The Hoto and the Fraction are supplied in carry cases, but neither charges the device while it is stored. No benchmarked product stores the machine, its attachments and its charger together in a free-standing unit sized for a $3m^3$ internal space allocation.

Docking and emptying stations do already exist. Samsung released the Clean Station in 2021 and LG the CordZero All-in-One Tower in the same year, both of which empty the dustbin into a sealed bag automatically, and Dyson released its own Auto-empty Dok in 2026. These products confirm that emptying is a recognized problem rather than one identified only by this study. All of them, however, are tall floor standing towers intended for a laundry or a garage, and the Dyson V15 unit. These products are not designed for the internal storage allocation of an apartment or the fixing restrictions noted above.

Various market gaps were found in modularity, ergonomics, and noise. This is particularly true for the Dyson V9 Submarine stick vacuum with non-replaceable sealed internal components making maintenance accessibility challenging, a bulky motor unit increasing heaviness, and a small trigger design leading to ergonomic discomfort. With other vacuums like the Shark MessMaster portable wet and dry vacuum it was found to produce high noise levels contributing to user annoyance, be corded reducing mobility, and had a short hose thus limiting reach. Although the vacuums repeatedly succeeded in other areas, for instance ease of use, suction performance, and overall convenience for quick cleaning, the benchmarking discovered that there are currently few vacuums available on the market that perform well enough to satisfy all needs.

Summary

The benchmarking shows that the market competes on cleaning performance and treats storage as an accessory. Every product in the comparison is designed to be put away rather than designed to be stored. This suggests an opportunity to develop a vacuum storage system that resolves the issues of space constraints, ergonomic comfort, maneuverability, and modularity for users in compact high density living environments.



Section Two – The Research

Research

Overview

Secondary research comprises the literature review and benchmarking reported above. Primary research was carried out through observations and surveys with the two user groups identified in the background, using a mixed methods approach. These observations captured contextual behaviour from the participants, and the survey tested whether those behaviours held across a larger group.

A total of 24 participants were recruited for the project, comprising of close friends, work colleagues and relatives. The participant sample had 14 females and 10 males. They came from a range of different age groups with 5 participants being between the age bracket of 18-24, 3 aged 25-34, 5 aged 35-44, 9 aged 45-54, 1 aged 55-64, and 1 aged 65 years and over. Their occupations included being full-time workers, tradespeople, students, homemakers, and retirees. They also lived in a mix of environments such as detached suburban houses and apartment style residences.

Observations

This research method involved performing face to face observations with participants. Six participants were recruited, exceeding the minimum requirement of five, and were selected by convenience based on regular vacuum use and proximity. Each observation took place in their own home environment specifically either their bathroom, kitchen, living, or dining room. However, one of the participants was observed vacuuming in their workplace at Bradnams, specifically cleaning inside their aluminium windows and doors test rigs. The observations looked for recurring trends and the underlaying issues participants had with their vacuum cleaners… An observation checklist was prepared in advance and used at these visits to assist with the data collection and guide what questions to ask along with determining which photos and videos should be captured.

Key questions included, “How long does it take you to vacuum clean?” or “What attachments do you use?” Some questions were followed up with the necessary photos and videos via iPhone to effectively document each participants behaviours, interactions, and issues during their vacuum cleaning sessions. Photos were taken to capture clear visual details of the participants with their vacuum, details that words alone could not adequately convey. Videos were also made to observe the live experience of how each participant interacted with and used their vacuum cleaner. The duration of each observation session spanned a total of approximately 20 minutes.

Survey

Google Forms was used to create a survey containing 32 questions. The survey was distributed to all 24 participants including the same 6 who took part in the observations. By including these participants in the survey, it enabled for a deeper exploration into their insights gathered from the observations. This survey was subsequently sent to participants via email for completion. Each response was automatically recorded and collected within Google Forms.

The purpose of the survey was to collect vital information from participants for data analysis. The survey mixed Likert scales, checkboxes and open-ended questions so the frequency and reasoning could both be captured. Some questions included, “What annoys you most about vacuum cleaners?” or “What specific areas do you clean regularly?” The survey took approximately 15 minutes for participants to complete.

Analysis & Findings

Overview

The primary research, specifically the analysis and findings of the data are covered in this section. The purpose of these results was to identify user behaviours, pain points, and contextual constraints through firsthand user accounts via observations and surveys. These methods will also allow for the interpretation of key user trends from the data collection.

Observations

The observations generated both qualitative data and quantitative data. Firstly, categorical qualitative data was undertaken via notes, photographs, videos, and a synthesis table, all through a checklist. Then the subsequent numerical quantitative data was gathered when participants completed a quick rating scale located at the bottom of the checklist towards the conclusion of each observation session. The 6 recruited participants were observed using their own vacuum in their home or workplace and as part of this exercise, each was asked to quick rate between 1 through 5 (1= poor, 5= excellent) their user experiences across six areas, shown in Table 4.

Area	P1 - Dyson V15	P2 - Dyson V11 Animal	P3 - Dyson V15 Detect Absolute	P4 - LG A9N-Multi	P5 - Ryobi VC60HDARG Wet & Dry	P6 - Shark Detect Pro
Handling	3	2	3	4	3	4
Cleaning Performance	4	4	3	4	3	3
Attachment Change	4	3	4	5	5	5
Emptying / Maintenance	4	5	5	3	2	5
Charging Battery	3	5	5	5	N/A	5
Storage	5	5	5	4	3	4
Cost	1	2	1	3	5	4

Table 4. Quick Rating Scale

Storage was the highest rated of the six areas, with an average score of 4.33. Participants rated themselves on how satisfied they were with where the vacuum is currently stored, and all kept their vacuums out of sight. However, this high rating may reflect how well the participants have adapted to their current storage, rather than storage that works well for them.

After the observation data collection was completed, the method known as affinity diagramming was used to effectively analyse the qualitative data. Each observation was broken into subcodes covering user actions, difficulties and workarounds, which were

then clustered into ten themes: storage, battery, modularity, posture, surface, debris, maintenance, adaptability, workarounds, and task flow. These were visualised as a sunburst diagram in RawGraphs 2.0 (Figure 12), weighted by theme and by subcode frequency.

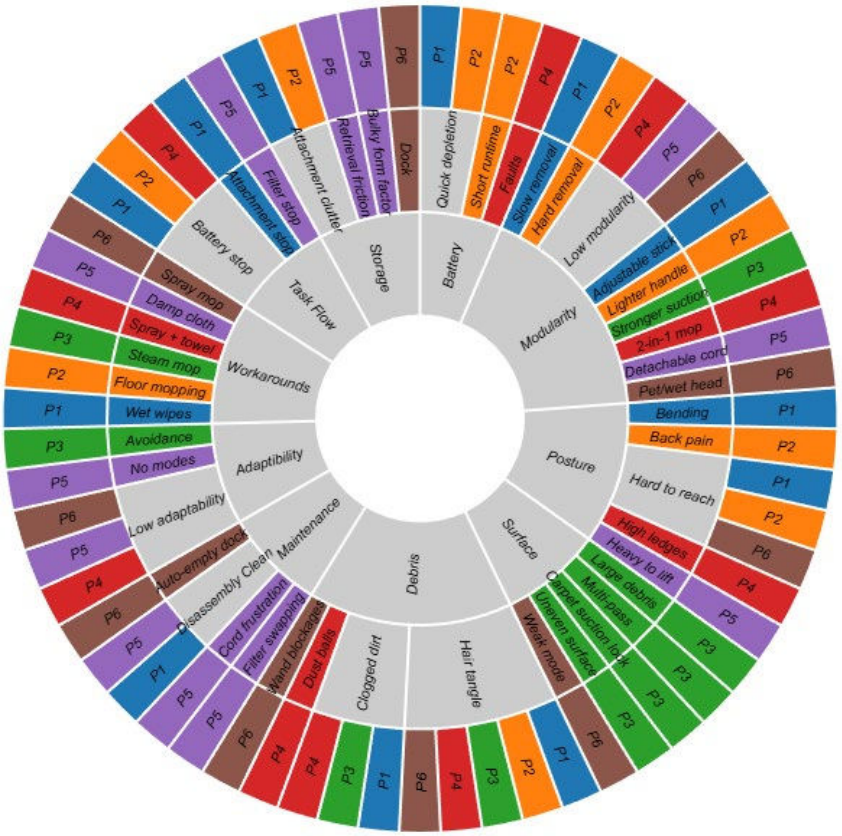


Figure 12. Sunburst Diagram

Following the completion of the six participant observation sessions, ten themes emerged. However, not all these themes were considered equally relevant to the focus of improving vacuum cleaning experiences within the context of compact high density living environments. More specific themes of battery, posture and modularity from the sunburst diagram in Figure 12 were selected for further analysis via an alluvial diagram in Figure 13. Each related sub code was then grouped with the corresponding theme and participant, illustrating the relationships between observed user behaviours and underlying user needs. These core user needs included usability, ergonomics, adaptability, and efficient storage in tightly confined dwellings.

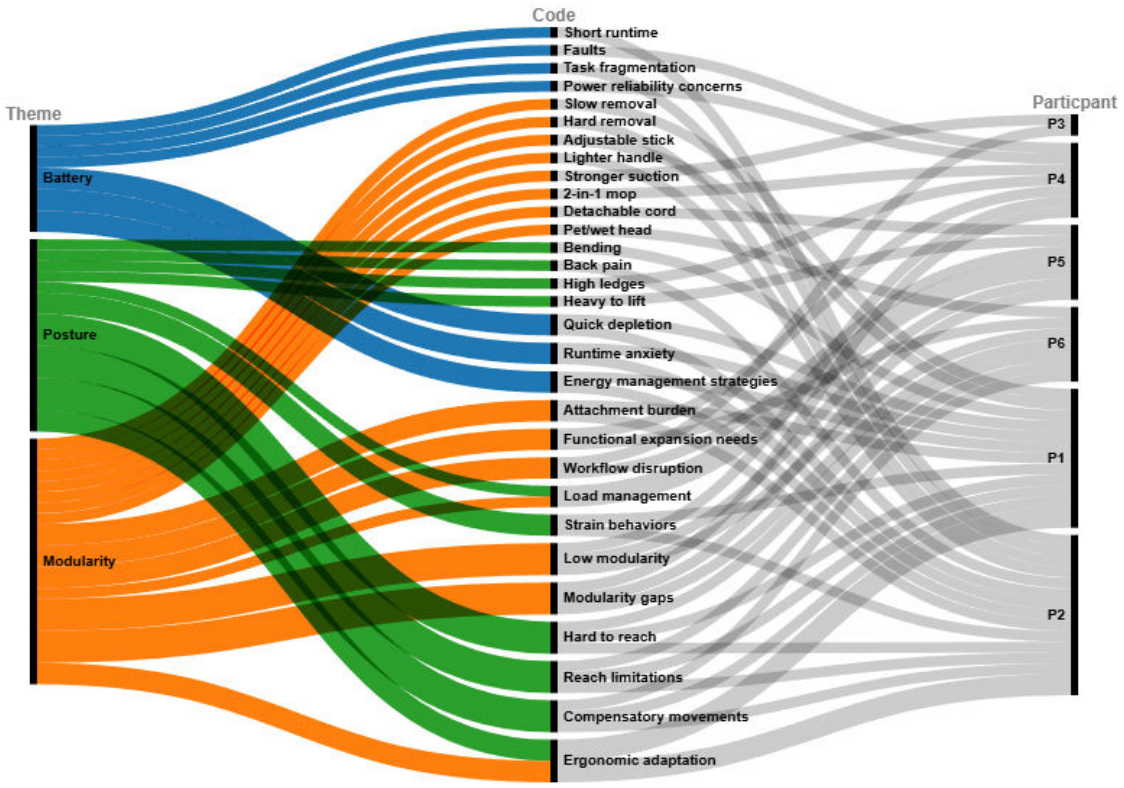


Figure 13. Alluvial Diagram

Key Findings

- 3 participants (P1, P2, and P4) had faced issues like battery depletion leading to runtime anxiety, power reliability concerns, or task fragmentation. Users living in these high-rise residential apartments often require a single vacuum device that has sufficient performance capabilities to prevent any interruptions.
- The most behaviourally dense theme with 5 participants (P1, P2, P4, P5, P6) having bending complications during vacuuming, necessitating reach limitations, compensatory movements, ergonomic adaptation, and load management. The furniture placement and confined spaces in these settings make it difficult to vacuum clean leading to the implementation of awkward cleaning positions.
- The most universally experienced theme being present across all 6 participants was modularity. Analytical subcodes like attachment burden, modularity gaps, and workflow disruption was frequent between users and considered the root cause of attachment changes. Having adaptable vacuum configurations that can successfully support many different cleaning activities whilst also minimising workflow disruption and storage requirements in these spaces is important.

Survey

The survey analysis involved performing methods like descriptive summarisation, central tendency (i.e. mean, median, mode), as well as a mix of univariate and bivariate variable analysis. Out of the total 24 recorded responses some contained ranges (i.e. 30-40 mins), so these were converted into single values using their midpoints to ensure a fully numeric dataset. Excel was used to create the univariate bar graph in Figure 14, along with the bivariate stacked bar graphs in Figures 15 and 16.

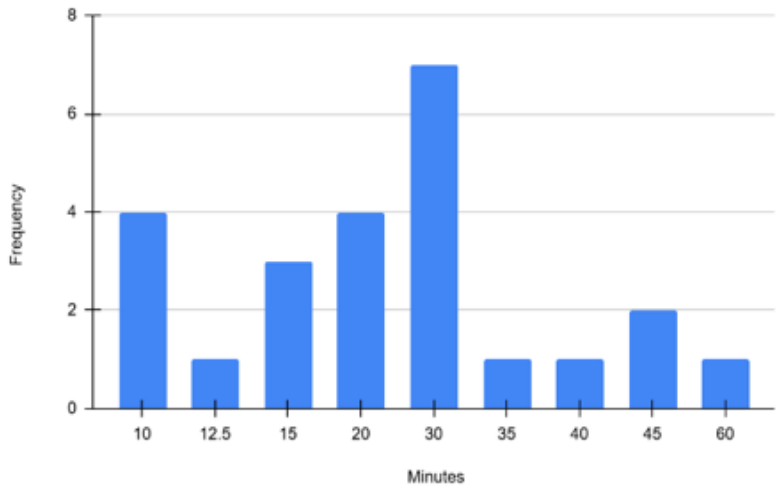


Figure 14. Univariate Bar Graph – Vacuuming Duration (Minutes)

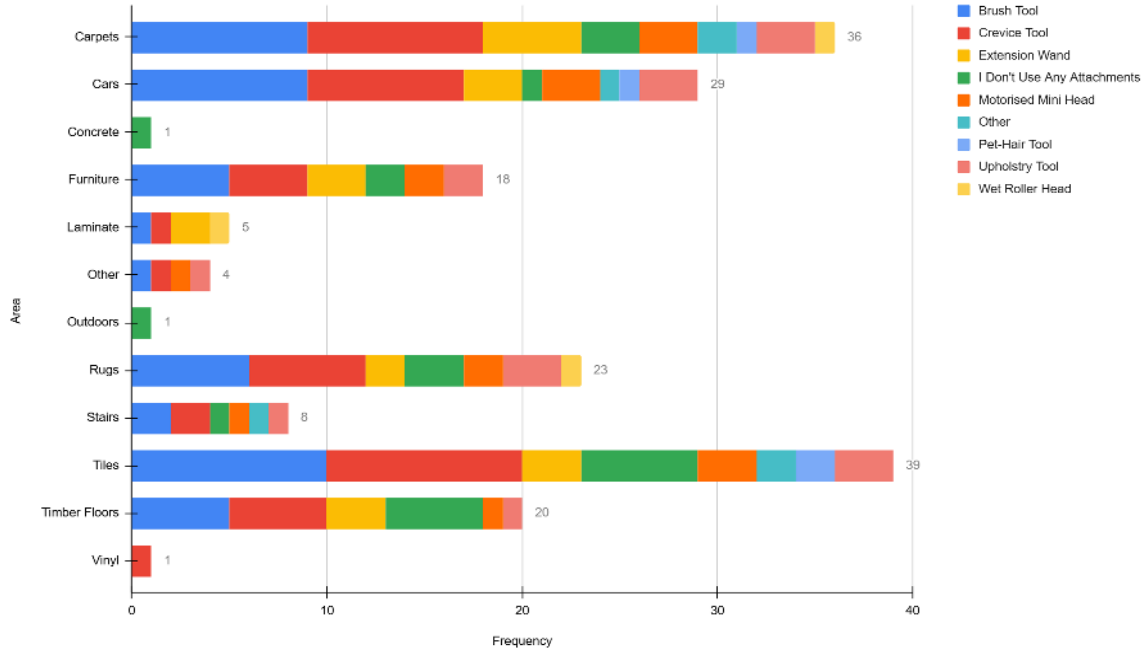


Figure 15. Bivariate Stacked Bar Graph – Cleaning Areas X Attachment Use

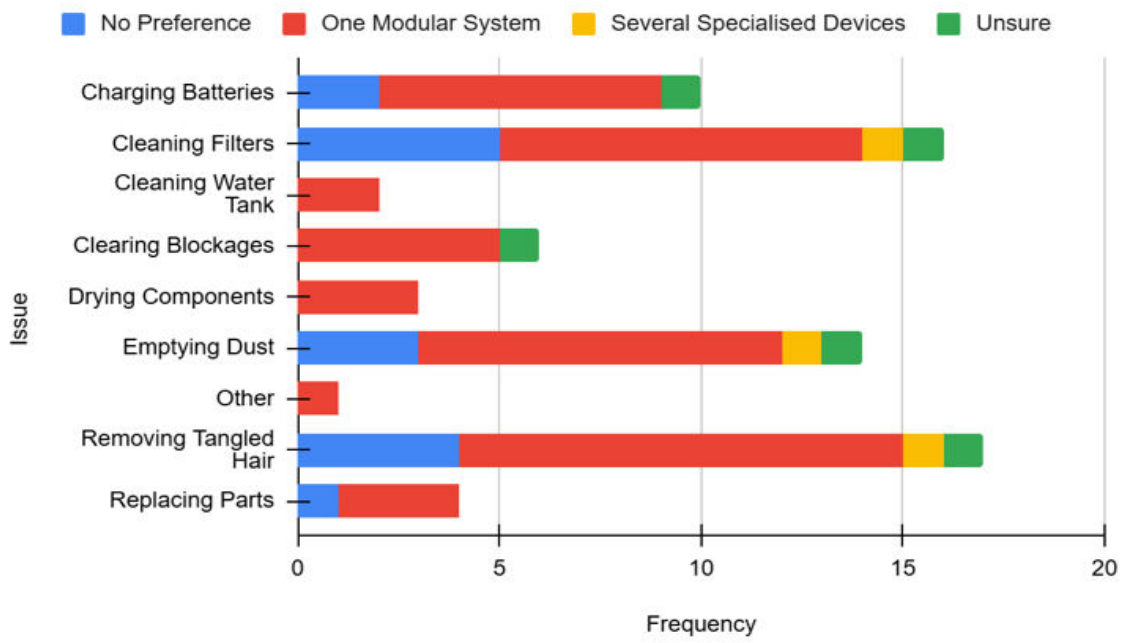


Figure 16. Bivariate Stacked Bar Graph – Cleaning Issues X Device Preference

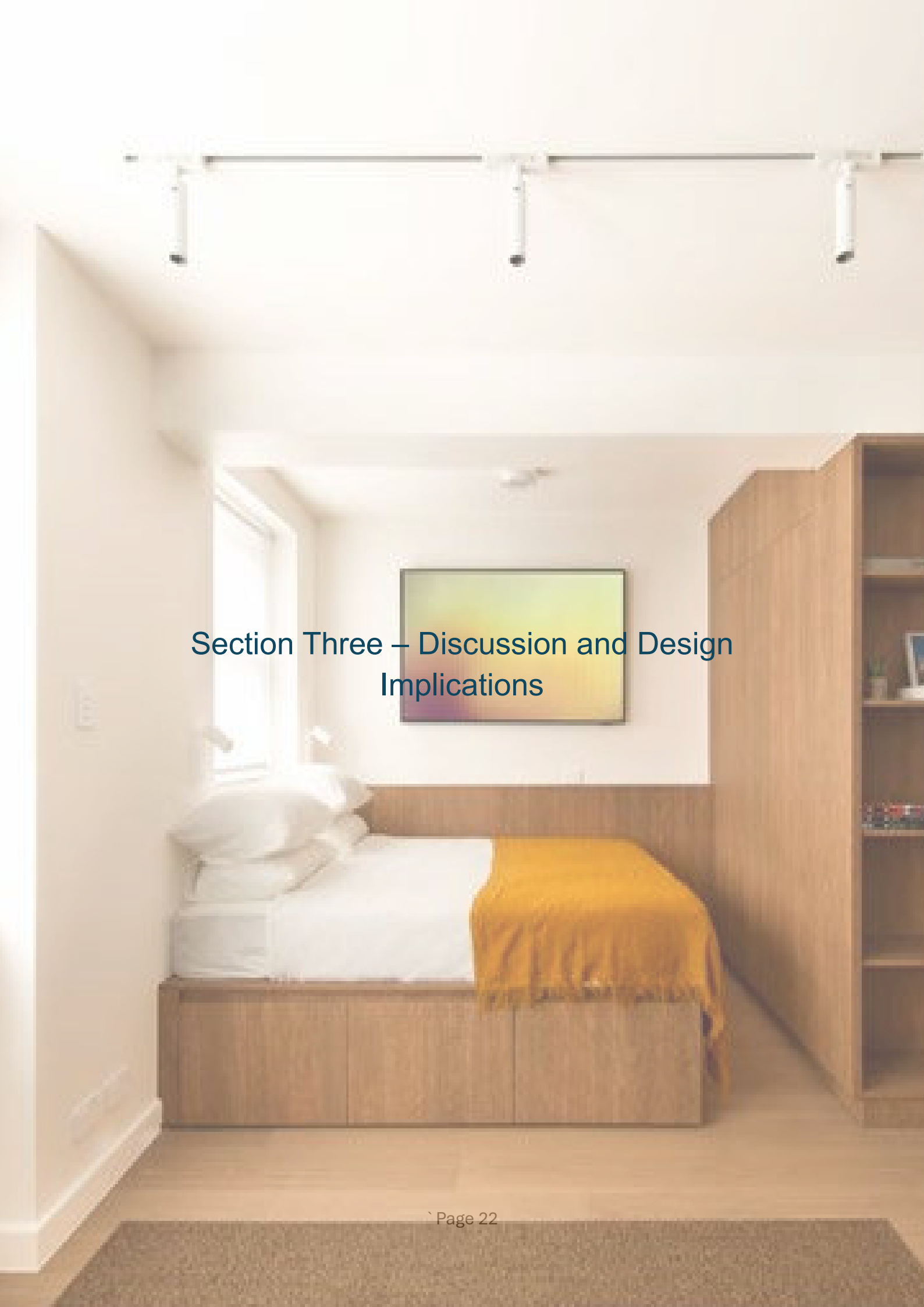
Key Findings

- A typical cleaning session lasts 30 minutes, with 7 responses (Figure 14). Completing all household vacuum cleaning tasks during one session in compact high density living environments is required as these users integrate them into their busy daily routines.
- Tiles and carpets were the most frequently cleaned surfaces with 39 and 36 attachments respectively (Figure 15). The constant transition between diverse floor types in these small environments is common.
- The brush tool and crevice tool were the most used across the many different cleaning areas. Concrete surfaces, vinyl surfaces, and outdoor areas had little attachment use (Figure 15). The need for countless specialised tools and additional storage space is reduced when users prioritise certain attachments that satisfy the various indoor cleaning requirements.
- The highest recorded preference was having one modular system with 17 responses whilst the lowest recorded was several specialised devices with only 1 response (Figure 16). A combined cleaning solution can better minimise storage requirements and support adaptability. It also indicates that the storage system should hold one machine and its attachments as a single object rather than distributing them.

- Removing tangled hair, cleaning filters and emptying dust were considered highly frequent issues (Figure 16). Simplified vacuum maintenance improves convenience and reduces disruption, thus increasing task flow for the user.
- Cleaning water tank, drying components, replacing parts, and other were the issues less frequently experienced (Figure 16). Daily maintenance concerns are therefore more closely associated with usability and routine vacuum operation as opposed to occasional cleaning activities.

Summary

The observations and surveys herein were successfully analysed by applying qualitative categorical affinity diagramming analysis and quantitative numerical descriptive statistical analysis. They conveyed various underlying user needs and user trends. For an efficient vacuum storage system, a user centred approach must be adopted that places the user at the forefront of the design process.



Section Three – Discussion and Design Implications

Discussion

Overview

The aim of this section is to compare both the primary research of the observations and surveys to the secondary research initially conducted in the background and benchmarking. In performing this we can obtain a better interpretation and confirmation that the research findings are valid.

Interpreting the Findings

Both the primary research approaches of observations and survey come to similar findings. The six observations identified that vacuums fail by ways of bending to swap attachments, carrying excess weight upstairs, hair jamming barrels, and dirt trapped during emptying. Similar complaints were also expressed by the 24 participant responses in the survey. The widest spread on the observation quick scale ratings was emptying maintenance having a range between 2 and 5 points. This shows an inconsistent product experience even within similar vacuum models, so this points to a design driven problem. Every observed participant placed their vacuum system in concealed storage regardless of brand, and the survey's preference for one modular system over several specialised indicates a clear preference for integration. This primary research suggests that there is a need for a better designed handheld vacuum storage system that reduces physical load, is more maintenance friendly and better addresses the accessible versus hidden storage conflict. These needs are considered especially important for compact high density living environments and the two targeted user groups as they have limited storage space with high physical and maintenance demands directly affecting usability and convenience.

Findings in Relation to the Literature

In many ways the primary research supports the background research. The observed bending and heaviness complaints align with Bak et al. (2019), finding that lifting, not stroke motion drives the highest muscular load. The frustration of attachment swap was also seen in the handle geometry findings of Kwon and Shin (2022). The observed maintenance supports the finding of Harmer et al. (2019) that perceived inefficiency not mechanical failure drives disposal. And that a preference for hidden storage identified by Albiz & Glaerum (2019) confirms the accessible versus invisible tension, this is also reinforced by the NSW Apartment Design Guide (NSW Department of Planning & Environment, 2015). The affordance theory of Gaffney et al. (2007) was seen by the survey participants desire to upgrade to the single modular system.

Limitations

The primary research findings are subject to three main limitations. The participants included friends, colleagues and relatives recruited by convenience, which introduces sampling bias. The sample of participants lived in a mix of detached houses and apartments, and only 10 of the 24 lived in the compact high-density context the project targets, so the sample over-represents detached housing. Each of the six observations captured a single cleaning session rather than a full cleaning routine. So, these findings should therefore be read as directional evidence to informs the design brief, rather than as a statistically representative account of Australian apartment residents.

Closing the Research Gaps

The secondary research largely addressed ergonomics, maintenance and storage as separate problems, and that no modular vacuum system had been properly tested against Australian compact high density living conditions.

This research narrows that gap in three ways. It records that all six observed participants concealed their vacuum regardless of brand or purchase price, which indicates concealment is a condition of the context rather than individual preference. It quantifies the maintenance burden that follows from concealment, at 70.8% for hair removal and 45.8% for emptying. And it establishes that the storage decision is made under an internal allocation of approximately $3m^3$, a dimension no benchmarked product is designed against.

Design Implications

Overview

Drawing on the primary research findings and the thoughts shared in the discussion, the following section outlines the design implications to consider when developing a storage system for an adaptable, modular vacuum suited to compact, high density living in Australia.

Key Design Priorities

The retrieval and return posture when using a vacuum was the lowest scoring dimension in the observed quick rating scale with the average being 3.17 as seen in Table 4 and 70.8% of the survey results ranking “lightweight” as a valuable attribute. Back and joint strain was reported by 25% of the survey respondents and from 3 of the 6 observed participants. The storage system implication is that the storage unit sets the height and the posture at which a 3.1kg machine is lifted and returned. That lift happens before and after every clean rather than during it, which puts it inside the scope of the project.

Storing attachment at the point of use and their accessibility scored well on average with a rating of 4.33 in Table 4, the individual feedback however from Participant 1 and 2 described the process as slow, effortful and at times awkward posturing to apply. The survey showed that 70.8% of the respondents want the cleaning head to be swappable (Q30 in survey). The storage implication is that attachments kept in a separate drawer add a second retrieval to every task. The tools and the machine must live in the same object, which is also what the 17 of 24 preference for one modular system points to.

Maintenance related issues were seen as the greatest annoyance across the whole study, 70.8% cited hair removal in Q24; emptying is the top general frustration at 45.8% in Q17, this reinforced by 4 of 6 observed participants describing trapped debris or tangled hair as a significant cleaning maintenance or performance issue. The storage implication is that maintenance currently requires the machine to be carried somewhere else, which in an apartment means the kitchen bin. A storage system that provides a maintenance position removes that trip.

Charging the vacuum while it is in storage also needs to be risk considered. Only 37.5% of the survey reported battery reliably lasts a full clean (Q13), and battery runtimes issues were in 4 of 6 observed participant studies. The “ease of charging” scored highest of all rated attributes with an average value of 4.6 in Table 4. The storage implication is that storage and charging are the same event, and that any enclosure

around a charging lithium battery raises the ventilation and compliance issues already noted in the problems below.

Problems and Opportunities Identified

Problems Identified

- Cleaning performance is prioritised more so than storage efficiency. Vacuums are left in storage for most of their product lifespans rather than used.
- Excess weight of vacuum devices can cause physical strain, particularly when carrying the devices upstairs.
- Current storage provisions do not work at apartment scale. A $3m^3$ internal allocation pushes users to hide vacuums in whatever compartment is free, and existing docking stations are too large for these environments and tangle their cords.
- Vacuums stored in the open or unsuitable locations such as bathrooms, near radiators, in pet accessible or cluttered areas risk scratches, impacts and general wear.
- Power charging devices must meet Australian standards. Ventilation and overheating issues could exist under new designs if not considered.
- Devices must be dry and clean before storage or odour develops and drying in these environments are limited given there is only a kitchen sink, toilet and wastebins, with no garage, no laundry, or no backyard available.
- Accessibility allowing the user to grab the vacuum for a quick job. Removing attachments require force causing participants to change body posture.
- Ergonomics to accommodate for a diverse range of users. Reaching under furniture into tight or narrow gaps or high ledges is difficult, this was the most consistent pattern from the 5 of the 6 observation participants.

Opportunities Identified

- A portable carry case solution that houses the device and its accessories so they can be used in other locations and be better stored in the environment.
- Consider a travel trolley which has wheels to increase manoeuvrability and an adjustable retractable handle for ergonomics.
- Introduce a furniture substitution that is integrated into the home environment and serves as a docking station with automatic charging and securely holds the equipment. Because it doubles as furniture it requires none of the $3m^3$ space allocation completely.

Summary

These design implications translate directly into actionable concepts, with three design opportunities identified for development to initial concept stage before prototyping begins.

Conclusion

Younger and mature adults in Australia regularly experience vacuum challenges relating to storage, maintenance and usability. The findings from this report show a consistent demand for a vacuum storage unit that is secure, portable, accessible, and efficient to improve the user experience. Benchmarking also showed that the market designs vacuums to be put away, rather than designing storage as part of the product, and this is the gap this project addresses. These findings now provide a foundation for initial concept design stage and prototyped.

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Appendix 1. Benchmarked Vacuum Systems

	Hoto Autocare Plus Air Duster & Vacuum	Black & Decker Wet & Dry Dustbuster	Shark MessMaster Portable Wet & Dry Vacuum	Dyson V9 Submarine	BOSCH Rechargeable 2 in 1 Mop	Fraction
Image						
Pros	• 20,000Pa powerful suction • 96,000 RPM brushless motor • 4 in 1 functionality • 180ml dustbin • 5-piece accessory kit included • Compact design • Portable storage case to carry it around • Perfect for car interiors, home surfaces, office desk and keyboard dust • 3 speed boost options • Battery lasts for 30-35 minutes • Cordless • Lightweight • Comes with a c-type charger (HOTO, n.d.)	• Wet and dry capable • Compact design • Can vacuum up to 240ml liquids • Easy to use • Lightweight • Reaches tight corners and high spaces • Suction is strong when empty but drops as the bag begins to fill up • Great for small messes, quick clean ups, crumbs and spills either at home or in the car • Cordless (Black & Decker, n.d.)	• Wet and dry capable • Compact • Self-cleaning - can vacuum a cup of water to rinse the hose and dustbin. • Can line the bin with just a plastic bag • Easy to empty the dustbin • Ideal for kitchens, pets, kids and DIY • Easy to use • Lightweight • Efficient • Strong suction • Not very modular as only the filter, filter housing, hose, nozzle attachment, tank components like seals, lids, and internal separators can be replaced (Shark Ninja, n.d.)	• Wet and dry capable • 120,000 RPM hyperdymium motor • Strong suction • Easy to maneuver • 40-minute battery run time • Interface screen displays real time alerts for the user • Touch-free dustbin emptying • Lightweight - 2kg • Three modes - eco, medium, boost • Attachments allow for versatility • Acoustic tuning to minimize noise levels • Manufactured with high grade materials which make it durable and long-lasting • Design prevents hair from getting tangled in the brush • Easy to use • Cordless (Dyson, n.d.)	• 2 in 1 - acts as a vacuum and a mop • Included accessories allow for versatility • 40-minute battery run time • Easy to use • Easy to maneuver • 3 different vacuum cleaner power modes - eco, turbo, auto • Illuminates dirt on surfaces • Electric powered allows for quiet vacuuming • Lightweight - 2.9kg • Excellent ergonomics • Cordless • Includes 2 changeable battery packs for extended cleaning • Flex tube and quick stand functions make for effortless handling • Auto mode differentiates between the floor type for streamlined vacuuming (BOSCH, n.d.)	• 100% modular • No tools are required as parts can be swapped by hand • Neural predictive AI senses wear, sends alerts and solutions to your iPhone • airflow • resistance • temperature • load • battery • replaceable battery packs • UVC light to Illuminate dirt • Bluetooth to connect to your iPhone • Manufactured from aerospace-grade 6061 aluminum which boasts a high strength to weight ratio. • Cordless • Comes in three colours - aluminum black, aluminum mineral and polar white (Prelaunch, n.d.)
Cons	• Limited colours available • Limited modularity as only filter, heads and charger can be replaced (HOTO, n.d.)	• Limited 10-minute battery run time • Struggles with pet hair, carpets and larger debris • Noisy • Dust can leak from vents • Limited colours available • Limited modularity as only the filter housing, charging mount, sponge filter, dustbin, charger, and squee gee attachment can be replaced (Black & Decker, n.d.)	• Noisy • Short hose makes it difficult to maneuver • Attachments work themselves loose during use • Limited colours available • Corded vacuum so it has limited movement (Shark Ninja, n.d.)	• Trigger design is small and uncomfortable - poor ergonomics • Small dustbin means frequent emptying (ProductReview.com.au, 2025; Lufy, 2026) • Limited colors available • Moderate modularity as only the battery, charging dock, charger, wand, anti-tangle brush bar inside the dry head, wet roller cassette for the wet head, attachments like the hair screw nozzle, combination nozzle, and crevice nozzle can be replaced (Dyson, n.d.)	• Weaker suction when compared to other brands like Dyson • Limited colors available • Only the microfiber pads, water tank lid, charger, and battery are the modular components that can be replaced (BOSCH, n.d.)	• Not officially released yet - still a concept (Prelaunch, n.d.)

Table 1. Pros and Cons of Existing Consumer Market Vacuum Cleaners

Factor	Description
Wet and Dry	Being able to easily switch between picking up either dry debris or liquid spills without changing to a whole separate tool.
Low Maintenance	The ease and frequency of performing tasks like cleaning, drying, unclogging, and managing odours for maintaining parts such as filters.
Weight / Portability	The heaviness, maneuverability, and convenience of the vacuum during cleaning.
Adaptable	Having versatile attachments that fit many different uses/environments such as crevice tools, brushes, wet-cleaning heads and upholstery tools.
Modular	Being able to replace or upgrade certain parts when they get damaged instead of purchasing an entirely new product.
Durability / Longevity	How much a product can endure during its intended use without causing any significant degradation and how long before it ultimately becomes obsolete or unusable.
Ergonomics	Fitting the product to the users physical and cognitive capabilities to ensure that the vacuum is comfortable, safe and efficient.
Ease of Use	Clearness of buttons, simplicity and the vacuums level of intuitiveness.
Cost / Value	The amount of money that the customer pays to purchase a product. The perceived benefit that the customer derives from a product.
Aesthetic Appeal	The visual attractiveness of the vacuum.
Suction Performance	The vacuums efficiency when collecting dust, crumbs, hair, dirt and any other debris.
Liquid Pickup Effectiveness	The total amount of liquid volume that the vacuum can hold, its pickup speed and if it leaves a wet residue behind after cleaning.
Noise	Levels of noise, pitch, vibration, and if it's fit for use around children or pets.
Battery Runtime	The vacuums battery runtime or battery level indicator, recharging speed, and if its performance drops as the battery drains.
Storage	Wall mounted or stand charging, attachment storage and how easy it is to grab the vacuum for quick cleans.
Dustbin Size	How frequently that users must empty the vacuum's dustbin after cleaning.
Emptying Disposal	How clean and easy it is for users to empty dry debris and wet liquids from the vacuum's dustbin.

Table 2. Descriptions for Key Factors

	Hoto AutoCare Plus Air Duster & Vacuum	**Black & Decker Wet & Dry Dustbuster**	**Shark MessMaster Portable Wet & Dry Vacuum**	**Dyson V9 Submarine**	**Bosh Rechargeable 2 in 1 Mop**	**Fraction**
Wet / Dry	3	9	10	10	8	10
Low Maintenance	7	6	6	6	6	8
Weight / Portability	10	9	4	6	5	3
Adaptability	7	6	7	10	9	10
Modularity	1	2	7	5	4	10
Durability / Longevity	6	5	7	9	8	10
Ergonomics	8	8	6	5	10	9
Ease of Use	9	9	9	10	10	10
Cost / Value	8	9	8	6	7	7
Aesthetic Appeal	7	6	6	9	8	9
Suction Performance	8	6	9	10	7	9
Liquid Pickup Effectiveness	2	8	10	10	7	10
Noise	8	3	3	9	9	9
Battery Runtime	6	3	N/A – corded	8	8	9
Storage	10	9	7	8	8	9
Dustbin Size	4	5	8	3	6	8
Emptying / Disposal	7	6	9	10	9	10

Table 3. Factors of Existing Consumer Market Vacuum Cleaners



Figure 17. Product Matrix 1 – Adaptability vs Modularity



Figure 18. Product Matrix 2 – Compact vs Low Maintenance