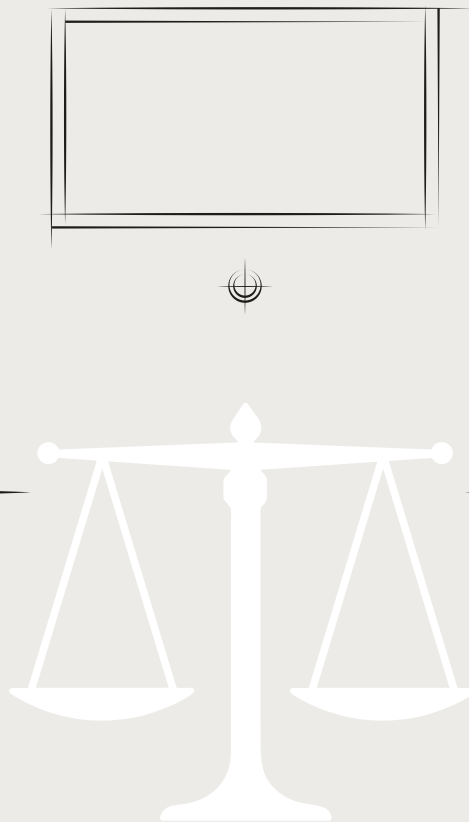


AUDIO VISUAL LINK SUITES IN CUSTODIAL CONTEXTS

BASIC ERGONOMIC AND TECHNICAL RECOMMENDATIONS



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We are a multi-disciplinary design team who work collaboratively. It is the diverse voices that bring quality to this work and we request the work is attributed collectively to the team, the client and stakeholders.

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1. INTRODUCTION

This document stems from a collaboration between the Audio Visual Link (AVL) Project group within Justice NSW and the Designing Out Crime research centre (DOC) at the University of Technology Sydney (UTS). The AVL Project group is tasked with transforming the NSW justice system to one that utilizes AVL technology and systems to enable the efficient and fair administration of justice. DOC is a research centre at UTS that applies design methods and expertise to problems related to justice, safety and community wellbeing. Based on a recognition by the AVL Project group that the physical design of AVL suites within custodial facilities impacts on the efficient and fair administration of justice, the DOC team was engaged in this project to assist in creating some initial design recommendations that could be used to inform the design of AVL suites in NSW.

Project Overview

The purpose of this project is to provide initial ergonomic and technical recommendations for custodial AVL suites. The recommendations are intended for use in assessing current facilities and contributing to the design of new AVL facilities in juvenile and adult custodial facilities. The research and testing was focused on AVL suites used to connect a person in custody with a court for a legal appearance. This included the use of the AVL suite to connect a person in custody with a legal practitioner, but contact with a health practitioner or other type of professional visit was not considered. Similarly, visits from family and loved ones was outside the scope of this work.

The recommendations were developed using a combination of review of academic and industry practice literature relevant to AVL facilities and the testing of general configurations of an AVL custody suite using a full-scale adjustable mock-up. A summary of each of these methods is provided in the attachments.

The research and associated recommendations in this document have a number of limitations that relate to scope. This includes a primary focus on ergonomics without close consideration of surrounding procedures and functions of justice as well as specific limitations related to the methods for creating some of the various individual recommendations.

Situating The Recommendations

Custodial audio-visual link (AVL) suites are the dedicated physical spaces within custodial facilities where people connect with a court to participate in legal proceedings. Most adult and juvenile custodial facilities in NSW currently have an audio-visual link (AVL) suite or suites. It is critical to the operation of the justice system that these AVL suites support and enable the effective and fair administration of justice.

The design of the AVL spaces and equipment has a significant impact on the quality of experience and communication between all parties. This document offers preliminary recommendations on basic technical and ergonomic qualities of these AVL suites. The recommendations are based on a review of the practice and academic literature on AVL suite type environments and, where key parameters could not be easily determined from this literature, semi-formal testing using a full scale AVL suite mock-up.

The basic technical, ergonomic and comfort recommendations offered within this document are general in nature. There are many design considerations not covered by these recommendations that impact on the effective and fair administration of justice. It is critical that these broader design considerations related to the justice process are also considered when designing new AVL suites.

The ergonomic and technical recommendations in this document also relate specifically to the typical AVL suite arrangements currently employed in

1. INTRODUCTION

custodial settings. It is quite possible, and potentially desirable, that other spatial configurations, types of technology and amenity will be provided in these facilities in the future. As such, this document should not be used as a reason not to use, or consider the use of, alternative environments for AVL contact in the future.

The next section outlines important broader considerations that relate to the design and use of AVL suites within the justice system. Section 3 and 4 describe respectively the recommendations based on the mockup testing and those based on the literature search. Attached with the document is a comprehensive bibliography and a description of the procedures and observations related to the three main mock-up tests.

2. CUSTODIAL AVL SUITES IN THE JUSTICE SYSTEM

Custodial AVL suites are situated and operate within a broader justice system. In this section we highlight some of the major themes and considerations related to AVL suites in the justice system. In so doing we want to situate these ergonomic recommendations in this larger context, while also drawing attention to other important design and process issues beyond the scope of this document. In this regard New South Wales is fortunate to have two court and criminology experts, Dr Emma Rowden and Carolyn McKay, who have conducted research into the design, operation and experience of custodial AVL facilities. This discussion draws largely on their work.

Custodial AVL Suites Are A Court Space In Law

Under NSW law a custodial AVL suite while in use is considered to be part of the court space.¹ This means that the judicial officer has responsibility and oversight of the custodial AVL suite including holding participants to the same expectations around appropriate court behaviour as in the courtroom. Therefore a principle of 'equivalence to' or 'improvement upon' the in-person experience of court proceedings should prevail for an AVL connection.² This extends to the experience of those in the courtroom as well as the participants within the custodial AVL suite. Achieving at the very least equivalence of the in-person court experience

is challenging and requires careful consideration of the design of the technology, the built environment, the legal and physical processes as well as the training of staff and the enactment of judicial rituals.³

Enabling Procedural Justice

Whether the design and operation of an AVL suite enables the effective and fair administration of justice can be conceptualized and assessed against the principles of procedural justice (Rowden 2011; Rowden et al 2013). In multiple studies Tyler 2007-2008 has shown that participant's perceptions of neutrality, respect, fairness, and the opportunity to have a voice and be heard, are shown to relate to the success of the justice process. Poorly designed and operated AVL suites are likely to impact negatively on perceptions of fairness, neutrality, the ability to be heard and have a voice, ultimately diminishing overall perceptions of the justness of the system (Rowden 2011; Rowden et al 2013).

The Impacts Of AVL Suite Design

In a custodial AVL suite the court process is communicated through specific AVL equipment (screens, camera, speakers and microphones) situated in particular physical settings (rooms of different sizes, furnishings, acoustic properties, natural or artificial lighting levels). Variations in the set-up of the AVL equipment, how it is used during

1. Evidence (Audio And Audio Visual Links) Act NSW 1998, s5C; Attorney General's Department of NSW (2005). *NSW Criminal Trials Benchbook: Remote Witness Facilities, operational guidelines for Judicial Officers*. Pdf file downloaded on 12/05/2010 at http://www.judcom.nsw.gov.au/publications/benchbks/criminal/evidence_given_by_alternative_means.html#p1-384
2. This principle has been articulated in the Netherlands as "True-to-Life", see: van Rotterdam, P., & van den Hoogen, R. (2011). *True-to-life requirements for using videoconferencing in legal proceedings*. In S. Braun & J. L. Taylor (Eds.),

Videoconference and remote interpreting in criminal proceedings (pp. 187-197). Guildford: University of Surrey. Accessed on 17/08/11 at <http://www.videoconference-interpreting.net/BraunTaylor2011.html>

3. For further information, see: Emma Rowden (2011). *Remote Participation and the Distributed Court: an approach to court architecture in the age of video-mediated communications*. Unpublished PhD Thesis. University of Melbourne, Melbourne. Abstract available at <http://repository.unimelb.edu.au/10187/11155>

2. CUSTODIAL AVL SUITES IN THE JUSTICE SYSTEM

proceedings and the physical qualities of the AVL suite and courtroom can impact dramatically on what is experienced and perceived of the court proceedings (McKay 2013, McKay forthcoming, Poulin 2004). The framing of the remote participant onscreen, how well eye-contact has been able to be replicated, the extent to which the person has a sense that they are in-court, are all factors that can impact upon the remote defendants' behavior and their perception of the court experience (Rowden 2011; Rowden et al 2013). While the ergonomic considerations discussed in this document affect the experience of AVL participants, undoubtedly there are many broader design and operational factors that also impact on the experience and need to also be considered. This includes the AVL studio needing to reflect the dignified space and furnishings of a courtroom (McKay, 2016).

Tensions

Within the broader justice system there are tensions regarding the use of custodial AVL suites and remote (as opposed to in-person) participation in court proceedings. Concern exists among participants and practitioners that appearance via an AVL facility could prejudice decision making (McKay 2015). Many within the system, for example, regard participation via an AVL facility in trials, negatively. In contrast to these concerns, there are also a lot of practitioners and defendants who report as preferable appearing at court via AVL facilities. Further complicating these decisions are the costs associated with facilitating in-person appearances by those in prison or juvenile justice centres, and the considerable savings of instead using an AVL facility.

3. RECOMMENDATIONS FROM MOCKUP TESTING

Intentions Of Mockup Testing

The initial literature search provided the basic foundation for numerous criteria whilst also highlighting areas within the design of an AVL suite that had little or no precedent. Certain fundamental criteria presented complexity and interrelation with one another that further literature research could not resolve. For these reasons, a full scale mockup prototype was built and used to test various parameters. The following key criteria were tested with the mockup:

- Room dimensions
- Seating position
- Table inclusion and position
- Display position
- Display image position
- Camera position

Additional information and rationale about the inclusion of a table within the AVL suites for all tests is provided in Attachment B.

Testing Description

Each of the above criteria was put through three stages of testing:

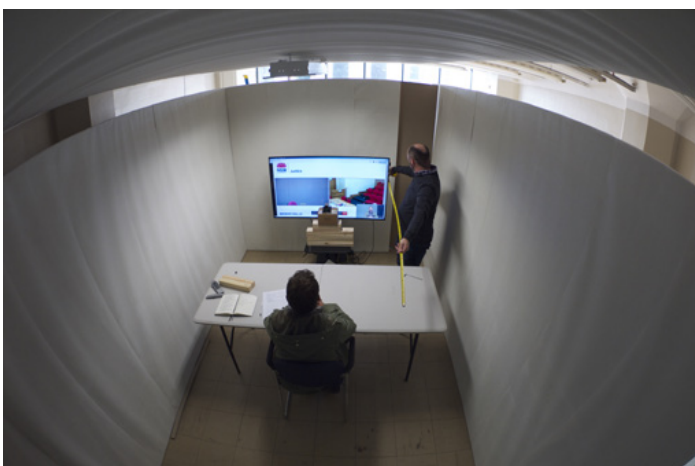
- Initial internal evaluation from the DOC research team to set basic parameters
- External testing with surveys to gauge perception of the various criteria

- Internal validation of the ideal scenarios with the DOC research team to refine and confirm parameters

A full scale prototype mockup of an AVL suite facilitated the testing procedure. The room had adjustable walls with a maximum size of 4m x 4m and room sizes of any increment up to this maximum size could be tested with seating and table placement also flexible within these parameters. An adjustable AVL mount was also provided to allow for various display and camera tests. Constraints during mockup construction included the requirement that the mockup be later moved from the DOC research centre to the Downing Centre; hence a modular design was used for the walls. A full description of the mockup and testing procedures are provided in Attachments A, B and C.

The above six criteria (i.e. room dimensions etc.) were tested for three broad AVL suite set-ups. The three setup were:

- 55" display with single participant (replicate adult custodial court suite with larger screen)
- 32" display with single participant (replicate juvenile/ adult custodial legal suite with small screen)
- 55" display with a single participant and two support staff (replicate juvenile custodial court suite with larger screen)

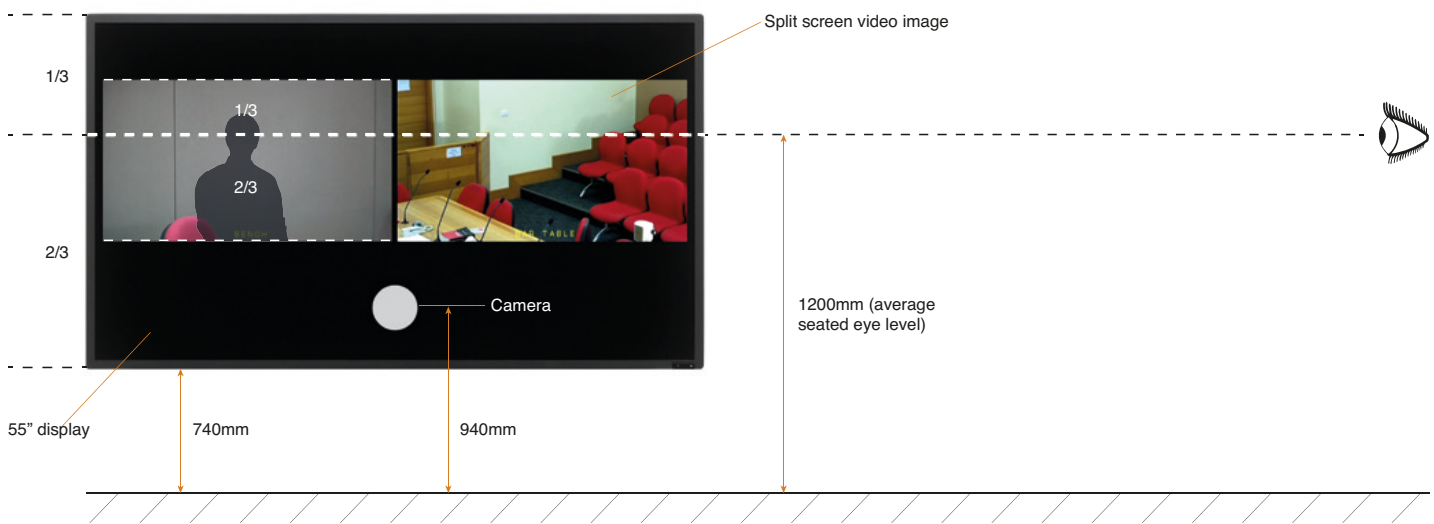


3. RECOMMENDATIONS FROM MOCKUP TESTING

3.1 SINGLE PARTICIPANT + 55" DISPLAY (COURT SUITE)

	RECOMMENDATION	CONSIDERATIONS
Room Dimensions	<ul style="list-style-type: none"> Width 2200mm ^C Depth 3600mm ^C 	<ul style="list-style-type: none"> Provides for 800mm circulation space between back of chair and rear wall Room height was set at 2400mm and not tested
Seating position	<ul style="list-style-type: none"> 2400mm from display to front of backrest ^B Positioned laterally to centre line of display & room ^B 	<ul style="list-style-type: none"> Based on standard multi-purpose seat height of 450mm
Table	<ul style="list-style-type: none"> 2050mm from table edge (seated side) to display ^B 	<ul style="list-style-type: none"> Table position determined based on provision of moveable or sliding seat with backrest
Display position	<ul style="list-style-type: none"> Height of display is 1200mm (measured from floor) at 2/3 distance from lower edge of display ^A Laterally positioned to centre line of room ^A 	<ul style="list-style-type: none"> Specified so bottom two thirds of display are below average person's eye height (1200mm) See below for diagrammatic explanation
Display image position	<ul style="list-style-type: none"> Vertical positioning of image on display is 1200mm (measured from floor) at 2/3 distance from lower edge of image ^A 	<ul style="list-style-type: none"> 'Display image' is actual video image of the court on the display Specified so bottom two thirds of image are below average person's eye height (1200mm) See below for diagrammatic explanation
Camera position	<ul style="list-style-type: none"> Vertically positioned 940mm from floor to centre of lens ^A Laterally positioned to centre line of display ^A 	<ul style="list-style-type: none"> Specified to minimise gaze angle between screen and camera based on 1200mm average seated eye height Specified to be recessed in front of display bottom section Based on 450mm seat height

** 55" display was 450mm proud of wall



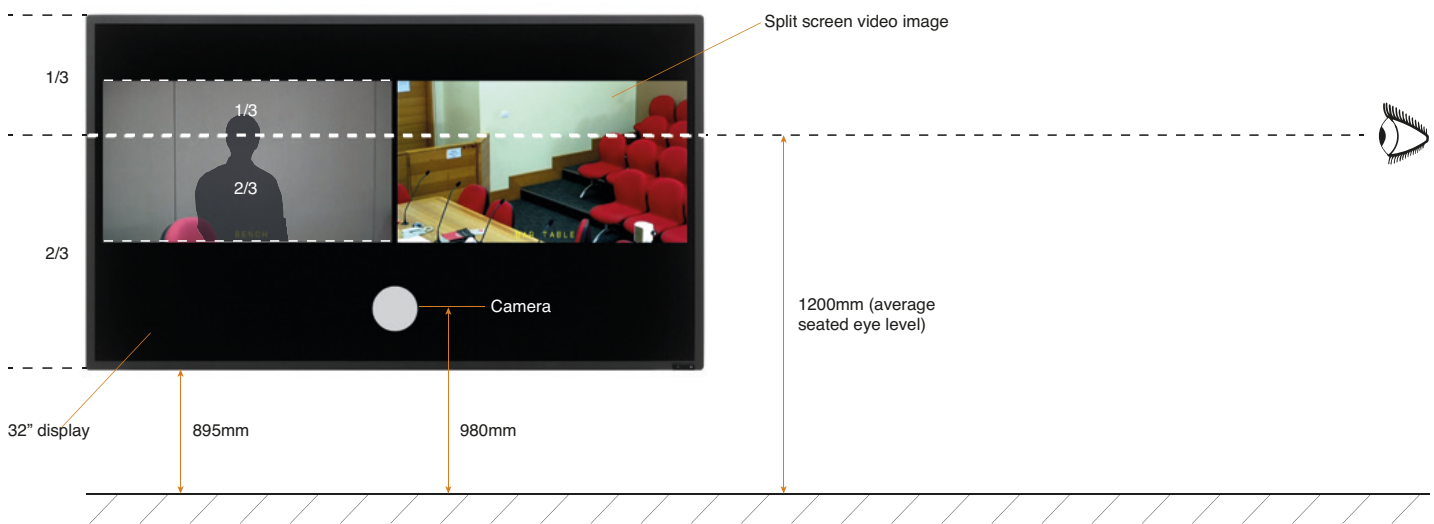
** diagram not to scale

3. RECOMMENDATIONS FROM MOCKUP TESTING

3.2 SINGLE PARTICIPANT + 32" DISPLAY (LEGAL SUITE)

	RECOMMENDATION	CONSIDERATIONS
Room Dimensions	<ul style="list-style-type: none"> Width 1800mm ^C Depth 3000mm ^C 	<ul style="list-style-type: none"> Provides for 1000mm circulation space between back of chair and rear wall Room height was set at 2400mm and not tested
Seating position	<ul style="list-style-type: none"> 1850mm from display to front of backrest ^B Positioned laterally to centre line of display & room ^B 	<ul style="list-style-type: none"> Based on standard multi-purpose seat height of 450mm
Table	<ul style="list-style-type: none"> 1500mm from table edge (seated side) to display ^B 	<ul style="list-style-type: none"> Table position determined based on provision of moveable or sliding seat with backrest
Display position	<ul style="list-style-type: none"> Height of display is 1200mm (measured from floor) at 2/3 distance from lower edge of display ^A Laterally positioned to centre line of room ^A 	<ul style="list-style-type: none"> Specified so bottom two thirds of display are below average person's eye height (1200mm) See below for diagrammatic explanation
Display image position	<ul style="list-style-type: none"> Vertical positioning of image on display is 1200mm (measured from floor) at 2/3 distance from lower edge of image ^A 	<ul style="list-style-type: none"> 'Display image' is actual video image of the court on the display Specified so bottom two thirds of image are below average person's eye height (1200mm) See below for diagrammatic explanation
Camera position	<ul style="list-style-type: none"> Vertically positioned 980mm from floor to centre of lens ^A Laterally positioned to centre line of display ^A 	<ul style="list-style-type: none"> Specified to minimise gaze angle between screen and camera based on 1200mm average seated eye height Specified to be recessed in front of display bottom section Based on 450mm seat height

** 32" display was 140mm proud of wall



** diagram not to scale

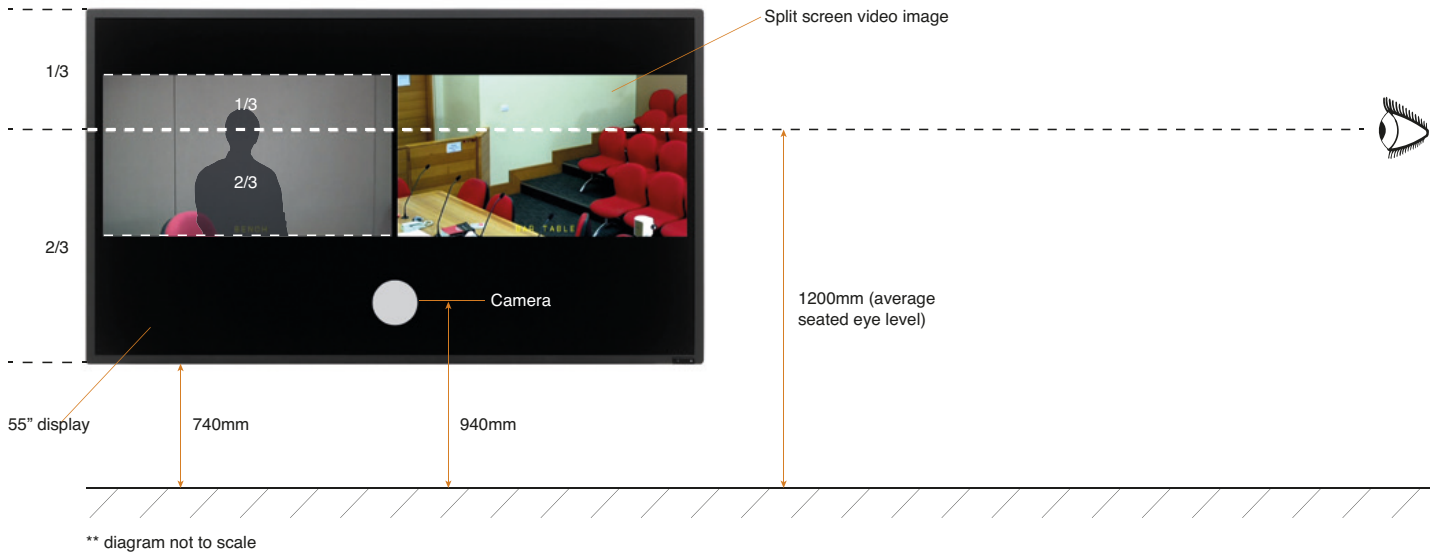
3. RECOMMENDATIONS FROM MOCKUP TESTING

3.3 SINGLE PARTICIPANT, TWO SUPPORT PEOPLE + 55" DISPLAY (COURT SUITE)

	RECOMMENDATION	CONSIDERATIONS
Room Dimensions	<ul style="list-style-type: none"> Width 2800mm ^C Depth 4200mm ^C 	<ul style="list-style-type: none"> Room height was set at 2400mm and not tested
Participant seating position	<ul style="list-style-type: none"> 2400mm from display to front of backrest ^B Positioned laterally to centre line of display & room ^B 	<ul style="list-style-type: none"> Based on standard multi-purpose seat height of 450mm
Support people seating position	<ul style="list-style-type: none"> 1600mm behind participant seat (backrest to backrest) ^B 500mm lateral spacing (centre to centre) ^B 	
Table	<ul style="list-style-type: none"> 2050mm from table edge (seated side) to display ^B 	<ul style="list-style-type: none"> Table position determined based on provision of moveable or sliding seat with backrest
Display position	<ul style="list-style-type: none"> Height of display is 1200mm (measured from floor) at 2/3 distance from lower edge of display ^A Laterally positioned to centre line of room ^A 	<ul style="list-style-type: none"> Specified so bottom two thirds of display are below average person's eye height (1200mm) See below for diagrammatic explanation
Display image position	<ul style="list-style-type: none"> Vertical positioning of image on display is 1200mm (measured from floor) at 2/3 distance from lower edge of image ^A 	<ul style="list-style-type: none"> 'Display image' is actual video image of the court on the display Specified so bottom two thirds of image are below average person's eye height (1200mm) See below for diagrammatic explanation
Camera position	<ul style="list-style-type: none"> Vertically positioned 940mm from floor to centre of lens ^A Laterally positioned to centre line of display ^A 	<ul style="list-style-type: none"> Specified to minimise gaze angle between screen and camera based on 1200mm average seated eye height Specified to be recessed in front of display bottom section Based on 450mm seat height

** 55" display was 450mm proud of wall

3. RECOMMENDATIONS FROM MOCKUP TESTING



4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

Intentions Of Literature Search

The literature search aimed to identify and investigate a large number of AVL related documents to identify ergonomic and technical criteria relevant to developing recommendations for AVL suites in custody. This included searching literature from industry, academia and practice in the justice and other related sectors.

Description Of Literature Search

Initial searches uncovered a number of industry publications related to the design and configuration of AVL suites within justice contexts in Australian states. These publications were used to develop an initial framework of ergonomic criteria (i.e. lighting levels, seat heights) and the associated search terms. The ergonomic criteria were organised in a table so that for each criteria any potentially relevant recommendations and considerations from a publication could be collated identifying the associated source. The document and initial set of criteria were subsequently added to through the review of the literature and consultations with various stakeholders with expertise in this area. Initial searches often started within the justice sector but then extended into related publications in other sectors such as business, health and education. While the purpose for use of AVL in these other sectors is different, the ergonomic considerations for the efficient and comfortable use of the technology within a discrete room were very similar. After two to three weeks of searching, the returns from additional searches using new search terms rarely found new publications. The literature search summary is provided in full in Attachment D that includes page number of any recommendations and considerations.

Specifying Recommendations From The Literature Search

Using the full literature search table, a process of consolidation was undertaken to identifying ergonomic recommendations and considerations. This included combining recommendations/considerations with the same meaning and those that were less relevant to the scope and purpose of the document. A number of peer review processes of decision making was made within the team.

4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

4.1 SPATIAL

4.1.1 Doors

	RECOMMENDATION	CONSIDERATIONS
Size	<ul style="list-style-type: none"> 2040x920x50mm ³³ 	<ul style="list-style-type: none"> 850mm is the minimum for wheel chair access Width of 920mm is oversized and commonly used in Police contexts
Type	<ul style="list-style-type: none"> Solid core flush panel 	<ul style="list-style-type: none"> Required for acoustic performance
Location	<ul style="list-style-type: none"> Ensure door position does not result in distraction for participant and/or viewer 	<ul style="list-style-type: none"> Avoid the door being in camera view ^{4,9} Place near rear of room - not in participant view ²¹ If external window required, ensure external movement does not distract participant and/or viewer Provide an entry sequence that ensures safety and privacy ³⁸
Seals	<ul style="list-style-type: none"> Seal gaps around entire door and frame to limit sound transfer ^{15, 33} 	<ul style="list-style-type: none"> Acoustic performance

4.1.2 Furniture

	RECOMMENDATION	CONSIDERATIONS
Table type	<ul style="list-style-type: none"> Provide table that is light in color and is not reflective 	<ul style="list-style-type: none"> Avoid high contrast (i.e white, black, strong colours) ^{1, 4, 9, 21, 28}
Table location	<ul style="list-style-type: none"> Place table directly in front of AVL participant seating ³⁸ 	<ul style="list-style-type: none"> Desk location will effectively specify seat position when seat is not fixed Fixing table is typical in most contexts
Seating type	<ul style="list-style-type: none"> Comfortable chair with backrest and non-swiveling action ³⁸ 	<ul style="list-style-type: none"> Swiveling action can lead to distracting movement All seats in standard suites must have a backrest If seat is fixed it should have a sliding action Seats should be height adjustable – essential in juvenile justice centres Removable for wheelchair access
Seating position	<ul style="list-style-type: none"> Varies with size of screen and related to displayed image (see Section 4 for examples) 	<ul style="list-style-type: none"> Allow participant's gestures to be communicated ³⁸ Interaction of visual field and screen size with seating position. Seating position should lead to screen being in normal field of view

4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

4.1.3 Surfaces

	RECOMMENDATION	CONSIDERATIONS
Walls	<ul style="list-style-type: none"> Even light colour 	<ul style="list-style-type: none"> Acoustic panels should also be light in colour ⁴ Avoid reflective surfaces, bright colours, complex patterns, bold textures and high contrast elements ^{7, 9, 28, 30, 31} Frames and skirting colour should be similar to walls ³³
Background wall	<ul style="list-style-type: none"> Paint colour 'Duck Egg Blue' ¹⁵ 	<ul style="list-style-type: none"> Allows for better recognition of AVL participant by camera ¹⁶
Ceiling	<ul style="list-style-type: none"> Standard ceiling white, if painted 	<ul style="list-style-type: none"> Frames and skirting colour should be similar to walls ³³
Flooring	<ul style="list-style-type: none"> A formal floor covering with good acoustic qualities 	<ul style="list-style-type: none"> Typically carpet is used ^{1, 15, 16, 21, 23, 28, 30, 36}
Durability	<ul style="list-style-type: none"> Appropriately durable for context 	<ul style="list-style-type: none"> Give preference to finishes that can be repaired and cleaned on site ²³

4.1.4 Accessibility

	RECOMMENDATION	CONSIDERATIONS
Accessibility	<ul style="list-style-type: none"> Provide ingress/egress according to wheelchair requirements 	<ul style="list-style-type: none"> Avoid unnecessary furniture or clutter in the room ^{21, 30, 36} Removable chair ¹⁴ Minimum wheel chair accessible door size is 850mm (AS 1428.1-2009) 180 degree turning circle for wheel chair is 1540 by 2070mm (AS 1428.1-2009)

4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

4.2 ENVIRONMENTAL

4.2.1 Lighting

	RECOMMENDATION	CONSIDERATIONS
Illuminance	<ul style="list-style-type: none"> Vertical illuminance of 500lux^{9,26} 	<ul style="list-style-type: none"> Measured at head height, facing camera³⁸ Note: Considerable variation in literature
Colour temperature	<ul style="list-style-type: none"> >5600K^{21,38} 	<ul style="list-style-type: none"> Provide consistent colour temperature across all fittings^{21,38} Utilise daylight coloured lighting^{21,38} Cameras work best in the >5600K colour temperature range¹
Type & Positioning	<ul style="list-style-type: none"> Use a variety of primarily indirect light sources out of camera view 	<ul style="list-style-type: none"> Lighting of different intensity in front of participant highlight and reduce shadows on face³⁸ Use backfill lighting to increase contrast between participant and background³⁸ Avoid direct fluorescent and bright LED lighting that creates harsh shadows^{4,28} Minimal direct light on participant, documents and camera lens^{5,16,21,24}
Windows	<ul style="list-style-type: none"> Windows should be positioned to limit any direct sunlight 	<ul style="list-style-type: none"> Prevent direct sunlight in camera view^{1,35,38} South facing windows³⁸ Avoid varying sunlight from affecting display viewing conditions²⁷ Where windows let in direct sunlight, install opaque blinds or curtains^{1,7,21,28,35,38}

Lighting is governed by the Australian and New Zealand Standards - AS/NZS 1680 for Lighting (as amended) and the government and building codes.

- AS/NZS 1680.2.1:2008 (as amended) Interior and workplace lighting - Specific applications - Circulation spaces and other general areas.
- AS/NZS 1680.2.2:2008 (as amended) Interior and workplace lighting - Specific applications - Office and screen-based tasks.

4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

4.2.2 Acoustics

The following acoustic recommendations refer to two different categories; firstly, the internal acoustics (the behaviour of sound produced within the room) and secondly, the sound proofing (the transfer of sound through the external walls of the suite). Some recommendations will cover both areas.

RECOMMENDATION	CONSIDERATIONS
<i>Internal acoustics:</i>	
Internal room noise	<ul style="list-style-type: none"> Room noise below 40 decibels (A weighted) (dB(A)) at microphone ⁴ Keep ambient sound to a minimum ⁷ Avoid sound-dead room ⁷
Desired acoustic qualities	<ul style="list-style-type: none"> Provide conditions for effective listening and intelligible speech ^{4, 7, 23, 38} Reduce reverberation time, flutter echo and comb filter effects Utilise software with noise reduction and echo cancellation algorithms
Treatment of room acoustics	<ul style="list-style-type: none"> Install acoustic wall panels ^{1, 4, 15, 16, 21, 28, 31, 38} Mineral wool makes for effective acoustic panels for both walls and ceiling Distribute the absorption elements about the walls, avoid absorption clusters ³⁰ Stagger acoustic tiles over approximately 50% of wall surfaces ⁴
Speech intelligibility	<ul style="list-style-type: none"> Ensure high speech intelligibility ^{4, 7, 23, 38} Utilise software with noise reduction and echo cancellation algorithms Allow communication to be clearly understood, not just of appropriate volume ¹ Measure Speech Transmission Index (STI) to be no less than 0.6, with a desired score of 1.0 ⁷
<i>Sound proofing:</i>	
External and services noise	<ul style="list-style-type: none"> Allow for the AVL suite to be free of distraction from extraneous and ambient noises Noise ingress from external sources <30dB(A) ^{4, 7, 23, 38} DnTw50 minimum level difference between AVL suite and adjacent spaces ^{23, 38} Sound level for air conditioning 35dB(A) maximum ³⁸ Install diffusers for Heating, Ventilation and Air Conditioning (HVAC) systems and maintain low air velocities ^{4, 30, 31}
Wall and ceiling insulation	<ul style="list-style-type: none"> Walls should have a sound insulation of 48 weighted apparent sound reduction index (R'w≥48dB) ²¹ Recommended type is 1" thick densecore fiberglass batons within wall and ceiling cavity ⁴ Mineral wool acoustic panels on wall and ceiling surface will also assist in sound proofing
Door specification	<ul style="list-style-type: none"> Door should have a sound insulation of R'w ≥ 38 dB ^{1, 21} A solid wood door will allow much less sound to pass through it than a thin hollow one Seal gaps around entire door and frame to limit sound transfer

4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

- *AS/NZS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors*
- *AS/NZS ISO 717.1:2004 Acoustics - Rating of sound insulation in buildings and of building elements- Airborne sound insulation.*

4.2.3 Thermal

	RECOMMENDATION	CONSIDERATIONS
Heating	<ul style="list-style-type: none">• Maintain a temperature of 23.5°C in summer and 21.5°C in winter $\pm 1^\circ\text{C}$ ²³• Relative humidity of 40-60% ²³	<ul style="list-style-type: none">• Allow additional 5275 Kilojoules of cooling capacity for AVL equipment ^{4, 21}
Cooling		<ul style="list-style-type: none">• Cooling will need to compensate for heating caused by AVL equipment ^{4, 21}
Ventilation	<ul style="list-style-type: none">• Air velocity 0.1-0.25m/s measured 1.0-1.5m above floor level ²³	
Smoke detection		<ul style="list-style-type: none">• Potential need for smoke alarm installed in such a way as not offering a hanging point ¹⁴

Subject in part to National Construction Code – Section J Energy Efficiency.

- *Australian Standard AS1668.2: The use of ventilation and air-conditioning in buildings.*

4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

4.3 AVL EQUIPMENT

	RECOMMENDATION	CONSIDERATIONS
Codec	<ul style="list-style-type: none">• Support video codecs H.261, H.263, H.263+, H.263++, H.264, H.265• Support these audio standards as minimum: G.711, G.722, G.722.1, G.728²³• Video Conference equipment supports H323 and/or SIP protocol	<ul style="list-style-type: none">• Provide synchronised audio and video data^{5, 8, 12}• Allow speedy coding to avoid delays during encoding and decoding^{5, 8, 12}

4.3.1 Video Display

	RECOMMENDATION	CONSIDERATIONS
Display size	<ul style="list-style-type: none">• Participant seating should be no closer than 2x the display diameter and no farther than 8x the display diameter⁴• Participant distance 2-3x display diameter⁹• Viewing distance should be such that the angle formed between left & right screen edges is between 30-50°²⁵	<ul style="list-style-type: none">• Display should be large enough to allow facial expressions to be legible³⁸• Avoid having seating too close to display to avoid a skewed and unnatural camera angle²¹• Slight eye movement could increase immersion in video conversation²⁵
Display features	<ul style="list-style-type: none">• High definition 1080p resolution, 16:9 aspect ratio^{7, 21, 38}• Picture in picture mode^{12, 16, 20, 35}• Tilt function, -5° to +20°²⁶	<ul style="list-style-type: none">• Low reflectivity, matte finish screen^{7, 38}• Support multiple signal formats²¹• Allow AVL participant to see the camera view of themselves^{12, 16, 20, 35}

4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

4.3.2 Audio Speakers

	RECOMMENDATION	CONSIDERATIONS
Loudspeaker features	<ul style="list-style-type: none"> Speakers fitted on either side of display ¹² 	<ul style="list-style-type: none"> Speakers must be co-located with display and microphone for a natural communication experience ^{31, 38} Avoid creating audio feedback loop ³¹ Present 80-85dBA-SPL, with peak reserve of 15-20dB ⁴
Frequency range	<ul style="list-style-type: none"> Frequency range of at least 130Hz-12kHz ³⁸ 	<ul style="list-style-type: none"> The use of in-built speakers within the video display is strongly discouraged
Adjustable volume	<ul style="list-style-type: none"> Allow for volume adjustment ^{16, 17, 38} 	<ul style="list-style-type: none"> Provide information making clear that this feature is available Provide volume control in AVL suite

4.3.3 Camera

	RECOMMENDATION	CONSIDERATIONS
Camera features	<ul style="list-style-type: none"> High definition camera with at least 720p resolution ³⁸ Autofocus ⁵ 	<ul style="list-style-type: none"> Establish pre-set camera configurations for participants of various statures ³⁸ View of participant should be cropped on the torso, allowing for hand gestures to be seen. Avoid showing too much of the room within the background or elements within the room which may cause distractions. ^{5, 20}
Camera location	<ul style="list-style-type: none"> Mount with stable bracing and vibration dampeners ³⁵ 	<ul style="list-style-type: none"> AVL participant's face should be clearly visible to camera. If the camera is behind protective material, ensure it does not reduce image quality or create visual barriers ^{34, 35}
Document viewer/signature device (if required)	<ul style="list-style-type: none"> Provide small screen on table to view documents and/or electronically sign documents ^{7, 12, 16, 21, 38} 	<ul style="list-style-type: none"> View written, drawn or photographic material Could be operated by other end of AVL connection, i.e. court clerk or otherwise

4. RECOMMENDATIONS FROM THE LITERATURE SEARCH

4.3.4 Microphone

	RECOMMENDATION	CONSIDERATIONS
Microphone type	<ul style="list-style-type: none"> Omnidirectional ceiling mounted microphone used in conjunction with audio processing ^{16, 38} 	<ul style="list-style-type: none"> Prioritise speech intelligibility by installing a microphone with a wide pickup pattern ³⁸ Avoid using over sensitive microphones ^{3, 31} Take care with ceiling mounted items that might provide hanging points ¹⁴ Not fitted with a mute button ¹²
Microphone position	<ul style="list-style-type: none"> Position microphone close to participant seating, away from other noise sources ³⁸ 	<ul style="list-style-type: none"> Microphone should be out of camera view and should be placed so as to not distract participant ³⁸

4.3.5 Other

	RECOMMENDATION	CONSIDERATIONS
Cable management	<ul style="list-style-type: none"> Equipment wiring and cabling to be securely managed and contained ⁵ 	<ul style="list-style-type: none"> Equipment should have a designated space and not require major repositioning ⁵
Power outlets	<ul style="list-style-type: none"> One double power outlet minimum ³³ 	<ul style="list-style-type: none"> Located close to AVL equipment ³³
Data access points	<ul style="list-style-type: none"> Two data access points minimum ³³ One 100Mbps or 1Gbps Ethernet port ^{8, 30} 	<ul style="list-style-type: none"> Located close to AVL equipment ³³ Provide high bandwidth of transmission such that audio and video quality is not restricted ^{8, 30}

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ATTACHMENT A: TESTING DESCRIPTION FOR AVL EQUIPMENT POSITIONING (DISPLAY & CAMERA)

Overview

This section includes testing description of the following three elements: display diameter size, display height from ground, camera placement. The literature scan that was conducted in the earlier stages of this project produced data for these criteria that was slightly contradictory, hence testing aimed to collect observational data to be able to provide accurate and appropriate recommendations.

It was determined to be crucial that the positioning of AVL equipment was tested before other criteria being tested; a clear chronology of testing was established as a result of dependencies that criteria had on one another. Ergonomic standards would help determine AVL equipment positioning; placement of AVL equipment formed a foundation for testing of viewing distance; finally, room size was tested based on parameters set by the other criteria.

AVL equipment testing was conducted for both 32" (legal suite) and 55" (court suite) diameter displays with separate testing and surveys enabling clear comparisons and contrasts to be drawn between the two sizes. For each of the displays a range of display heights and camera positions were tested using the procedure described below.

Procedure

Stage I – Initial Testing

The primary purpose of this stage of testing was to establish parameters within which the next stage of testing could occur. DOC research team situated each of the displays in the mockup space in order to set and evaluate various settings for the camera and display. Dimensions for camera placement and display height were based on discussions around gaze angle, perceived eye movement, participant

posture, bodily gestures and overall comfort. Camera positioning was trialed in various positions on all sides of the display.

Stage II – External User Testing

Subsequent to setting basic parameters for criteria in the previous stage of testing, this stage aimed to further test the criteria to gauge perceptions on initial dimensions. A survey was given to 12 random participants with rating scales used to measure perception on a few key questions. In particular, ratings were provided on display height, with options ranging from 'too low' to 'too high'. Different participants were engaged to test the two different display sizes, with a rating on image clarity included to gauge display size preference in an unbiased manner. Participants also made comment on camera placement through judgement of their self-view present on screen.

Stage III – Ideal Scenario Testing

Results from the second stage of testing allowed for adjustment of initial dimensions according to user perceptions. This stage of testing involved the testing of these adjusted dimensions with a view to further refining these dimensions where necessary. Ideal scenario testing was conducted such that all the various criteria could be evaluated holistically in the mockup environment. All criteria invariably interacted with one another – as a result final refinements were made considering these elements in the space together.

Findings & Considerations

Camera Placement

- Single participant + 55" display: 940mm (from ground to centre of lens); laterally positioned to centre line of display
- Single participant + 32" display: 980mm (from

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ground to centre of lens); laterally positioned to centre line of display

- Single participant, two support people + 55" display: 940mm (from ground to centre of lens); laterally positioned to centre line of display

Preliminary literature research suggested that the camera should be co-located with the display – that is to be placed as close to the display as possible in order to enable a more realistic conversation. This placement was found to vary with the size of display used as there is an intimate spatial relationship between the two pieces of equipment.

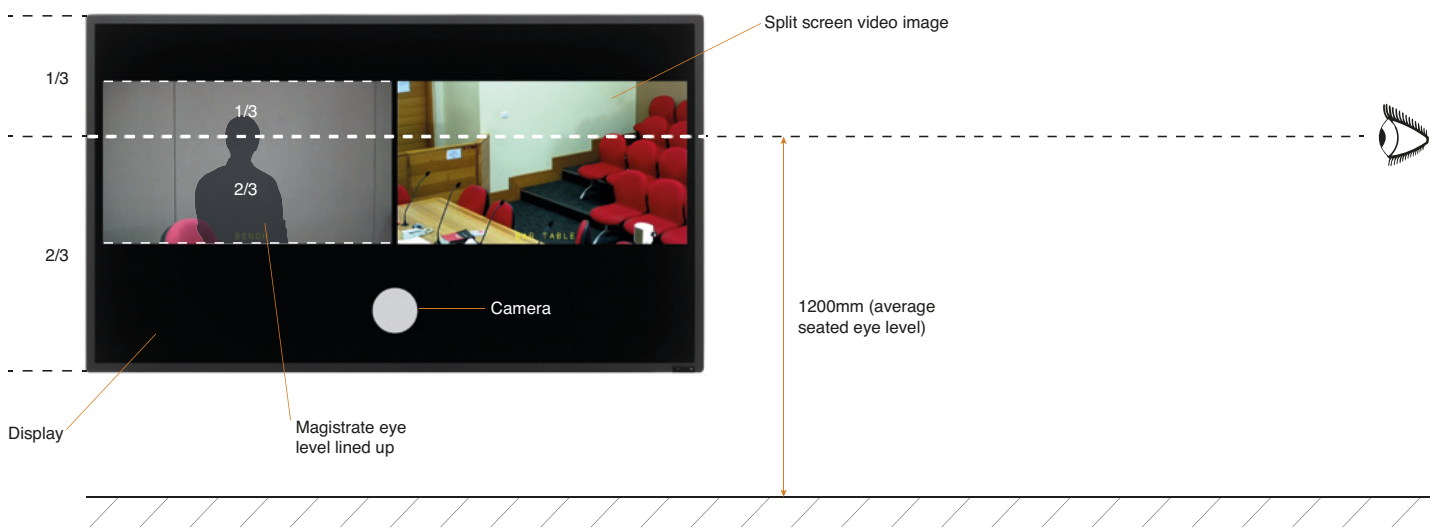
A neutral view of the participant is desired; too low a camera angle could be unflattering, while too high a camera angle could be seen as inherently punitive. Through testing it was found that the ideal position for the camera was to the bottom of the display, recessed above the bezel so that the camera is actually sitting in front of the lower display. This slightly recessed placement acts to create a smaller gaze angle; the closer the participant is sitting the more recessed the camera would need to be placed for an acceptable gaze angle.

Display Height

- For all scenarios: height of display is 1200mm (measured from floor) at 2/3 distance from lower edge of display; laterally positioned to centre line of room

While testing display height it was quickly realised that ideal preference was dependent on seated eye level. Each person wanted the display at slightly different heights depending on their torso height. The ideal display height would by necessity need to be based on average ergonomic data for seated eye level height. A seated eye level height of 1200mm was used as a basis for display height recommendations. Consideration was also given to the potential replication of courtroom hierarchy by placing the display slightly higher, however testing showed that a neutral placement of display would best allow for unbiased communication. To further enable unbiased communication, it was recommended to have the eye level of the magistrate on screen at the same height as the eye level of the participant in the AVL suite.

Having the display too high caused participants to crane their necks, having it too low caused them to hunch, while having the display at a middle height allowed for an upright and neutral posture. Data from research recommended that displays be placed 2/3 below eye level and 1/3 above; the split screen video images on the display were aligned to this 2/3 horizontal marker and display height adjusted accordingly to meet average seated eye level height at 1200mm. The diagram following illustrates these measurements. (Specific dimensions vary for each display size as presented in the 'Recommendations' section.)



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Display Size

Both 55" and 32" displays were tested independently, having ramifications on almost every other criteria being tested. As expected the larger of the two displays necessitated larger room sizes, seating further back, while providing a more realistic appropriation of a court appearance. Testing participants evaluated the 55" display to have on average a higher image clarity than the 32" display, with comments on an inability to see faces clearly on the smaller display. A limitation to this segment of the testing was the lack of a greater variety of display sizes as a part of the study.

ATTACHMENT B: TESTING DESCRIPTION FOR VIEWING DISTANCE & SEAT POSITION

Overview

This section includes testing description for seating position as well as the description of rationale and findings around the inclusion of a table. The literature scan provided many recommendations pertaining to the positioning of seating; many of these recommendations were directly correlated with the display size being used. Testing used these parameters to set a wide range of potential seating positions within which an accurate seating position could be determined.

The crux of an AVL conversation is the quality of connection between the participant and the AVL equipment in front of them. Seating distance will determine how well they can see what is on the display and how they are captured by the camera. The type of seat used with variables such as swivelling action, wheels, armrests, seat back and the seat height will determine in part the perception of the participant playing into their posture and presentation. For this testing a standard ergonomic seat height of 450mm was used.

Rationale For Inclusion Of Table

While experimenting with various seating positions a table was also brought in to the mockup space to see how the experience of the suite may change. The inclusion of a table increased the formality of the space for numerous reasons. With a table in the space test subjects showed a more upright posture, while the table also provided a place for documents to be placed. Participants generally placed their hands on the table allowing for gestures to be captured by the camera further increasing the level of formality of the space while also enabling more effective communication.

Procedure

Stage I – Initial Testing

This stage of testing intended to use the initial AVL equipment positioning as a basis upon which parameters for seating positioning could also be formed. The DOC research team individually trialed various seating positions taken from the literature search in an attempt to determine if there were any notable trends. A table was also placed into the mockup following recommendations in the literature scan and trialed in various positions. Initial seating and table positions were created through collaboration and discussions on display image clarity, ability to make out faces on display, perception of participant on camera, participant 'eyeballing' camera (as described in 'Findings'), gaze angle and general sense of comfort in space.

Stage II – External User Testing

The initial seating positions that were dimensioned in the first stage of testing were not used in this stage; rather, this stage was open ended to survey participants taking part. Individuals entered the mockup space and moved the chair from the side of the room to their preferred distance from the display. They could place the chair at any distance from the display where they were most comfortable; these distances were measured and averaged to determine what these preferences were. The table was not placed in the mockup space in order to prevent corruption of seating placement testing and to keep the focus purely on seating and viewing distance.

Stage III – Ideal Scenario Testing

Adjustments made to initial seating distances after the second stage of testing were tested in this stage of testing. All tested criteria were evaluated holistically in the mockup space during this stage of

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testing; the chair was placed as determined by the first two stages of testing and incrementally shifted where necessary to create a well functioning space as a whole. The table was again introduced to the mockup space such that it did not affect seating position and notes were taken on its affect on the AVL space and experience of the participant.

Findings & Considerations

Seating Position

- Single participant + 55" display: 2400mm (from display to front of backrest); positioned laterally to centre line of display & room
- Single participant + 32" display: 1850mm (from display to front of backrest); positioned laterally to centre line of display & room
- Single participant, two support people + 55" display:
 - Participant seating: 2400mm (from display to front of backrest); positioned laterally to centre line of display & room
 - Support people seating: 1600mm behind participant seat (backrest to backrest); 500mm lateral spacing (centre to centre)

Once camera placement and display height were adjusted to ideal settings, each of the display sizes being tested were subject to trials from various seating positions. Clarity of image, perception of participant by camera and sense of comfort in space were some of the descriptors used to determine ideal seating locations. Sitting too close to the display produced an 'eyeballing' effect whereby participant's eye movements were distractingly obvious to the camera. On the other hand, sitting too far away meant that any realistic sizing of images on the display was diminished and participants were observed squinting and leaning forward with bad posture in order to view the display. The smaller display necessitated a closer seating position.

The second stage of testing largely provided support for initial testing recommendations, with adjustments made to slightly increase the seating distance accordingly. Comments were made numerous times of the instinctual need to have an appropriate distance behind the chair to the back wall. If this distance were to be too much then participants felt there could be a threat behind them, whilst on the contrary if this distance was too little then the room felt extremely cramped.

Table Position

- Single participant + 55" display: 2050mm (from table edge on seated side to display)
- Single participant + 32" display: 1500mm (from table edge on seated side to display)
- Single participant, two support people + 55" display: 2050mm (from table edge on seated side to display)

Since having the table in the space created an automatic standard against which the seat may be pulled up against, it was best to conduct second stage testing without a table in the space at all. Once ideal room size and seating position was known, then a table was introduced to see whether or not it was preferred in the space – participants overwhelmingly supported the inclusion of a table. It was noted that the table played a large part in giving participants a sense of security during their AVL experience, whilst also mirroring how the magistrate and prosecutor on display were situated. The table should be partly captured by the camera to have a larger view of the participant and to help extend a sense of formality to the space. The recommended height for a table is 740mm, with width and depth dependent on room size.

ATTACHMENT C: TESTING DESCRIPTION FOR ROOM WIDTH AND DEPTH

Overview

This section describes the testing procedure for room width and room depth, which were tested simultaneously after initial dimensions were set for AVL equipment positioning and seating position. The literature search unveiled quite varied existing specifications for AVL room sizes, with only a limited amount of precedents and information available. The little correctional context specific research that was found helped to provide basic parameters which were supported by limited research from health and corporate contexts. As a result, the mockup testing of this criteria was very important in determining ideal specifications.

Room width and room depth serve as the foundation of the experience the participant has in the AVL space; room sizing would help determine whether or not the space is perceived as a remote space of the court. Various factors affect the determination of an appropriate room size for any of the given scenarios including both practical considerations as well as functionally subjective considerations. This testing was conducted in order to set basic recommendations for room size with considerations as will be described following.

Procedure

Stage I – Initial Testing

This initial stage of testing sought to visualise parameters set by recommendations in the literature search and in doing so set parameters for the second stage of testing. Among the dimensions being tested were room sizes currently used by Corrective Services NSW in AVL suites. Various room sizes were tested in various scenarios with both 32" and 55" displays as well as with and without two support people. The DOC research

team specified a range of room sizes to be further tested through discussion and testing of accessibility, bodily gestures, field of vision, space behind participant, perception of participant as well as general comfort.

The following five room sizes were tested in this stage:

- 900mm x 1500mm
- 1200mm x 2000mm
- 1600mm x 2500mm
- 2000mm x 3000mm
- 2400mm x 3600mm

Stage II – External User Testing

Second stage of testing room sizes involved distilling findings from the previous stage to create a framework of three measured rooms that survey participants would rate in size. The survey allowed participants to specify whether the room they were evaluating was too small, too large or somewhere in between on a scale of 1-10, as well as specifying whether width and/or depth was the cause of their response. Along with this, participants were also able to rate their general comfort in the space and were encouraged to leave critiques and suggestions. Different sizes of rooms were tested with four survey participants for each of the three scenarios as outlined below.

Single participant + 55" display:

- 1600mm x 2700mm
- 2000mm x 3000mm
- 2400mm x 3600mm

Single participant + 32" display:

- 1200mm x 2300mm
- 1600mm x 2600mm
- 2000mm x 3200mm

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Single participant, two support people + 55" display:

- 2200mm x 4200mm
- 2500mm x 4200mm
- 2800mm x 4200mm

the side of the AVL participant have a role in framing them on camera and also had an impact on survey results.

Stage III – Ideal Scenario Testing

Findings from the previous stage of testing were graphed to determine what room sizes were most preferred amongst survey participants. There were clear correlations in the data which helped to identify which room dimensions were to be further tested in ideal scenarios. Rooms were set up at dimensions specified by survey results and adjusted to further agree with comments left by survey participants. These dimensions were recorded and form the ideal specifications listed in the following section.

Findings & Considerations

- Single participant + 55" display: 2200mm x 3600mm
- Single participant + 32" display: 1800mm x 3000mm
- Single participant, two support people + 55" display: 2800mm x 4200mm

Through the entire process, testing of room size was limited to the testing of width and depth only, while the height of the ceiling was maintained at the industry standard 2400mm. The process of testing showed a majority preference towards rooms that are large enough to have space on either side of the display as well as some space behind the participant for comfort. The ideal room allowed participants to feel more comfortable, less threatened and more focused without feeling cramped or claustrophobic.

It is worth considering also that rooms that were too large in size created a feel of insecurity and isolation amongst participants, a feeling that also occurred when there was a large amount of space behind their chair. The distance of the walls behind and to

