



A Software Defined Future: Clarifying the change drivers impacting the training of Audio-visual technicians in a post converged topology

Rowan Humphrey

2014 Higher Education and Skills Group Overseas Fellowship Report

An ISS Institute Fellowship sponsored by

Higher Education and Skills Group Department of Education and Training Victorian Government



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Published by International Specialised Skills Institute, Melbourne

Extract published on www.issinstitute.org.au

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i. EXECUTIVE SUMMARY

The audio-visual industry is pervasive. Wherever a message or idea must be disseminated to others it is invariably conveyed through the use of media or it is supported/reinforced by technology. Over the internet or on radio or television, in conventions, exhibitions, conferences, classrooms, lecture theatres, boardrooms and auditoria, technology is installed, maintained, operated and exploited/enhanced by audio-visual (AV) technicians.

The technology landscape of these technicians, which might once have been described as 'hardware defined', long 'digital' in its construction, has only recently become truly digital in terms of the workflow paradigms arising from software and Internet Protocols (IP).

Long ingrained analogue paradigms are giving way rapidly to workflows of automation. Notably, in industry sectors such as broadcast television, where declining budgets drive the quest to leaner production methods, the skill set of AV technicians is increasingly 'software defined'.

Through a series of meetings with industry leaders in Europe and the UK as well as attendance at the International Broadcasting Convention (IBC) in Amsterdam in September 2014, the Fellow, Rowan Humphrey, sought to clarify the impacts of recent and emerging trends on the training requirements of AV technicians now and for the future. Discussions revealed the extent to which 'software defined networks' are changing the skill emphasis for these technicians. Developments in train for all broadcasters and operators of live productions highlighted a rapid transition from hardware biased modes of engineering solutions toward making all systems 'intelligent' including, in a sense, the very cables that carry the data.

The realisation of convergence

The purpose of this report is to unpack this message to the audio-visual industry in Victoria as it continues its evolution through embracing new technologies, inform the continuous improvement cycle of training new participants in the workforce, and to clarify and articulate the Fellow's enhanced vocational skills.

There are no actual limits to the scope of these developments but for the purposes of this report, which focuses on the production, delivery and consumption of screen based audio-visual content, the following parameters/assumptions serve to define practical limits for the next five years:

- The standards contained in recommendation ITU-R BT.2020 for the production of television material. This standard describes a maximum screen resolution specification of UHDTV-2 (7680 x 4320 pixels), 120-Hz frame frequency, 12-bit encoding and wide colour gamut. At present only Japan proposes to implement the full extent of this standard as Television by 2020, however the broader AV industry including Digital cinema to a lesser degree will adopt the highest resolution possible as soon as screens and projectors support it and budgets allow its implementation. Large-scale broadcast of 4K media is expected as soon as 2016 and OTT services are expected to deliver in 4K during 2015. Australian broadcasters routinely deliver Standard Definition (SD) 720 x 576 pixels with limited HD content @ 1080 interlaced (Ten) or 720 Progressive (ABC).

i. EXECUTIVE SUMMARY

- High Efficiency Video Codec (HEVC), ITU-T H.265. This is the latest video compression standard, which will deliver twice the efficiency of its predecessor H.264 and is fundamental to delivery of video content over bandwidth-restricted services. This new standard was reaching practical implementation at the time of the Fellows visit. It should be noted here that standards of this kind are not static and while the 'Main 10' profile of this standard supporting 10 bit processing is well established extensions to 12 bit processing have been developed and are relevant to other emerging technologies such as High Dynamic Range (HDR) and Wide Colour Gamut (WDR).¹
- Consumer take-up of '4K' screen hardware. SD CRT technology is still factored into the design of all broadcast television delivery processes as well as its 4:3 aspect ratio. By the time 1080 HD, 16:9 screen technology is actually ubiquitous in Australia most other developed markets will be routinely broadcasting in '4K'. HD delivers a perceived viewing improvement of around four times that of SD and UHDTV 16 times the SD experience on sheer resolution. With larger screens and the ability to view from closer distances screen manufacturers are banking on the 'immersive experience' of '4K' to overcome buyer resistance to purchase cost.
- Will Australian broadcasters deliver the content? Cinema screens/projectors, computer screens and mobile phones (retina display) by contrast are likely to average around the 4K standard. 3D is not dead but is not a considerable factor for most of this report.

This report has been presented to representative bodies including the Australian Video Producers Association, Live Production and Technical Services and Certificate IV of Screen and Media Program Advisory Committees.

¹ Dueñas, A & Ridge, J 2014, Implementation of enhanced HEVC/H.265 encoders: supporting new requirements and functionalities, NGCodec and Nokia, USA.

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ii. ABBREVIATIONS/ACRONYMS

4K	Video content Measuring 4096 x 2160 pixels.
AR	Augmented reality
ASI	Asynchronous Serial Interface
AV	Audio-visual
AVB	Audio Video Bridging
BBC	British Broadcasting Commission
C31	Channel 31 – Television Broadcaster
CRT	Cathode ray tube
DPP	Digital Production Partnership
EBU	European Broadcasting Union
F1	Formula One Motor Racing
HEVC	High efficiency video coding
IBC	International Broadcasting Commission
IP	Internet Protocol
LTO	Linear Tape-Open
OTT	Over the top
SDI	Serial digital interface
SDN	Software defined network
UHDTV	Ultra High definition Television (used interchangeably, though incorrectly, with 4K. UHDTV-1 prescribes 3840 x 2160 pixels).
VET	Vocational education and training
VR	Virtual reality

iii. DEFINITIONS

Audio Video Bridging

The common name for the set of technical standards that will allow time-synchronized, low latency streaming services through Internet protocol networks.

Audio-visual technology

The discipline and resources engaged in the high fidelity transfer of information from one mind to another. It includes face to face through lighting and acoustically reinforced theatre and auditoria to transmission of radio and television.

Augmented reality

Software applications design to interactively add visual and other content into live training or presentation situations.

Candela

The SI base unit of luminous intensity; that is, luminous power per unit as emitted by a point light source in a particular direction.

Digital native

Someone born in the digital era whose experience of technology largely excludes an understanding of analogue electronics and linear workflows.

LogC

The logarithmic encoding of video designed to preserve maximum contrast ratio and colour gamut in a scene to allow greater manipulation in post-production.

Nit

A unit of luminance relating the brightness value of light, equal to one candela/m².

Oculus Rift

Wearable virtual reality system for immersive gaming and video experience.

Over the top

Video services delivered over the public Internet such as YouTube and 'Netflixes'.

Retina Display

Apple term for screens with resolutions exceeding the normal visual acuity of users when used at specified distances.

Software defined network

A network made capable of dynamically controlling the flow of data, such as video, over an otherwise fixed hardware infrastructure. By defining other commodities, such as vehicles, as data these networks can be adapted to dynamically control the flow of traffic over roads.

1. ACKNOWLEDGEMENTS

Rowan Humphrey thanks the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide him throughout the Fellowship program.

Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the ISS Institute are our Fellows. Under the **Overseas Applied Research Fellowship Program** the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

1. Preparing a detailed report for distribution to government departments, industry and educational institutions.
2. Recommending improvements to accredited educational courses.
3. Delivering training activities including workshops, conferences and forums.

Over 200 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.

International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.

In this context, the ISS Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the ISS Institute's work.

For further information on our Fellows and our work see <http://www.issinstitute.org.au>.

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1. ACKNOWLEDGEMENTS

Rowan Humphrey also thanks the CEO (Bella Irlicht AO) and staff of ISS Institute, Ken Greenhill and Paul Sumner for their assistance in planning and development of this Fellowship.

Fellowship Sponsor - The Higher Educations Skills Group, Department of Education and Training

The Victorian Government, Higher Education and Skills Group (formerly Skills Victoria) is responsible for the administration and coordination of programs for the provision of training and further education, adult community education and employment services in Victoria and is a valued sponsor of the ISS Institute. Michael Hatton thanks them for providing funding for this Fellowship.

The following organisations and individuals gave generously of their time and assisted the Fellow prepare, plan and develop his research activities:

Industry

- Riedel Communication, Wuppertal, Germany
- Network Ten, Sydney, Australia
- ABC Television, Melbourne, Australia
- EON Reality, Manchester, UK

Professional Associations

- Australian Video Producers Association (AVPA), Melbourne, Australia

Education and Training

- RMIT University, Melbourne, Australia
- University of Salford, Media City, UK
- University of Applied Sciences Dusseldorf, Germany

Community

- Channel 31 Community Television, Melbourne, Australia

Other Individuals

- Glenn Blair, Associate Director-Development, Melbourne Polytechnic
- Paul Calleja, Project manager, EBU
- Marius Foley, Lecturer, Communication Design, RMIT
- Ron Frim, Senior News Director, ABC TV
- Barbara Gliddon, Teacher, RMIT
- Dave Hannan, Broadcast Sound Engineer, Supersonic Productions
- David Harris, Technical productions coordinator, ABC TV

1. ACKNOWLEDGEMENTS

- Clive Hodge, Head of operations, Digital Media Services, BBC
- Dr. Lars Höhmann, Assistant to CEO, Riedel Communication
- Corrine Humphrey, Facilities manager, Mentone Girls Secondary College
- Dan Lejerskar, Chairman, EON Reality
- Mike Lewis, Head of Operations, Pacific Broadcast P/L
- Richard McLelland, CEO, Channel 31
- Professor Heinrich Schmidt, Director e-Research, RMIT
- Dr. Helen Smith, Senior consultant, Learning and Teaching, OEDVE, RMIT
- Lisa Thompson, Deputy Director Vocational Education, DSC College, RMIT
- Natasha Willcocks, Programme Leader, University of Salford
- Kim Wright, Program support officer, RMIT

2. ABOUT THE FELLOW

Rowan Humphrey has been a technical skills trainer in the field of audio-visual and broadcast television technology over the past 17 years. With a background in live theatre and a day job in commercial finance he retrained in Corporate Video Production at RMIT University in the early 1990's. Practical placements allowed Humphrey to engage in a wide range of production experiences from drama to outside broadcast and set him on a successful freelance career over the following decade. He was invited by RMIT to conduct training sessions and these grew to the full time role he enjoys today.

Highlights in his career include working as a video researcher for the Third International Mathematics and Science Research project in 1999, an Arts Australia Council auspiced, Centenary of Federation audio-visual project in 2001 and working as a broadcast production technician at the 2006 Commonwealth games in Melbourne. He has also annually technical directed the RMIT School of Media & Communication 'MAVIS' production at Trades Hall and the Corner Hotel. This annual multi-camera production (since 2004) has enabled him to roll out new technologies with audio-visual students every year in a real world environment. Productions have developed from three camera standard definition digital recordings to seven camera, high definition, live switched productions with 2013 incorporating fiber connected vision, audio and communications deploying technology at the leading edge of world practice.

- Commercial banking and finance, Commonwealth Bank 1977-1994
- Freelance corporate video production 1995- 2010
- Sessional Teacher, RMIT, 1996-2000
- Production supervisor, LJ Productions, 1996-1997
- Audio-visual Technology Teacher, RMIT, 2001-2011
- Program Coordinator (Television production), RMIT, 2012-2015

Qualifications / Awards:

- Certificate of Business studies, RMIT, 1983
- Advanced Certificate of Corporate Video Production, RMIT, 1995
- Diploma of Video Production, RMIT, 2000
- Certificate IV in Training and Assessment, RMIT, 2005
- Graduate Diploma in Industrial Education and Training, RMIT, 2006
- Master of Education, RMIT, 2008
- Certificate IV in Training and Assessment, RMIT, 2011

3. AIMS OF THE FELLOWSHIP PROGRAM

- To enhance the teaching of digital technology work flow paradigms in audio-visual industries including television production and broadcast media by meeting with industry experts in the key international markets of Europe that lead in the implementation of these new paradigms.
- To build capability in AV teaching staff by integrating their traditional skills with those of so called 'digital natives' by exposing them to leading edge technologies in key international production facilities of the EBU, BBC and leading universities.
- To facilitate post fellowship mentoring of existing and new staff in teaching positions and in AV and broadcast media industry roles responsible for training of staff by synthesising the outcomes of this research into a comprehensible model for progress.

4. THE AUSTRALIAN CONTEXT

The AV industry encompasses a wide range of sectors, which include but are not restricted to education, training, exhibitions and conference facilities, broadcasting and entertainment. As digital technologies have improved and become ubiquitous over the last two decades the range of services and the way these services are deployed have become myriad and interconnected.

For example television productions routinely incorporate audio-visual devices and corporate annual general meetings are now often conducted using broadcast television techniques. An AV technician can expect to be able to move relatively freely in employment between all of these sectors. Indeed it is common for graduates of training programs such as the Diploma of Audio-visual Technology (now Diploma of Live Production and Technical Services) to work in a wide range of roles before settling into any particular area of expertise.

Internet based AV services, Social Media, 'Over the top' (OTT) video content and a "consumer desire for 'TV Anywhere'"¹ are driving a new wave of change and are redefining areas requiring skills enhancement as fast as they can be articulated. Occupations in demand show a shift from traditional on set roles to IT influenced (data wrangler) and new media roles.² European and US markets have harnessed these changes well ahead of their roll out in Australia allowing us to utilise their research and development and address the emerging changes in the Victorian context.

Australian technicians, companies and training organisations are leaders in innovation and early adopters of emerging technologies. However, structural inhibitors in Australia such as Internet capacity and bandwidth restrictions, relatively small populations separated by large distance as well as sheer economies of scale mean that many innovations in other markets do not roll straight into the Australian experience. False starts such as 3D as it relates to Television production complicate the process of deciding which technologies to embrace. The size of the Australian industry limits the capacity of graduates and training staff to experience many innovations that are becoming ubiquitous in other overseas markets.

However, many innovations such as studio automation reach a tipping point in Australia where relatively high staffing costs makes previously deferred strategies suddenly attractive if not totally necessary. This puts graduates and trainers in a catch up position amid rapidly changed employment conditions.

Recognition of Additional Skills required:

- The Fellow believed that workflow innovations in once relatively stable production environments had reached a tipping point as early as 2012.
- ABC Melbourne had been actively seeking multi-skilled news directors capable of operating in an automated control room. TAFE programs had become increasingly constrained by capital implications of introducing automation systems in their programs. While ABC news directors had been recruited successfully in the recent past from community television and commonly held Diploma/degree qualifications in either an audio-visual or media related stream, IP and automation skills were not a particular feature of their academic training.
- There was no formal training ground for operating in automation workflows and as Seven Network moved to automate during the later part of 2013 the opportunity to develop training in this area became more attractive.
- Nationally, Network Ten began automated news broadcasts in September 2013. That Network has since moved Sport production back to Melbourne and sport is an area internationally that has also seen a trend to automation over the past few years. Since 2007 Network Ten have progressively

¹ Huschke, J & Voigt, H 2014, Video over LTE: exploring efficiency in distribution, Ericsson, Germany & Sweden.

² Environment Scan-2013, Innovation & Business Skills Australia

4. THE AUSTRALIAN CONTEXT

turned to recruiting exclusively from Universities and TAFE/VET institutes following the successful training initiative 'inTENSive' designed by Mark Stewart of Network Ten and the Fellow. From an initial intake of five RMIT Audio-visual Diploma students the then Head of Broadcast operations in Network Ten, Mike Lewis rolled the initiative out to encompass all the major relevant universities across all states. In Victoria alone 76 recent graduates have been recruited to full time positions in a time that has seen two rounds of redundancies affecting traditionally trained staff.

- New technologies and the rapid contraction of traditional skill areas are opening up an opportunity for skill enhancements for students coming into training and have implications for graduates entering the industry over the next few years. Employers need an increasingly complex set of skills that retain many of the old disciplines but now include modern digital workflow paradigms.
- There have been difficulties in finding suitably trained staff to conduct training in these disciplines. At a time when parts of the industry are shedding traditionally trained staff there is a shortage of technicians/trainers with good levels of traditional skills and currency in multiplexing, automation and digital workflow specialities. This combination of skills is highly valued by industry and it represents the broad skill set that will be sought by all AV employers in to the future.

Benefits of obtaining New Skills and Threats if not done Successfully

- While the networks are currently employing audio-visual and production graduates the skill set required of them is beginning to shift. Traditional single skill roles such as camera operator or Floor manager are being combined and while we currently facilitate training to reflect this trend new roles are also emerging. Young 'data wranglers' and social media staff bring non-traditional skills into traditional AV and broadcast environments without requisite skills in other areas. The benefit of this research was in combining these two approaches in a more informed or considered way.
- Benefit unemployment in Victorian youth by reducing the need to import overseas specialist staff to rapidly emerging technical roles coming on stream as the National Broadband Network (NBN) rolls out and as broadcasters engage with emerging technologies such as Cloud delivery. A significant percentage of the training cohorts come from a poor experience of school in secondary or tertiary settings. They are often shy of an academic environment but demonstrate highly functional skills in work places where these capabilities are in strong demand. There is a risk that this demographic is caught in the reduction of low skill level operational roles but by obtaining these new skills that risk is diminished.
- Improve the current flow of graduates into higher value starting positions and insure against skills shortages in Broadcast Media into the future.
- Benefit Industry by giving them access to multi-skilled graduates to improve productivity in the Broadcast Media and Corporate/Institutional and Government Media and presentations sectors in Victoria.
- With many Broadcast activities already Sydney centric this is an opportunity to ensure that graduates of training programs in Melbourne are highly sought after and drive Networks like Ten to push more production and delivery services back to Victoria. Network Seven currently drives its national agenda from Victoria and should accordingly require a strong work force supply into the future.

5. IDENTIFYING THE SKILLS AND KNOWLEDGE ENHANCEMENTS REQUIRED

There are examples of areas in Australian industries and activities where there are weaknesses in skills, knowledge, experience, innovation, policies and/or formal organisational structures to support the ongoing successful development and recognition of individuals and the particular sector.

The focus of all ISS Institute Fellowships is on applied research and investigation overseas by Australians. The main objective is to enable enhancement and improvement in skills and practice not currently available or implemented in Australia and the subsequent dissemination and sharing of those skills and recommendations throughout the relevant Australian industry, education, government bodies and the community.

The skill enhancement areas to be addressed through this Fellowship were:

Enhancement Area 1: Broadening the skill set of AV technicians

Aim: Improve the breadth of IT and Network IP skills in mainstream AV and Broadcast Media technical operators. Many technicians trained in pre digital workflows struggle to deal with the changes required to operate in the 21st century emerging models. The ability to store, distribute, track and recover media and associated metadata within a complex digital domain needs to be expanded. As described above the typical trainee has limited academic aptitude but excellent operational capabilities. The broadening here is not to the level required of an engineering degree. Engineering level skills would be required to fully understand how these systems are designed while Vocational level skills enable higher-level operational capacity.

Benefit: Workflow innovations currently being devised or rolling out in Europe can be leveraged in Australia on the leading edge of industry. Rather than wait for change to be realised and then respond, AV graduates entering industry will already be conversant with these trends. The intention was to identify adaptations made in Europe and elsewhere to facilitate this research.

Enhancement Area 2: Deepening the skill capacity of AV technicians

Aim: To address a perceived lack of capacity in the area of digital workflow innovation. Workflow innovation leverages technologies to produce productivity gains in unexpected areas. A raft of new standards has emerged to process audio and video across IP and, moreover, these technologies are merging. The aim is to deepen understanding of areas such as system topologies, redundancy and alternate methods in the event of failure of parts of the system such as Dynamic bandwidth allocation as it impacts 'Quality-of-Service' (QoS).

In the UK the Fellow met with production staff from the BBC, seen as an innovator in production paradigms and also met with representatives of the UN sponsored World Skills organisation EON Reality in Manchester. In Geneva, Humphrey met with a graduate of the Diploma of Audio-visual Technology RMIT, who works in research and development for the European Broadcasting Union (EBU)

Benefit: By investigating production paradigms, which are impossible or rare in Australia due to economies of scale, the Fellow intends to distil a range of suitable transferable models for Victorian conditions.

5. IDENTIFYING THE SKILLS AND KNOWLEDGE ENHANCEMENTS REQUIRED

Enhancement Area 3: Redefining the skill base of AV teaching staff

Aim: To better describe the skills required to teach into programs such as the Diploma of Live Production and Technical Services. To highlight areas where ongoing professional development should be focused. Avoid training in areas that have the potential to become cul de sacs. An example is 3D for broadcast that rose rapidly in 2009 to fall almost as quickly by 2011.

Benefit: To continuously improve the skill set of existing teaching staff and to attract new appropriately skilled staff to the role.

6. THE INTERNATIONAL EXPERIENCE

Visit 1: EON Reality (EON) - Virtual and Augmented Reality training and development facilities,

Location: Manchester, UK

Contact: Ken Swain, Managing Director

Objectives:

Establish fresh parameters for benchmarking AV technologies used in training and education. Consider the implications for teaching methodologies and pedagogy and the technologies AV students will be required to install, implement and operate.



Caption: Virtual reality presentation technology.

A screen based world, but what shape is the screen?

EON develop audio-visual tools and environments for training in a vast array of industries from automotive to mining. Highly specialized virtual reality (VR) and augmented reality (AR) environments facilitate learning for complex, dangerous or repetitive scenarios. The facility at Manchester features a number of three dimensional and immersive environments. A large translucent curved panel greets visitors in the first area with a virtual head that can be dismantled by the trainer to reveal skull, muscle layers and then eye construction. Used primarily in medical teaching the resource could easily be repurposed for other audiences and VR exploits the entertainment/engagement value extensively.

AR allows anyone with a smart device to approach a static display and have that display come to life on his or her phone or tablet.

6. THE INTERNATIONAL EXPERIENCE



Caption: Augmented reality. Photo courtesy of Corrine Humphrey.

The Fellow was able to experience a prototype of 'Oculus rift' and 'Leap' hand recognition technology which create a totally immersive environment, albeit it your head. Unlike traditional screen based games environments Oculus has solved the previous limitations of other VR systems¹ with this one wrapping around behind you. Since visiting Manchester the first feature film has been developed for it, while the device itself was expected to be delivered to the market in 2015. Again with the help of polarising glasses, 3D virtual soccer balls as featured at the last World Cup of Football and the 3D engine manipulation tool allow a trainee to get up close and personal with objects that would not normally be able to be scrutinized in that way.

¹ Grossman, L & Luckerson, V 7 April 2014, Head Trip, Time, USA.

6. THE INTERNATIONAL EXPERIENCE



Caption: 3D manipulation tool. Photo courtesy of Corrine Humphrey.

In the 'iCube', safety scenarios can be simulated with a complete 3D oil well or rollercoaster and participants can even have dolphins swim about them. You don't get wet but you do get an authentic sense of size and scale and a proximity effect that renders a high level of reality into the scenario. These environments are development heavy but vary considerably in terms of actual hardware or space requirements. After initial development of the software, modifications are relatively easy and adaptation to new applications is very simple.



Caption: 'iCube' VR simulated environment. Photo courtesy of Corrine Humphrey.

6. THE INTERNATIONAL EXPERIENCE

EON employs a 'work based learning' model whereby they partner with a University and students work on real world projects virtually from the outset.

Outcomes:

Augmented reality is a paradigm-shifting training advance driven by digital technology. Experiencing devices like 'Oculus rift' first hand help to redefine what we see as possible. While traditional AV environments such as television may seem under threat by new competition the role of the AV technician seems relatively undiminished though a higher degree of technical skills is very much indicated in this environment.

Innovation in software based systems and commercial advantage off the back of rapid advances in technology are driving in the same direction in this part of the industry. The Fellow found this was not uniformly the case during later visits. This is highlighted in the outcomes from the various experiences. EON's existing client base seems more open to a level of risk through innovation and are looking to maximize change into non-traditional methods of training to drive economies of scale. A graduate AV technician in this environment would require all of the traditional skill set plus a deep understanding of VR and AR software. As systems like 'Oculus Rift' come to the market those complexities continue to change.

6. THE INTERNATIONAL EXPERIENCE

Visit 2: University of Salford - Media City production and teaching facilities

Location: Salford, UK

Contact: Laurence Murphy, Senior Lecturer, Media Technology

Objectives:

To observe innovations in training environments directly related to television production. The facilities at the Media City campus, which are also used by BBC and ITV, had only been recently commissioned providing a rare opportunity to see facilities with a very low level of redundancy.



Caption: Media City Salford.

Education and production – What potential for drawbacks of a co-sited model?

With BBC facilities decentralised away from London, Media City in Salford has allowed the effective merging of training and production. The Salford university facilities that are also used by overflow productions from BBC and ITV reflect established production specifications typical of most television studios. Their co-siting with BBC and ITV in the Media City precinct is a primary feature that holds them apart from most traditional university facilities. Notable exceptions of co-sited educational facilities in Australia being the Australian Film Television and Radio School (AFTRS) in the show-grounds media precinct in Sydney and those of Open Channel in Docklands in Melbourne.

6. THE INTERNATIONAL EXPERIENCE

Murphy specified the facilities that were opened in 2013 and has a thorough technical understanding of how they are configured as well as teaching into them in his areas of expertise. The studios and facilities have been completed to a high standard with features including ORAD interference keying that are the envy of the broadcasters who use them. The main control space has a state of the art audio control desk that exceeds BBC/ITV facilities.



Caption: Exceeds BBC/ITV equivalents.

Some of the design aspects and arrangement of control rooms favour commercial production over absolute training requirements though they are undeniably first class and still represent an enviable learning environment. Interestingly, robotic head cameras were not a feature in these facilities.

6. THE INTERNATIONAL EXPERIENCE



Caption: The fellow in main control room. Photo courtesy of Laurence Murphy.

A separate multipurpose space with 500mm square floor panels each containing a full suite of connectivity as well as seating for (50-100) which can be completely configured. From an AV perspective the presentation experimentation area at the front of the building (effectively in the foyer) included some very interesting technology. A large open space called 'the egg' in the foyer hosts a range of media events and can be used for motion tracking as well. Two multi screen Christie microtile backlit panels were featured.

6. THE INTERNATIONAL EXPERIENCE



Caption: Large Christie microtile array.

How long before '4K video @ film grade is carried over 4G?

For Murphy high technology priorities are 4K video over mobile telecommunications systems and developing bandwidth saving technologies to facilitate this. His ambition is to get 'Film' grade High Definition using a 'LogC' codec that can preserve the dynamic range of the picture. The implication for AV technicians is the further deepening and complication of video codecs and the range of possible output formats.

Outcomes:

Meeting the commercial requirements of the partner broadcasters has influenced the traditional design of most of the production spaces while some spaces such as the foyer and multipurpose space represented a leap forward in technological advances. While the university conducts research in innovation the commercial operator seeks production reliability and therefore a relatively traditional workflow. The Fellow was also engaged in relocating existing facilities at RMIT in Melbourne during 2013 -15 rendering this an excellent opportunity to review this new teaching and learning facility first hand.

Visit 3: BBC Studios and Post Production – Postproduction quality control and archive services

Location: South Ruislip, UK

Contact: Tony Hurt, Review coordinator, Digital media services

Objectives:

To experience a range of environments from production to post production in current operational configurations within an internationally recognised broadcast organisation. At the BBC this would take into account legacy technologies and show what new processes were already in play. The effects of BBC decentralisation were also observed.

Can the Digital Production Partnership end a workflow paradigm decades old?

At BBC South Ruislip the Fellow was introduced to a number of departments in the quality control and archive sections of the commercial arm of the corporation. Offices and some facilities have been relocated to regions while central London is revamped and because of pressure on real estate values and the high cost of staffing. This has been impacting in a similar way on facilities in Melbourne. High levels of legacy technology is employed, such as 1/2" D3 video tape for archiving to LTO tape based data files though they do use 'Apera' software for file transfer over IP. Technical operators in this area need to utilize traditional skills as well as software skills to maintain and operate in these facilities, which underpins current training strategies around these legacy technologies.

RMIT AV is a tapeless environment but that is not the case in many production environments in UK and Australia such as Network Ten in Sydney, which Humphrey had previously visited. Reliability, cost effectiveness and functionality mean these legacy systems have some time yet before they will actually be replaced. The Digital Production Partnership (DPP) in the UK had specified 1 October 2014 as the date when all UK broadcasters would begin accepting file delivery.² Another commercial imperative for broadcasters is also the safe storage of the media asset and the ability to repurpose that asset for other uses and other markets. While 'the cloud' offers technological and economic advantages today other imperatives are yet to be resolved in favour of eliminating the direct physical possession of media assets. This was very much in evidence at South Ruislip.

Who will drive UHDTV as it looms on the horizon?

One driver of change for this facility was the transition to 4K, or more accurately, UHDTV that will eventually come but that would traditionally have been guided and specified by the European Broadcasting Union (EBU) or the Society of Motion Picture and Television Engineers (SMPTE). The feeling from Hunt was that the drive will more likely come from China as they have the largest uptake of 4K monitors or TV in the world by a large factor. This feeling was reinforced by comments made during the Fellows visit to the EBU. While we will be slow to pick up 4K in Australia the Chinese market will be quite mature by the time we do so that whatever formats and technical standards they adopt will have a significant influence on what we decide to do around standards to be adopted. However, Hunts view seems to be at odds with recent research in China by Gospel & Lovett.³

Hurt ran Humphrey through the technical specifications for programs that are distributed through the facility and the Fellow discussed details with technicians as they worked on various parts of the

² de Pomerai, R et al 2014, A producers guide to file delivery, The Digital Production Partnership, UK.

³ Gospel, C & Lovett, N 2014, Cognate and contrast: An investigation into Chinese Television production in 2013, International Specialised Skills Institute Inc., Australia.

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process. Discussed the impact of the impending DPP and the standards contained in AS-11 on compliance checks and automated quality checks. The over all sense here was that while automation was becoming a feature, the advances in it were not significantly ahead of the workflows in Australia at this stage. Given the introduction of the DPP in the UK since October 2014 however, it supports Gospel and Lovett's recommendations for Australian industry to embrace a tapeless workflow.

Do our eyes and ears still have a place in highly automated environments?

Humphrey spent a very productive period with Phil Dee [audio post] doing quality control of programs coming from independent producers and observed Dee review an episode of a popular UK games show after discussing possible rectifications for an episode of "Who Do You Think You Are?" Dee and the Fellow discussed what attributes Dee thought were important going forward for technicians in this field and Dee had some very succinct insights that the Fellow believes will continue to stand the test of time regardless of the innovations in technology. Technicians need to be able to pay attention for extended periods of time. The sound mix remains vital as "you can look away from the screen but you can't turn your ears off". There remains a need for 'Glass' monitors for audio latency and lip sync. Issues of quality include Sync, Aspect Ratio and digital artifacts were still fundamentally being judged manually. Automated quality control included 'Harding' automatic pass or fail of strobing.



Caption: Mix of legacy and automation technology.

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The facility retained some legacy technology that reflects that we don't always improve quality over time while we may make leaps and bounds in cost and features, benefits are sometimes lost. Craft skills don't come cheap and ultimately there will be a determination as to whether quality or cost will prevail. The quality question arose later in Wuppertal and the quality cost dichotomy was addressed at the conference in Amsterdam.

It was interesting to see first hand the consideration by two highly paid full time technical staff over a series of quite transient technical issues. In the end they determined to let each of these pass and as in other industries the luxury of quality control may not last in TV in the UK for too much longer. If it does disappear then quality either has to be sacrificed or has to be embedded further, by automation, in the process. The issues in this case were the sorts that the original editor responsible would likely no longer be able to see in his own work. A second set of eyes is needed, but at what cost? That they were all passed in the end "is significance" (sic). Automated systems will need to reach a high state of complexity to match our ability to differentiate spoken words like significant and significance in context.

Outcomes:

The BBC environment was commercially constrained, in the same way as many companies in Australia, in its ability to make rapid and far reaching technology innovations. Cost and reliability of existing methods such as delivery by tape, overrode the need to innovate or implement new technologies ahead of the overall capital cycle. While a level of automation was emerging at this facility it was not pervasive, which was a little surprising. This situation may have changed significantly with the subsequent launch of DPP in October 2014.

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Visit 4: BBC Studios and Post Production – Studio facilities, Elstree Centre,

Location: Borehamwood, UK

Contact: Mark Lewis, Operational compliance manager

Objectives:

As for Visit 3 to BBC South Ruislip.

Are parts of the industry immune from automations grasp?

At BBC Elstree the Fellow learnt that the commercial arm of BBC no longer sees drama as a mainstay of production. Game shows and reality TV shot in very large studios or Big Brother in very 'one off' specialised spaces are where highest output is and where it is likely to stay. Traditionally configured control rooms were visited, but for the large-scale productions an Outside broadcast style temporary facility was also in place. This is indicative of the state of the industry in keeping options open. Production uncertainties may see staff in temporary control rooms for quite some time.



Caption: Big brother facility.

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The sourcing of workforce has also been affected by decentralisation of BBC production facilities first from London to Salford and then, with drama, to Wales. Some have followed from London but over time the workforce has begun to be replaced from a more local pool. Given the size of Melbourne this may not become a factor here.

Outcomes:

Live production methods are slower to change than other more controllable parts of the industry such as formulaic news bulletins. High tech advances in camera and lighting were obvious here but there was not so much in terms of software innovation. The visit allowed the Fellow to observe some of the lighting and other staging elements for large-scale productions, which were of particular interest to colleagues at RMIT.

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Visit 5: Riedel Communications – Communications and broadcast production solutions,

Location: Wuppertal, Germany

Contacts: Thomas Riedel, CEO

Dr Lars Höhmann, Project assistant- executive management

Objectives:

Riedel had expressed an interest in exploring prospects for student exchange between Germany and Australia in the disciplines aligned with his company and the programs delivered by the Fellow. Humphrey wished to see first hand the environment in which Riedel products are developed as they currently represent some of the core front line innovations in the industry, covering audio, communications and video distribution. This would also provide a key supplier perspective to that of the end users.

How is content delivery prioritised in Software Defined Networks?

Riedel Communications designs, manufactures and distributes pioneering real-time networks for video, audio and communications for broadcast, pro-audio, event, sports, theatre and security applications worldwide.

To the question of where technology goes next, Riedel replied along the lines of, “More important than technology is content, good quality content that has value or is educational in a sense”. This was interesting from a technical person but resonates with Faria’s “shift to a content centric paradigm”.⁴ While Faria reflects the notion that content should dictate the carrying capacity of cables rather than vice versa, both views reassert the primacy of content in an industry that can become obsessed with technical parameters. Riedel went on to explain as he felt frustrated with TV content and that there was so much potential to make good content affordable again. He felt automation and digital technology could facilitate good quality content and this had been true in the sense of the development of cameras and other technology. Riedel felt that as soon as you have a worthwhile challenge the enthusiasm to solve the problem technologically is heightened.



Caption: The Fellow with Thomas Riedel in Wuppertal. Photo courtesy of Dr Lars Höhmann.

In the last several years everything has been budget driven and much production that is deemed economically viable hardly engenders technical excellence to make it happen. Höhmann explained that Software Defined Networks (SDN) where bandwidth priorities are maintained by the software rather than having to define it by the total number of cables and switches available was one of the main game changers. Audio video bridging (AVB) was discussed at length and the RJ45 Ethernet plug as a ubiquitous connection standard also posited.

Riedel was content in achieving 95% reliability in transmission/broadcasting instead of 100% as the cost savings in not meeting the last 5% are significant. Also that

⁴ Faria, G 2014, The landscape for global broadcast standards, TeamCast, France.

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the broadcast industry is rapidly hitting 30% traditional broadcast infrastructure and 70% IT/IP. This point would be reinforced at length during the IBC conference.

The impact that suppliers to global scale productions such as F1 motor racing can have on the rest of the industry was also discussed. F1 turns over \$2B and a profit of \$1B but there are many companies who are so keen to be involved they will pay for the privilege of providing the service. Large mobile phone companies and IT firms can leverage these opportunities and impose themselves on the market. The impact on competitors is clearly significant. Riedel were not in a difficult position but time will tell if they can remain competitive in the face of commodity/ service suppliers.

Outcomes:

Riedel confirmed that the company's representative in Australia struggles to get qualified staff. That degree or engineering level skills are not necessarily what is sought. Operators can have a lower skill set but must have reliability and good communication skills as more of the technical process is completed before the event and operators have less direct impact at the operational end. That there needs to be a clear focus on SDN's and their implications for the way AV and broadcast environments will operate in the very near future. Dr Höhmann gave the Fellow a detailed description of SDN's while driving from Wuppertal to Dusseldorf. Dr Höhmann's PhD is in Electrical Engineering (Dr.-Ing.) and his thesis is about Car2X-Communication (or VANETs = Vehicular Ad-Hoc Networks), which cover safety systems for vehicles by means of adapted communications protocols for these domains. Autonomous vehicle control and road systems and the discussion and its context have enabled the Fellow to develop a useful analogy with Data over SDN's for training.

At Riedel a commercial imperative is to make a quantum leap when introducing new products while servicing the needs of existing clients. In this case the capacity of clients like F1 or World Cup at present to invest heavily to ensure maximum reliability for temporary installations means innovation is expected and innovation provides cost improvements along with reliability improvements. The Fellow's industry mentor has, coincidentally, since deployed an Australian developed software protocol for audio and communications (Dante) across a Riedel Mediornet system that was a case in point for workflow innovation in this discipline space.



Caption: Riedel test and preparation facilities.

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Caption: Mediornet demonstrated at IBC exhibition.

Visit 6: University of Applied Sciences, Virtual Sets and Virtual Environments Laboratory

Location: Dusseldorf, Germany

Contact: Professor Jens Herder, Director, Department of Media

Objectives:

To observe the research facilities, which feature VR and robotic camera rigs to compare and contrast with studios in Media City Salford, as well as explore possible exchange opportunities for students in Australia. Virtual sets have become popular around the world as their level of realism has improved and the ability of robotic head cameras and systems to track in the environment has advanced. Versatility and reducing costs is driving this innovation.

Is there a role for operational staff in an increasingly software engineered world?

At Professor Herder's facilities a fairly typical control room environment gave way to an exclusively Green screen studio designed to accommodate only virtual sets and environments. Virtual sets require all cameras to recognize the same set of spacial parameters for the studio as well as any occupants and in addition this facility could track and include virtual objects within the space that either moved independently or in connection with an actor. The Fellow saw similar commercial facilities promoted at the IBC exhibition later in his international experience.



Caption: Virtual Sets and Environments studio.

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Motion tracking rigs were demonstrated by Masters degree candidate students. These featured marker-less virtual sets driven by VIZ (Studio) software.



Caption: VIZ (Studio) rig demonstration at IBC exhibition.

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From an AV perspective many of the tools and technologies that students were interacting with would be familiar to students at RMIT but the studios and camera rigs were highly specialised to the task compared to the configuration of studios in Media City for example. This contrast makes the prospect of direct exchanges between these two cohorts unlikely but opportunities at other levels in RMIT are being pursued.

Outcomes:

Innovation is the key driver at this facility and constraints around commercial television output being non-existent, traditional technologies can routinely be made redundant. Professor Herder emphasized the importance of students learning Visual Basic.

These were highly specialized research lab environments with robotic head cameras and software-controlled processes, which would have been impractical for typical productions undertaken by VET students in Melbourne. This highlighted a gap between the two cohorts. The Dusseldorf cohort is clearly engineering design oriented and the Melbourne AV cohort far more operational in its outlook. There is however a number of AV design and installation sector companies in Australia and graduates of the RMIT program have been filling positions in those companies for many years, so, some further extension of our qualifications is suggested.

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Visit 7: European Broadcasting Union (EBU), Central European networked broadcasting facility

Location: Geneva, Switzerland

Contacts: Graham Warren, Director of Network

Paul Calleja, Project Manager and Technical Designer

Objectives:

To obtain an overarching view of the state of broadcasting and associated technology directions. Learn the high level technical and business drivers for change in the industry from those in a key position to either influence the change, or understand the impacts at a macro level with changes in its direction.

Humphrey was pleased to meet with Calleja, a graduate of his from RMIT, and now project manager and technical designer. He was also able to interview Warren.

How many flavours of video can we cope with in an increasingly IT/IP world?

EBU has been a Provider of broadcast services, through the evolution from analogue to digital. PAL analogue became digital mpeg2 then mpeg4 and HEVC and so on to the current state of convergence as IT meets broadcast. Traditional one directional services in a single format for Satellite news gathering (SNG) and tape play out have disappeared to be replaced by highly technical multi format mpeg4, 4:2:2 & 4:2:0. EBU customers now want more two-way data and dynamic bandwidth allocation. EBU customers have realised that if someone provides a stable pipe the customers could do the rest themselves.



Caption: EBU headquarters Geneva.

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As video encoders are configurable, IT departments are now driving the process of setting up projects and events that would once have been the exclusive domain of broadcast technicians. There has been a rise and rise of file transfer over the past several years. However IT mentality does not necessarily fit with the broadcast definition of high quality transmission or QoS. While in desktop computing it is considered acceptable for a computer to 'hang' or need rebooting, broadcast television and live productions require an absolute continuity of transmission.

What once had an ASI output now has an IP output so that technicians now need to know about IP routers. IT people are naturally familiar with IP workflow. They have skills in IT but are not yet competent at thinking in a broadcast network paradigm. Accordingly there were skill shortages at the recent football world cup.



Caption: SDI patch bays.

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Warren had been grappling with the same key question as the Fellow. How to train a traditional digital AV technician in IP?

How long will Outside broadcast trucks head off to sporting and cultural events?

It is already possible to do away with the traditional OB truck and send the entire selection of camera outputs back to a central facility. However, long distance lets down the service provision across public networks such that higher bandwidth signals of 21mbps and 42 mbps don't get through. EBU have a huge fiber network locked in with a single provider. Again the \$1b rights value of Formula 1 was raised as well as world cup soccer on a similar value scale. This means that the cost of transmission is a tiny fraction of the budget but these customers want 100% reliability. 4K was also emerging as a big impact. However, remote production at low bandwidth is being rolled out. In Sweden all individual sources of video can be sent back for mixing at a central production facility, which changes workflow dramatically. In other markets with less well-developed broadband, signals go through a series of switches which limit bandwidth. US major league baseball uses no OB trucks at stadiums. In the Middle East however it is still better to send a truck. There is some inertia even in well-covered locations because production people still want to go to events.

What are the drivers for a centralised broadcasting entity going forward?

Low latency (200-300 milli second) and bandwidth issues are two of the main technical hurdles to effective live sport implementation and completely IP solutions. But using IT commodities lowers the cost of production significantly. So much so, that in the last 18 months the EBU production paradigm has become predominantly Ethernet based. Satellite though is not going away. Mpeg4 is still used for Tour de France or in the middle of a desert. HEVC and 4K demand will drive bandwidth demands but 'Hypermux' which is a unique, EBU-designed contribution multiplex platform, might reinvigorate EBU's capacity to grow organically focusing in the middle east. If EBU were web based and OTT companies such as Netflix change their own mode to distribution versus contribution then the game may change for EBU to continue "business as usual". EBU therefore are questioning who they really are and do they make acquisitions?

China and Japan are driving standards in 4K and 8K but because China has taken a large foothold in 4K, Japan are going to leapfrog to 8K. There is no money in screens and Warren highlighted the commoditisation of hardware related to broadcast. Can Japan create an 8K market? HDR and high frame rate were innovations to be embraced but 3D was being buried as fast as it could be.

Decisions for all broadcasters are made around CAPEX vs OPEX and while mpeg encoders drop in price to giveaways, satellite transponders still cost \$2m. For the EBU 99.999 % quality is what they are selling and so they maintain for the moment the market of high-end sport. EBU maintains the world's biggest network of dedicated fiber delivery. They are highly appreciated by high-end customers but when 'Netflix' goes to sports revenue they could bypass EBU and be a threat to them, as well as all traditional broadcasters.

Content is still king. Mobile means big screens are not the only way a sporting event is going to be seen and people are prepared to watch on personal sized screens.

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Outcomes:

Some technology directions appear so advanced that they are unlikely now to become genuine cul de sacs. The Australian experience does not always reflect the rest of the world though, which remains a point for caution. End to end delivery across IP is inevitable and dedicated networks of EBU and other providers are at risk in the medium term from players outside the broadcast realm. HD will give way to UHDTV and evolve through 4K to 8K either smoothly or potentially with a very short capital cycle around 4K. In order to deliver increasingly data heavy file based media compression, SDN's and associated automation will continue unabated. This conversation had significant impact on the overall outcomes of this report and set the Fellow up extremely well to maximise value at the IBC conference.

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Visit 8: International Broadcasting Convention (IBC) 2014 Conference and Technology Exhibition

Location: Amsterdam, Netherlands

Objectives:

To consolidate the various points of view in the preceding visits into a broad forward thinking vision. Key industry players use IBC and the US equivalent National Association of Broadcasters (NAB) convention, which is held six months offset, to make major product and acquisition announcements, debate technology directions and review the state of the industry. Driven originally by broadcast manufacturers, the 2014 conference highlighted the converged nature of the industry including sessions on laser projection, in-home architecture, D-Cinema, Interactive entertainment as well as having a host of IT exhibitors. In particular this was not a conference to discover the relative merits of one technology over another but to articulate clearly the overall direction that technology is taking.

Speaker: David Abraham, CEO, Channel 4, United Kingdom

Keynote session to open IBC 2014

Topic: Assessing the health of Broadcast TV.

Can you afford to ignore non-linear content in an IP centric world?

Abraham's key message, echoing to some extent the comments from Riedel was that content as much as technical innovation would determine the ongoing health of broadcast television.

Video via IP, cloud based delivery and multi platform commissioning were areas he felt were now fundamental, so that designing a linear program required non linear/other platform content ideas to be produced as a matter of course, rather than as an add on.

This proposition would fuel the rise of the independent production companies as well as games companies etc.

Data, which is fueling the flight by advertisers to IP and mobile platforms, allows analysis of the viewer relationship with Channel 4 having a direct connection with 11 million people in the UK. Data provides targeted sales opportunities. Blue chip brands are spending on mobile video. Channel 4 is partnering with universities in the UK to improve Video on demand (VOD) and scheduling. These are both major software environments.

To this end their flagship has become '4 on demand', where the prime viewer connection is online with the broadcast channel as part of the feature set instead of the other way around. The future is a blend of channel and the digital estate. The user interface is of primary concern and '4 on demand' features a new three tiered approach, 'on demand', 'now' and 'on soon'.

One platform works for mobile, VOD and in home.

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Speaker: Bruce Tuchman, President, AMC Global,
Sundance Channel Global and MGM Channel Global, USA
Keynote session to open IBC 2014

Topic: Assessing the health of Broadcast TV.

Is content still king?

Tuchman represents the highly successful AMC networks whose growth is being driven by high quality independent drama. Pay TV consumers love the characters and the sector is competing directly with film production. His business model is “content, content, content” and he doesn’t think pay TV will squeeze out free to air.

Tuchman rejected the spectre of US imperialism raised by UK broadcasters but that is something that would raise animated debate in Australia and appears to have already directly impacted on the work opportunities for AV graduates.

Speaker: Charlie Vogt, CEO, Image Communications and Gates Air, USA
Keynote session to open IBC 2014

Topic: Assessing the health of Broadcast TV.

Is video ascending or descending? Can live TV be ubiquitous over IP by 2016?

Vogt, previously of equipment giant Harris, had a simple message which was to “manage, move and monetise video content”. These ambitions leverage ‘the Cloud’ and virtualised, ‘software defined’ TV to IP. Vogt envisaged the need for an open, collaborative ecosystem if the majority of current players wished to survive.

The drivers for him were access and experience, a broadband and mobile experience interweaving with social media. His view was that video is the killer application as it provides a demand driven platform that supports targeted advertising.

As for technology his message was also clear and the was for end to end IP, and he made a bold prediction that there would be ubiquitous live TV over IP in 2 years.

Outcomes:

In a highly competitive environment, television is poised to undergo a generational change in the face of innovations driven by the rise of the Internet. These industry leaders are not assessing if these changes will come but simply when they will be able to be brought to market.

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Caption: The transition to an IP centric workflow.

Speaker: Touragdj Ebrahimi, Professor EPFL, Switzerland,

Technical Stream Session: High Dynamic Range imaging – contrasting views.

Objectives:

To understand the current thinking around aspects of vision technology that compete for development and for ascendancy in their progress to market. The subsequent impact on the technologies AV technicians will deploy in the future. Current competitors in this space are Ultra High definition television (UHDTV), higher frame refresh rates and High Dynamic Range (HDR).

Why should High Dynamic Range (HDR) now complicate UHDTV?

Ebrahimi demonstrated by empirical evidence that HDR shows a higher perceived improvement than any of UHDTV, increased frame rates or 3D. In a world of increasing demand for immersive experience HDR provides the most clearly measurable improvements.

Speaker: David Brooks, Senior Director, Technology Strategy,
Office of the CTO Dolby Laboratories Inc, USA,

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Technical Stream Session: High Dynamic Range imaging – contrasting views.

What is the impact of legacy technology on HDR?

Current television dynamic range is up to 100 nits and has been hamstrung by the limitations of that value by decades old CRT technology. By contrast the dynamic range required by visual entertainment content is up to 10000 nits.⁵ However the major limiting factor to implementing HDR is the requirement of a 12bit system to avoid technical flaws, such as contouring, in content delivery. While Dolby has developed several standards, the current 10bit operating environment is a limitation.

Outcomes:

This session demonstrated that while some technologies will show great promise other technologies, such as the need for 12bit systems in this case, would temper the outright pace of change. Also the relative demise of 3D after a rapid rise in interest in 2009 is cautionary.



Caption: Technological change is often more complex than it is made to appear.

Speaker: Richard Sambrook, Professor, Cardiff University, UK

Strategic Insights Session: The future of News.

Objectives:

News has been a main stay of television production for a very long time and now that automation has impacted the associated workflows the impetus to reflect that change in our training is being driven by the ABC who are looking to maintain access to well trained multi-skilled graduates.

⁵ Brooks, D 2014, The art of better pixels, Dolby Laboratories, Inc., USA.

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Is broadcast television news dead or has it been sleeping?

On the up side for broadcasters data from the conference showed 85% of people still watch news on television. Advertising revenues are set to rise as the economic cycle edges more positively. More news channels are being launched albeit they tend to be automated. Brand matters. CNN or Sky News will still be the tune in preference when large-scale events unfold.

On the flip side the young demographic is shifting away from broadcast news. From the Fellows experience university students are as likely to think of 'Russell' when considering Brand in the context of accessing news online. However, a benefit of the drift to Internet delivery is that digital metrics are better online. IP TV was again highlighted.

Sambrook declared a challenge for the industry is to reflect the dominance of the consumer over the producer. It is the consumer who will ultimately determine the longevity of even the most trusted brands. Closed linear technology constrains the ability to adapt to consumer demands and many producers "Talk digital but act television". This resonated with production paradigms prevailing at the BBC.

Speaker: John Steinberg, CEO, MailOnline, USA

Strategic insights Session: The future of News.

Is television news actually dead?

Steinberg contrasted the cautiously optimistic tones of others in stating, "The young people have gone from TV and they're not coming back". The long-term implication is that News, as we have known it is at genuine risk of decline.

Outcomes:

The statement by Steinberg has direct implications for Channel 31, which if they can be embraced, may not be all bad. What can't be known for sure is what happens as young viewers mature.



Caption: 'The News' According to Michael Peters, CEO, Euronews, France.

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Speaker: Peter White, CEO, International Association of Broadcasting
Manufacturers (IABM), UK,

Business Operations Session: What future for broadcast technology?

Objectives:

To hear from the broadcast infrastructure vendors how they are dealing with the threat of IT and IP in the world of hardware, which has defined the television landscape for decades.

When does a product become a commodity? Where will the technicians come from?

White presented a number of graphs with an over all positive outlook. They revealed an obvious shift in investment to IP related services rather than traditional broadcast products.

He argued that hardware suppliers would have to become service companies or merge with service providers because into the future services will replace products. Traditional broadcast products are now commodities. Since the dawn of television purpose built hardware has dominated the technological landscape. Major capital infrastructure investment has been intimately linked to the large multinational companies like Sony who effectively steered the direction of Televisions progress. With the inevitable move to common off the shelf IT infrastructure, hardware becomes a commodity and suppliers become service providers.

During White's presentation he posed the question "How do we get trained staff?" In part answer to this he elaborated on IABM's training academy, which is training broadcasters in IP disciplines.

Speaker: Dan Castles, President/CEO, Telestream, USA

Business Operations Session: What future for broadcast technology?

Telestream started as a hardware supplier and looked at opportunities to move to software then to automation. Castles sees his company in the long term working with IT companies.

Castles was "Looking forward to DPP and 4K" and expressed confidence in the transition to IP saying "as a vendor change creates opportunity". His company appeared to have been set on an IT path for some time.

US private equity investment company, Thoma Bravo, has since acquired Telestream.

Speaker: Ray Cross, CEO, Quantel, UK.

Business Operations Session: What future for broadcast technology?

How does money come from clouds? Where will the technicians come from?

Cross made a simple but important point that "cloud = outsourcing". The merger of Quantel and Snell has strengthened a long-term equipment supplier that has aggressively engaged the digital era. With 4K and UHD TV (practically the same but technically different) ⁶ a high priority and they are still actually manufacturing.

⁶ Fautier, T 2014, Ultra HD deployment perspectives, Harmonic, USA.

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Cross was confident that monetising the net would come over time as “people will grow up expecting to pay.”

Quantel are looking for good people, sponsoring students and bringing people from technical colleges.



Caption: 4K looming as the next step.

Speaker: Marco Lopez, President, Grass Valley, Canada.

Business Operations Session: What future for broadcast technology?

Is all hardware based broadcast technology obsolete?

Lopez reported that Grass valley maintains a large Research and Development agenda. Consolidation was high on its business plan. Prime technical considerations were 4K, SDN's, migration to IP networks and the move from SDI to IP. “To monetise multiplatform you must automate”. Companies have to adapt and migrate existing customers, that is the broadcasters, from legacy, proprietary hardware driven systems.

Speaker: Charlie Vogt, CEO, Image Communications and Gates Air, USA

Business Operations Session: What future for broadcast technology?

Can broadcast suppliers go it alone? Where will the technicians come from?

Vogt was adamant that equipment vendors would need to vertically integrate. He urged the need for suppliers to consolidate, not the least because costs had increased. “The industry is ten years behind where it should be” and “ must get to a common protocol of IP”

In promoting SDN's as the way forward, Vogt said, “Software can't be tethered to hardware”.

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Vogt called for training in IP and software because the average age of a broadcast technician is 45 and they need new IP skilled entrants to the industry. He questioned if IT companies could 'take on' broadcast and stated that; "Customers have to move to the new platform". Companies such as Cisco & Microsoft are looking at media broadcast as vertical integration paths prompting him to further question, "who will consume whom?"

Outcomes:

Europe and the US are facing a similar dilemma as we are in needing to enhance skills in the areas of IP as it relates to Broadcast and AV.

In the US, for example, there are 1300 Television broadcast transmitters whose commitment to an analogue workflow using digital transmitters and allocated bandwidth in the UHF frequency has limited their capacity to radically innovate.⁷ Cable television by comparison has been adopting digital or IP workflows over time. More recently YouTube and other OTT services that " have evolved from niche offerings to disruptive competitors."⁸ simply piggybacking the Internet; have been devised from the ground up using IP. These new entrants are therefore much more agile and rather than being hamstrung by capital intensive resources are able to continuously modify and improve services and productivity using IT commodities. Video on Demand (VOD) and mobile devices 3G and 4G only accelerate the demand for production/distribution companies to innovate to IP solutions.

Caption: The Panel for "What future for broadcast technology?"

Speaker: Matt Brittin, Vice President, Google Europe, UK,

Day 2 Keynote

Topic: Transforming TV and Beyond:



⁷ How IOT's work 2012, The OnlineEngineer.org, viewed 22 February 2015, <https://www.youtube.com/watch?v=fx0asm1kvRw>.

⁸ Waesche, Dr N 2014, Multi platform delivery and customer data disruption: Do we need the broadcaster? International Broadcasting Convention 2014, Amsterdam, Netherlands.

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Google's vision of video for everyone, by everyone and everywhere.

Objectives:

To gain an insight to what a major innovator sees beyond traditional television. As the owner of "YouTube, which has redefined what we consider to be broadcasting."⁹ given the nature of Google to innovate in ways that directly impact the work of the AV technician this was a great opportunity to hear the thinking behind the hype.

Who will lose out in a post Google broadcast landscape?

Brittin delivered an upbeat presentation highlighting the whys and wherefores of how Google and consumers are changing the broadcast landscape. He likened today's TV to a 2006 mobile phone, "Not too intelligent". He talked enthusiastically about 'fans' not audiences heralding 'YouTube' where advertising revenues are being generated from 'performance' small users and Android TV as just two examples of how "the screen itself is irrelevant." Brittin's position is that "All media is going to be screen based" and reflecting statements from earlier in the conference the distinction between broadcast and the Internet is no longer a useful discussion point.

His view is "people want technology to get out of the way" echoing again Riedel's thoughts on content over technology. "The power of sight sound and motion" will ensure video is in the ascendancy. "Quality does not equal cost" meaning it does not have to be increasingly expensive to provide quality. Where the Internet distinction is currently useful is in the monetising of content, which will become ubiquitous by leveraging "micro payments".

Competition suggests a loser but Brittin stressed " Its a world of 'and' rather than 'or!'" Like many of the speakers at this conference, his sense was television and the Internet simply merge into 'screen' and the winners, potentially most current players, are those that integrate and innovate. Broadcasters will be integrating with IP. Hardware suppliers will be innovating with software. Brittin summed this up in saying " Its not the technology. Its about the power of partnership to bring innovation"

Outcomes:

It seems that Google doesn't need to revolutionise television as it will likely transcend it. Whether traditional broadcasters fall away or respond will in part depend on their ability to shed linear modes of thinking.

This will be true for AV technicians. Even digital natives need to be educated to thinking innovatively. This presentation was very much about depth of skills. The ability to harness technology to new outcomes and to bring new thinking to old problems.

⁹ Chronnell, D 2014, Transforming TV and beyond: Google's vision of video for everyone, by everyone and everywhere. International Broadcasting Convention 2014, Amsterdam, Netherlands.

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Caption: Google not standing still.

Speaker: Paul Gardiner, Standards Manager, Sony Europe Ltd, UK.

Technical Stream Session: Next Generation studio interconnection.

Objectives:

The Fellow was also responsible for the temporary relocation and long term reinstatement of television studio facilities at RMIT. This session provided the potential to not only inform the core questions in this report but also embed latest innovations into the process of redeveloping RMIT's Media Precinct. The session had major implications for the training of AV technicians. As SDI has been a mainstay of installation technology for decades¹⁰ and IBC 2014 had declared SDI 'dead', this was a not to be missed opportunity to understand why this was going to happen.

What is driving the demise of SDI?

Gardiner presented a technical overview of the broadcast landscape and the hybrid state of current production designs. A crucial consideration in getting the industry to embrace end to end live video over IP was the potential to:

- Reduce complexities and costs in both studio and outside broadcast (OB), removal of dedicated video, audio and communications cabling in favour of purely IP which can also continue to facilitate file based and general networking requirements.¹¹ A typical (OB) installation would see reductions in cables from 1300 to 500 and common 'off the shelf' switch fabric would provide additional economies.
- Enable video format flexibility across a network and future proof for the transition to UHD TV.

¹⁰ Crawford, D & Lodge, N 2014, Next generation studio interconnection. International Broadcasting Convention 2014, Amsterdam, Netherlands.

¹¹ Gardiner, P et al 2014, IP Live production, Sony Europe Ltd, UK and Sony Corporation, Japan.

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- Improve production workflows by being able to access media on desktop PC's,
- Centralise configuration, maintenance and diagnostics.

Speaker: Nigel Seth-Smith, Strategic Technology Manager, Semtech Corporation, UK.

Technical Stream session: Next Generation studio interconnection.

What technical hurdles inhibit an IT solution?

Timing any broadcast installation is crucial to maintaining synchronization and is currently distributed via the SDI network. However SDI cannot be made 'smart'. An IP based 'software defined network', consisting of a control plane and a data plane can have an embedded and smart timing structure built in that is able to self check from all points of the system. Starting with the timing epoch of 1970:01:01 at 00:00 all data is synchronised to the same universal time reference.¹² This process is yet to be fully realised though due to issues of robustness, reliability and clean switching.

Outcomes:

This session highlighted the opportunity realised by IT companies that the broadcast system has revealed. It is a tangible example of workflow innovation driven by leveraging one technology, IP, and seeing how it can be used in a new domain. It seems obvious with the benefit of hindsight but the cross over point of HDTV exceeding the capacity of SDI (now 3gbps but 12gbps for 4K) and the capacity of Ethernet (which leapt from 1Gbe to 10 GBe)¹³ to carry the required load has been converging for several years.

"The [Advanced television systems committee] ATSC Forum organised a "Boot Camp Workshop" in Washington D.C. on 7th May 2014,...". One of the slides presented, "perfectly summarises the ATSC3's disruptive approach with regard to the previous ATSC's evolutions and it equally sustains the [Future of Broadcast TV] FOBTV's suggestion: the Internet Protocol formalism shall become the point of convergence for the implementation of all MultiMedia services (including TV), with the direct consequence that, in the TV studios, the service signaling must be reformulated using an "IP language" to permit a delivery either over broadcast and/or broadband infrastructures."¹⁴

Interestingly, the Japanese 8K ¹⁵ process uses an optical system more akin to SDI but clearly by 2020 the same bandwidth convergence will no doubt occur with IT companies looking at that convergence point as a business opportunity. The actual transition to 'end to end' IP will, to a great extent, be phased as several parts of the process have standards declared but not all of the technical issues have been resolved. That SDI will disappear seems assured.

¹² Seth-Smith, N 2014, Broadcast timing, genlock and time code in the multi format network age, Semtech Corporation, Canada.

¹³ Gardiner, P et al 2014, IP Live production, Sony Europe Ltd, UK and Sony Corporation, Japan.

¹⁴ Faria, G 2014, The landscape for global broadcast standards, TeamCast, France.

¹⁵ Soeno, T et al 2014, Development of 8K-UHDTV system with wide- colour gamut and 120-Hz frame frequency.

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Caption: The rise and rise of software.

Conclusions from the various international experience, interviews and discussion:

When the Fellow originally planned to attend this conference he did not appreciate just how specifically it would address the needs of this project or the currency of the skill enhancement issues being addressed, even in Europe and for this reason alone the visit was timely.



Caption: The Fellow reflecting.

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Many screens – many more standards.

The foreseeable future for AV is screen-based. The distinction between Broadcast and online content will disappear. UHDTV delivered over SDN's at 4K and above with rolling innovation through HDR and increasing frame rates will maintain fluidity in the technology. IP renders SDI and other analogue, in nature, technology redundant.

'Oculus rift' and truly 3D technology remain an additional complication but continue to lie on the horizon.

In the work of AV technicians there have always been permanent and temporary installations but this experience has allowed the Fellow to reflect on these two aspects from a new perspective of competing commercial imperatives. The deployment of capital equipment into permanent installations and the tendency to lock down associated processes for maximum reliability, appear to influence the uptake of new technology negatively.

Workflow paradigms in these environments tend to mature and become difficult to dislodge even as budgets routinely squeeze downwards. Large scale but irregular upheavals such as the automation of news finally become financially imperative and cause rapid changes and considerable new capital outlays. However, they then must become stable, reliable platforms once again. Video conferencing is an example of technology that has experienced similar cycles and often the redundant equipment is physically in good shape having never moved during its operational lifetime.

In this cycle, research and development takes place in parallel, often externally and systems themselves reach a level of maturity before being implemented into permanent facilities.

By contrast, temporary installations can constantly make use of the most current and emergent technology, often it should be said, leveraging relatively higher budgets, such as Olympic games and Formula 1 motor racing, based on their enormous economies of scale. Also the constant rigging and de-rigging of equipment has an impact on the service life of the gear. It is into this environment that innovators are able to maintain a process of almost constant change. Here, the research cycle is more 'series' in nature and the innovators must be closer to the action. While this may not have been true for decades after the introduction of analogue television where the underlying technology did not change considerably it has proceeded to accelerate through the digital era and is now growing exponentially as AV processes merge in the IT era. At least one authority offers a caution on this point however that the CRT continues to have a damping effect on the design of television standards.¹⁶

Decreasing costs accompanied by increasing reliability of digital devices has been a major driver of change. It is the ability to make all systems intelligent, which is now the driving impulse for change. Even stalwart technologies such as SDI that digitized an existing analogue paradigm now have a sunset clause. They cannot deliver the needs of an SDN. Similarly broadcast over dedicated radio frequency facilities has been deemed by some as having only two years to run before delivery via the Internet becomes ubiquitous. While this is being driven by some of the biggest players, other big players will react on different time scales. As an example, permanent facilities heavily encumbered by legacy SDI chains and while still endowed with licenses to broadcast might continue to do just that. Channel 31's transfer to IP delivery may be seen as highly innovative by contrast if they can maintain their 'Fans'.

However, this does not instantly make the implications for training technicians clear. Whether permanent or temporary, AV installations require the deployment of transducers that convert light and sound waves to electrical signal and vice versa. Fundamentals such as the inverse square law, how our eyes and ears work and persistence of vision are not going change. Current innovations add to the mix rather than replace them and while SDI appears to be on the way out the overall quantum of technical knowledge required continues to grow. In the sphere of permanent facilities the role of the

¹⁶ Brooks, D 2014, The art of better pixels, Dolby Laboratories, Inc., USA.

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AV technician may tend to become more and more highly specialised and IT driven and consequently less numerous. In the sphere of temporary installations, however, the opposite seems true. The need to physically install will not easily be automated though some aspects are diminishing and disappearing from some parts of the industry such as heavy cables in OB and over time OB trucks to remote sporting venues. Innovation has often meant that more can be done with similar budgets so that sporting events have substantially greater numbers of cameras than ever before. Apparent exceptions where baseball, for example, uses 4K cameras to scan portions of the picture to reduce the overall number of cameras can be understood, as they are effectively if not actually permanent installations.

It is important to note though that these modes are not absolute. The nature of permanent installations is that they seldom sit absolutely still. They can foster however less flexible workflow outcomes. Similarly as temporary installations become more complex, achieve higher budgets or gain any level of repetition they will be documented and a system put in place to make them repeatable, which in turn constrains innovation.

7. KNOWLEDGE TRANSFER: APPLYING THE OUTCOMES

There are many possible approaches to disseminating the skills and knowledge accumulated by the Fellow during this international research. Specific recommendations are included in Section 8 following, but for the industry to benefit, dissemination should be implemented across all areas – to Government, Industry and education in particular.

- Preliminary findings from this Fellowship have been shared with colleagues and students in the weeks following the International visits and a presentation made to the School of Media and Communication in December 2014.
- Findings from the visits are being imbedded in the process of redevelopment of RMIT studio facilities that form part of the Universities 'New Academic Street' project which incorporates the 'Media Precinct'. This information is impacting internal parts of RMIT as well as external partners such as Architects, AV consultants and Project managers.
- The fellow presented his initial findings to the Program Advisory Committee of the Diploma of Audiovisual Technology, RMIT at a meeting in November 2014. Members come from a wide range of Audiovisual sectors including Installation, education and conference and formal presentations have been incorporated into future meetings of the now Live Production and Technical Services Program advisory Committee to ensure a broad distribution to the industry.
- Informal meetings have been held with members of Melbourne's production community and a formal presentation has been delivered to the Australian Video Producers association.
- Dissemination sessions for this report have been delivered for the Certificate IV in in Screen and Media (Television Production) program advisory committee and RMIT property services.

8. RECOMMENDATIONS

Industry/Government

By the time the NBN is properly rolled out in Australia SDN's will be mainstream technology around the globe affecting every corner of industry but certainly screen and media production and many arms of AV. Technicians entering the field over the next few years while still requiring legacy skills from the hardware era will increasingly work in the IP/IT paradigm. Often the biggest innovators in this business are the small operators who do not have resources to develop a work force. A ready supply of well trained youth is in the interest of business and government in Victoria as the AV technician remains the skilled individual between the CEO and his presentation reaching his employees and the Government official or politician getting his message to his constituents. Accordingly the Fellow is seeking support from appropriate departmental representatives and industry bodies to:-

- Maintain and increase support for training in Audio-visual disciplines through recognition of the Certificate IV and Diploma of Live Production and Technical Services as a protected and technical training discipline rather than simply an extension of 'Arts' education. Rationalisation of training providers through modification of funding models has left RMIT as the sole provider in this space.
- Recognise an ongoing industry need for operational staff that will come from a VET environment. Not only will highly technical, degree qualified electronic and IT professionals be required in Victoria in to the future but vocationally skilled staff will be actively sought by an industry heavily driven by local and international sport, entertainment and cultural events that continue to bolster the Victorian economy. The coincidence of 'White Night' with ICC Cricket in Melbourne in February 2015 is a case in point.
- Review units written for Diploma level programs where assessment is currently aimed at 'task management skills' almost to the exclusion of 'task skills'. Whilst task management skills should be highlighted at this AQF level a void seems to have emerged that becomes a roadblock to effective training engagement. New entrants to the workforce do not enter at management levels. The Fellow is currently engaged with the review process being undertaken by Innovation and Business Skills Australia (IBSA)

Organisation

- The Fellow has implemented changes to course delivery at an organisational level to reflect changes in the industry such as removing the training package unit 'Install and upgrade broadcast equipment' and replacing it with 'Implement vision systems designs'. The new unit can incorporate elements from the old while broadening the scope of training into the future. This has been undertaken for delivery in 2015 at RMIT.
- Engage new staff specialising in current vision systems. This has been implemented for expansion in 2015. While at RMIT the Fellow has been successful in applying this outcome it remains a challenge for the present to find suitable new training staff.
- Expand student 'critical' interaction with 'Facebook' and 'Youtube' as well as other social media and OTT services as destinations for content and as platforms requiring 'non-linear' approaches to media implementation. Within the School of Media & Communication this is being partly addressed in 2015 with the role out of 'Livestream' facilities and processes.
- The Fellow is proactively ensuring the redesigning of the RMIT Media Precinct television infrastructure will now have an improved level of detail around IP, 4K and other emergent workflow implications. Embedding of 'automation' strategies' is being pursued while maintaining traditional workflow methods for training diversity.
- The Fellow is pursuing opportunities for the development of Augmented Reality and VR technologies. At RMIT this is being facilitated by the Office of Executive Director Vocational Education (OEDVE) in conjunction with EON Reality.

8. RECOMMENDATIONS

Community/Industry

- The Fellow will engage with and support C31 in transition from broadcaster to 'internet caster' with the parallel aims of C31 's survival and opportunities for students. This initiative will role out during 2015 and before the expiration of C31 digital broadcast license.
- The Fellow is actively identifying opportunities to have Diploma level students work with members of the AVPA as that organisation continues to shift its workflows to fully file-based and ultimately IP operations.

9. REFERENCES

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10. ATTACHMENTS

Appendix 1.

Conference Material

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