Institution: University of Wales Trinity Saint David

Unit of Assessment: 32

1. Unit context and structure, research and impact strategy

UWTSD's submission under UoA32 focuses on research activity and outputs from the Wales Institute for Science & Art (WISA). This covers the broad range of methodologies and approaches from fine art and critical theory in the Swansea College of Art and applied design research in four specialist design centres, each of which interface with the needs of life-sciences and health professionals. This structure was initiated following the merger of UWTSD and Swansea Metropolitan University late in the previous REF cycle, and more recently the merger with the University of Wales. This research is therefore focused in two main areas: **i)** Design for Life-Science, Health and Wellbeing and **ii)** Contemporary Arts Practice.

i) Design for Life-Science, Health and Wellbeing.
Design based research has an applied focus and is principally based on the needs of the life-science and health sector, including NHS, health-based charities, industry, private sector service providers and veterinary sciences. This work is organised in three research centres. The Assistive Technologies Innovation Centre **(ATiC**), established in 2015, collaborates with the private sector, NHS trusts, research charities, and academic partners in the development of innovative products, services and systems in the health and wellbeing sector. The Cerebra Innovation Centre (**CIC**), established in 2004, is a collaborative endeavour between national charity Cerebra and UWTSD which conducts applied research to design and manufacture bespoke equipment for children with neurodevelopmental conditions where there is a shortfall in market-available products. The Wales Centre for Advanced Batch Manufacturing (**CBM**) was established in 2014 and is a leading authority in additive manufacture specialising in industry focused research, product development and batch manufacturing. CBM supports innovation across a wide range of disciplines and industry sectors including medical, veterinary and dental, aerospace and automotive.

ii) Contemporary Arts Practice.
Swansea College of Art has a long and established record of excellence in practice-based research drawing on interdisciplinary and collaborative research methodologies. Such creative explorations position our research nationally, with strong ties to Welsh art and culture, and internationally showcasing our innovative contemporary practices. As such work fits into three broad themes, of collaborative research with healthcare professions and communities to promote health and welling, with particular reference to sexual identity and sexual health; socio-geographic themes of identity, community and belonging, these ranging from local site responsive work to global geo-political issues; and theoretically informed work based on perceptions and readings, for example audience relationships with creative forms and objects, and also work on drawing, creativity, semiotics and literary criticism. Swansea College of Art also houses the Creative Industries Research and Innovation Centre **(CIRIC)** which has since 2005 been the primary vehicle for the development of multi-disciplinary, multi-partner collaborative knowledge exchange projects in the creative and cultural industries, and the Metadesign Research Centre **(MDRC).** Launched in 2019, MDRC acts as a bridging, collaborative and creative research space for those working in contemporary arts practice and those in design for life-science, health and wellbeing.

Objectives
Following the significant progress reported in REF2014, the unit's strategy has been growing the depth and breadth of research in contemporary arts practice, this being the focus of the ten staff submitted in that assessment exercise; establishing a firm research infrastructure in design for life-science, health and wellbeing; and to build a strong portfolio of research, this being aligned to broader knowledge transfer programmes which deliver significant research impacts.

Objective I: Establishing Research Centres

UWTSD was previously part of the Wales Institute for Research in Art & Design (WIRAD), a collaboration between the University of South Wales and Cardiff Metropolitan University. Despite the increase in research collaboration with both institutions in this period, it was agreed to make separate submissions for REF2021 for both practical and strategic reasons. For example, each university has expanded its research capability during the period (partly thanks to WIRAD); revised REF requirements have made a joint submission less practical; and the impact of COVID-19 has created additional logistical challenges. From this basis, significant investment has been made in establishing and consolidating UWTSD's five research centres, and each now has an excellent track record in partnership working, applied research, contract research and grant capture. Details of each centre and research output are provided below.

Objectives 2: Staff capacity

To achieve its objective of increasing research activity across the unit the University has invested QR income to maintain staffing levels and to free up research active staff. Additional external funding has been secured from EU Structural Funds, the EU Erasmus+ (Key Action 2) and Culture programmes, the Arts Council Wales, UKRI, charitable sources and HEFCW grants. This increased capacity has been used to support research as well as to increase the number of PhD supervisors and PhD students. The aim was to increase the number of active researchers from 10 staff (6.8 FTE) to 15 staff. The present submission sees a total of 22 current staff (18.2 FTE) submitted, along with a further 5 former members of staff, two of whom moved to new positions during 2020, and a third late in 2019. Of the total 12 are in the newly established design for life-science, health and wellbeing strand, and 15 in that of contemporary arts practice, evidencing considerable strategic focus and investment in both areas since 2014.

Objective 3. Research, knowledge exchange and impact.

ATiC, CIC and CBM.

Research and knowledge exchange activity in the area of design for life-science, health and wellbeing, was first established as an area of expertise through the Institute of Sustainable Design (ISD). Following a period of business planning, ISD was relaunched as the Assistive Technologies Innovation Centre (ATiC) in 2015. ATiC is currently engaged in a four-year partnership with Cardiff University School of Medicine, Swansea University Medical School and the Life Science Hub Wales, through the ERDF and Welsh Government funded ACCELERATE programme (total funds £33m). Led by Jenkins (Principal Innovation Fellow) and a team of six innovation fellows (Rendon Guerrero, Hagerman, Thatcher, Stokes, Soltani and Zhang), and research manager (Doolan), research brings together human-centred design thinking, design research methods and strategic innovation tools in a unique multi-modal research laboratory (described in Section 3). These unique facilities (including a Noldus reference lab) enable it to respond to the immediate challenges and commercial demands of healthcare providers, charities and industry with applied and collaborative RD&I.

A key focus of research encompasses user-experience evaluation and user-centred development of assistive devices and service innovation, such as infrared thermography for human-product interaction and multi-user virtual environments for physical education and sport training and exergaming (e.g., Jenkins 32-SJ1, Soltani 32-PS1). Stokes' interests include how bio data that are harvested on personal devices and wearable technologies can be used by designers and clinicians to prevent disease and injury and guide our health and wellbeing. Recent work in this area (e.g., 32-TS1) has been conducted in collaboration with PocketMedic Ltd. to better understand the behaviours of people living with dementia in domestic settings. Rendon Guerrero has investigated the possibilities of a low-cost prosthesis DIY kits and the optimisation of furniture design through parametric design tools. She has worked in collaboration with Head and the Cerebra Innovation Centre (32-YRG1) on a design optimised solution for bespoke helmet production suited to children with neurodevelopmental conditions. This is complemented by the recent appoint of Zhang, who works in the field of sports biomechanics, ergonomics, health and rehabilitation sciences.

Head likewise leads a team of product design engineers (employed by the national charity Cerebra) in the University's Cerebra Innovation Centre (CIC), and responds to requests from families to investigate and develop interventions to support independent living and to improve life-quality. The main focus here is on increasing social inclusion by utilising intelligent user-centred design. The products, once designed and manufactured, are given free to families at their point of need. CIC also works with partner companies to commercialize products. This is reported in REF3 (Head) and output 32-RH1, concerning an assistive seating device (Scooot seat) which has been licenced to Leckey/Firefly. Additional work in CIC, for example in collaboration with Surfability UK has focused on the design of a tandem seated surfboard which has allowed hundreds of wheelchair-bound users to participate in surf sports (32-RH3) and a novel set of assistive sports devices allowing children with cerebral palsy to take part in mass participation sporting events (both triathlon and marathon) (32-RH2). A further area of research output is in the design, optimisation and manufacture of medical equipment and devices. Work in ATiC is led by Hagerman, who has a background in synthetic chemistry (32-CH1) and Thatcher who specialises in CAD, rapid prototyping, CNC machining & 3D data capture (e.g., 32-NT1).

The design, optimisation and manufacture of medical equipment and devices is also a key area of research output in the Wales Centre for Batch manufacture (CBM) which has gained British Standard ISO accreditation for both ISO13485:2016 (Design & Manufacture of Custom-Made 3D printed surgical guides and implants intended for end user sterilization) and ISO 9001:2015 (provision of a design, prototyping and small batch manufacturing services). CBM has developed implant solutions enabling the significant reduction in surgical times and dramatically increasing the success of clinical outcomes in the veterinary field. Patient specific implant systems cover limb sparring systems, angular limb deformity correction systems, mandibular implant systems and tailored spinal stabilisation systems (e.g., 32-LS2). Through this research and consultancy, CBM has developed key working relationships with world leading veterinary referral centres and surgeons in various disciplines, being involved in the design and manufacture of over 120 successful patient specific implant systems (e.g., 32-AL1, 32-AL2). In the veterinary sector, collaborative research has seen outputs on the design and development of bespoke surgical devices for the efficient treatment of osteosarcoma in large breed dogs, and the creation of bespoke orthopaedic implants for small dogs (reported in REF3). Additional research has included the design and production of prosthetic devices for dogs.

Swansea College of Art.

Work in Swansea College of Art fits into three broad themes: collaborative research with healthcare professions to promote health and welling (especially sexual identity and sexual health); socio-geographic themes of identity, community and belonging; and theoretically informed work on perceptions and readings. Health and wellbeing research is demonstrated for example in Williams' work *Throb* (32-SW3), a collaboration with Professor Nick Ossei-Gerning (Consultant Interventional Cardiologist, University Hospital of Wales) regarding vasculogenic erectile dysfunction and also in her response to the Covid pandemic through *Bear Red* (32-SW6). Lockheart's *DreamsID* continues this theme, in collaboration with Professor Mark Blagrove (Director of Swansea University Sleep Lab), working on new approaches to dreaming and empathy (32-JL2, 32-JL3). This builds upon earlier work by Ingham (former Professor, now Fellow) on neurology and intersections in art and science (32-KI1) as well as that of Maddock who explores the ways in which craft, making (in this case knitting), mending and care can promote wellbeing (32-AM1). Questions of wellbeing are central to the second theme of identity and belonging. Franks' work on youth participatory theatre practices (for example 32-AF1) explores issues of sexual consent in teen-cultures, which are also enduring themes in Williams' practice, seen vividly in *My Cherry Bomb* (32-SW1). These are strong themes in the work of Webster and Roy Efrat. Both *Pansy* (32-CW2) and *Passing* (32-CW3) create new thinking around painting while exploring contemporary LGBTQ issues.

Broadly socio-geographic themes of community and belonging, and their exploration through creative practice have seen significant development with Webster's theoretical work (32-CW1) with John Wyle (Dept. of Geography, University of Exeter) and explored further in practice during

her residency at the British School in Rome (32-CW4). Davies' site responsive pieces *Figures on the Foreshore* (32-TD1), commissioned for the major Thames Tideway infrastructure project, explores and connects people to local history and locality, as does his work for the Vancouver Biennale *Figures in Stanley Park* (32-TD2). Wood's three projects interrogate definitions and categories of scale and the complex matrix of interconnectivity between the banal and the profound and the local and the global (32-CWD-1). Specific explorations are based on China through the *Chongqing Project* (32-CWD2) and Georgia in his *Tbilisi Project* (32-CWD3). The broadly semiotic and affective or phenomenological relationship between people and their environments are extended at a different scale in the readings and perception theme. Duncan's work, *Blow In* (32-AD1), explores our haptic engagement with objects, while Moule's *Latent Frequencies* (32-RM1) and *Vessels & Vestiges* (32-RM2) solicits audience engagement in the collective responsibility of viewing photographic images. Williams (J) work *Infinito Presente* (32-JW1) uses observational drawing to explore the value of the activity of drawing. These themes exploring the value of creative practice, and the relationships between theory and practice are explored in different ways in Riley's, Lockheart's and Allen's outputs, ranging from the pedagogical equity (32-JL1, 32-HR1, 32-HR4), psychosocial approaches to drawing (32-HR3), semiotics (32-HR2), Deleuzian and deconstructive approaches to writing (32-MA1, 32-MA2), and literary criticism (O'Neill and Jones; 32-TON1, 32-RJ1).

Strategy 2021-2025.

Targets for next five years are based on growing the existing areas of design research in the Assistive Technologies Innovation Centre, Cerebra Innovation Centre and the Wales Centre for Batch Manufacture; increasing grant capture from UKRI and replacing ERDF income (for example through UK Government regeneration funds alongside other regeneration grants and funds from local and regional bodies). We will further develop collaborative research and knowledge exchange partnerships to enable research impact through Innovate UK funding and Knowledge Transfer Partnerships. The Centres will also seek to support spinouts from the research base and intellectual property with University co-ownership and seek to incentivise staff start-ups. Capital investment will see the development of the 'Innovation Matrix' research and knowledge exchange building in the University's Innovation Quarter. This being a part of our commitment to the transformation of Swansea as a 'Digital City' part-funded by the Swansea Bay City Deal.

Open Research

Following the University's Open Access Publications and Data Management policies, all researchers in the unit are actively encouraged to seek out opportunities to publish in open access journals or those that have acceptable embargo limits. Central licencing agreements with major publishers (e.g., through Jisc) have accelerated the Unit's transition to open access publishing models in this regard. In cases where gold open access is not possible researchers are strongly encouraged to publish under the green route and make the output available under creative commons licences in the UWTSD open access publications repository. As an essential competency and rapidly evolving policy area, all staff are encouraged to participate in training and staff development in this area, which is led by the open access team in Learning and Library Services. Staff also work closely with Research, Innovation and Enterprise Services developing research data management plans for funded research proposals. A culture of open access is embedded in contemporary arts practice as exhibitions are premised on communicating an idea to a wide and varied audience. The University has close ties with several venues in this regard (e.g., Elysium Gallery, Mission Gallery, Glyn Vivian, Gallery TEN).

Research Integrity

Human participation is critical to much of the unit's research and knowledge transfer. Consequently, research integrity is essential and all applied research projects undertaken with external collaborators are submitted to the University's ethics committee for approval. In addition to following the UWTSD Research Ethics & Integrity Code of Practice, the UWTSD Data Management Policy, many projects also follow the British Psychological Society (BPS) Code of Human Research Ethics. As such the unit has full accountability and are able to provide assurances to the sponsors, participants, recipients and those who undertake research that robust measures are being taken to support

high standards of research integrity. Researchers for example are engaged in a variety collaborative projects in partnership with other Welsh HEI's and University Health Boards (UHBs) where ethical approval is required. This varies depending on the level of engagement with NHS patients and/or staff. For example, collaborative work with NHS hospital staff at Cwm Taff Morgannwg UHB requires approval for service innovation while work involving patient participation at Hywel Dda UHB requires full NHS REC approval. The work undertaken by CBM requires it to operate quality management systems that comply with ISO 9001:2015 and ISO 13485:2016 & EN ISO 13485:2016.

2. People

2.1 Research Staff

Recruitment and Development.
The unit's staffing and recruitment policy is driven both by its research strategy and by the need to ensure equitable access and opportunity for all staff to engage in research at early career, mid-career and late-career stages. The University is committed to the principles of the Researcher Development Concordat and facilitates researcher development and research time through the staff appraisal process. Individuals plan and agree their research activity with their line manager in-line with the unit's research objectives. The degree to which they are released from teaching to engage in research and knowledge exchange is dependent on funding and strategic research priorities. This strategy is focused on maintaining support for successful areas of research in contemporary arts whilst building up research activity in design, as it relates to life-science, health and wellbeing. In this regard, research staff have benefitted from opportunities to take sabbaticals to develop their research and practice. In the field of contemporary arts this includes for example Webster spending extended periods undertaking work in Rome; Jeff being released for half a year to finalise a book project; Wood released for a year (2017-18) to collate a retrospective body of work. Several staff are seconded to research projects as detailed below

Regarding staffing patterns, of the twenty-two submitted staff, sixteen are on permeant core-funded contracts, the remaining six on 4-year project funded contracts, which will be extended wherever possible to retain our research capacity. Fifteen of these are full time, with half of the remaining combing academic work with wider creative practice (for example on a freelance basis). Early career researchers are supported either through direct appointments to research and knowledge exchange roles (e.g., Hagerman, Rendon-Guerrero, Zhang, Soltani, Thatcher); or by releasing them to contribute to research projects (e.g., Stokes). In many cases this can take the form of a full-time or part-time fixed-term secondment from a substantive post. All new research appointments undergo a 6-month probationary and induction period during which they are encouraged to identify and develop personal research interests aligned with key areas of capability and/ strategic research interest. Mid-career researchers are encouraged and supported to take on greater leadership of research. Examples include Jenkins secondment from Head of School of Design to Principal Innovation Fellow in ATiC; Howe's secondment from Head of School of Engineering to be Head of the MADE project in CBM; Doolan to be Project Manager in ATiC, Webster to lead on PGR and Lockheart to lead on contextual theory and to establish MDRC.

CBM also employs a comprehensive training program creating a multidisciplinary workforce. The centre currently has three members of staff seconded to the MADE suite of European funded projects, *Advanced Design Engineering* (ADE), *Upskilling for Industry 4.0*, and I*nternational Innovation Masters* (detailed in part 4). In support of this policy the University also releases staff to undertake external leadership training for strategic research and innovation such as that provided by HEFCW. For very senior, late career researchers, the emphasis is on ensuring research knowledge is retained and cascaded to ensure continuity and succession planning as in the case of research fellows such as Prof Kelvin Donne and Prof Howard Riley. Our strategy is inclusive of those staff on fractional and hourly paid contracts who are critical to the research environment. As opportunities arise, the strategy is to move early carer research staff onto permanent fractional and full-time contracts (e.g., Duncan. Moule, Head, and Doolan). Two of

CBM's previous cohort of funded PhD students have been employed by the centre. Asanovic is employed full-time in the role of Medical Project Engineer and Gupta is employed on a fixed-term contract in the role of Research Officer assigned to ADE within the MADE project. Both are being supported to move into research independence.

More generally, academic staff use a planning and workload management tool, which is negotiated and agreed with the line manager and is aligned to the Performance and Development Review Scheme (see REF5A). The University provides financial support for conference attendance for professional learning and dissemination purposes, and for doctoral fees where staff are undertaking PhD studies. There is recognised time allocated in the academic activity profile for research activity. Other forms of support for staff engagement in research activity include financial support for research centres as a seed fund. Professional development opportunities are equally available for all members of staff regardless of whether full-time, part-time, fixed term or hourly paid members of the academic community.

The unit also supports staff in developing relationships business, industry, public and third sector bodies. In the area of design for health and wellbeing, UWTSD works closely with Hywel Dda University Health Board (HDUHB) with Prof Ian Walsh (ATiC Director & Provost) sitting on the Board's R&D Committee. HDUHB have incorporated ATiC as a key partner in their five-year plan (2021/26) for their new Clinical Engineering, Innovation and Research team. As part of this exchange a newly appointed Clinical Scientist / Engineer will be seconded to ATiC for a 12-month period, funded by the Accelerate programme, to facilitate knowledge transfer between the University, HDUHB and private sector companies and build a consortium of collaborative partners to support RD&I in medical product and healthcare technologies. This has been strengthened by the conferment of the title of Professor of Practice to Chris Hopkins, Head of Clinical Engineering and Consultant Clinical Scientist at HDUHB. Similarly, Jenkins sits on the R&D Committee of Cwm Taf Morgannwg University Health Board.

Equality and diversity

In preparing its submission to UoA32, the University has complied with the processes detailed in the approved REF Code of practice, in order to ensure that equality and diversity responsibilities are fully considered. This has included regular reporting through the University's governance process, a University wide process in activity profiling, a full staff briefing programme, ongoing opportunity to declare personal circumstances, an appeals process and data analysis to undertake equality impact assessments. The analysis highlights that the submission has a significant gender bias (64% male, 36% female), against the entire cohort of submitting academics in the University which is 42% male and 58% are female). The selection of outputs however partly mitigates this imbalance, with 43% female and 57% male. An objective of the University's Strategic Equality Plan is to address gender inequalities including consideration of participation by women in STEM and design subjects. There is no evidence of discrimination between any age group with a broad distribution of staff between 26-34 (18%), 35-44 (23%), 45-54 (27%), 55 -64 (23%) and 65+ (9%). 91% of staff declare their ethnicity as White, which is consistent with the University's entire submitted cohort. Within the Strategic Equality Plan the University will consider appropriate actions to increase the diversity of its workforce and this will include a review of recruitment and selection policy, process and practices. Further analysis is published in the full equality impact assessment.

The unit's approach to supporting and managing the well-being of staff is focused on prevention and early intervention strategies. The implementation of family friendly and flexible working polices enables people to balance work and caring responsibilities, and the principles of equality and diversity are fully embedded across all employment related polices and processes. Flexible working arrangements, including working primarily from home (facilitated by VPN connection to the IT network) and job-sharing, have enabled colleagues with carer roles to adapt work patterns to diverse personal circumstances, thus ensuring retention of experienced staff. This flexibility has been essential to ensure continuity of research projects during the periods of national Covid lockdown. Staff with caring responsibilities have the option to move to a fractional contract if they wish. In case of prolonged medical leave, staff receive support upon return with a phased

return to full duties. The University offers all staff this level of support for research activities (e.g., grant application, training, conference support) and professional development opportunities, which are equally available for all members of staff regardless of whether full-time, part time, fixed term or hourly paid.

2.2 Research students

Recruitment.
The unit has a pursued a successful strategy in developing the postgraduate research environment, developing collaborative research programmes and in recruiting research students. Since 2014, forty students have joined our programmes and twenty research degrees were awarded, an uplift of 40% on the last assessment period. A key priority in this regard has been to develop collaborative and funded projects with industry, the NHS and the third sector, which are aligned to our strong practice-facing research and knowledge exchange strategy. In this regard, we have seven Knowledge Economy Skills Scholarship (KESS) PhD scholarships with funding from the European Social Fund (£321k for the unit's students). The provides students full bursaries at UKRI rates, fee waiver, a £9k training allowance and access to collaborative training with other universities in Wales (Cardiff, Swansea, Bangor, Aberystwyth, South Wales and Cardiff Metropolitan). These are collaborative projects with students working with key partners, including Hywel Dda University Health Board, Cerebra, Orangebox, Coastal Housing, Gwalia Care and Support and the Mission Gallery. This builds upon the earlier round of KESS funding in which the unit had four students (now completed). Since 2015 CBM has also funded three full PhD scholarships focussing on the application of advanced manufacturing technologies to the medical sector, with two now working in full time research posts in the Centre (Asanovic and Gupta). Looking forward, the relationship between taught post-graduate teaching and research is central to our sustainability. Masters' numbers have grown from 15 students per year in AY14/15 to 150 in AY19/20. This growth, combined with increasing numbers of research students, is creating a critical mass in our postgraduate research culture. This is being supported by the University through the allocation of new research and studio spaces for these students alongside research staff, in the refurbished Alex Building.

Supervision and Training.
As noted in REF5A, the University has an exceptional record in research supervision and training, as evidenced in the 2019 Postgraduate Research Experience Survey, ranking 17th overall (out of 103 institutions), with scores in the top 10% of institutions for supervision (1/103), research skills (6/103), professional development (8/103). Upon acceptance by the UWTSD PGR Applications Sub-Committee PGR students are enrolled within the relevant research centre, and all have access to university wide opportunities for training and researcher development, as well as to locally arranged programme specific provision. Doctoral research students are supervised by a team of at least two supervisors (lead supervisor and second supervisor), often a mix of ECR and experienced researchers. The Institute has a Manager of Graduate Studies (Webster) overseeing all research students. Important milestones on that journey include submission of the full research proposal, ethics submission and probation interview (half-way through the period of study). The University's central progress review board monitors the progress of all research students on an annual basis. Where problems arise, additional support, training and action plans are established. These systems are centrally monitored by the Academic Office who can ultimately withdraw a student if satisfactory progress is not made.

Students on the PhD programme are encouraged to establish personal development plans using Vitae's online RDF planning tool. To support this, all PhD students are invited to attend the termly research days held within the institute at which staff and research students come together to share, critique and discuss their research. This is a supportive forum at which research students often rehearse their presentation skills prior to presentation for a wider audience. PGR students, upon completion, are supported to draft a post-doctoral publication and research plan. Students in Art and Design are encouraged to share their work at local, national and

international fora. Additionally, all students are invited to present at the annual Summer Graduate School (in Lampeter) and at the Postgraduate conferences which also offers the possibility for distance-learning students to present via online facilities. Some research students also have the opportunity to develop teaching skills and to gain teaching experience. The University runs a PG Cert in HE Teaching for research students on teaching contracts.

In addition to institute-based provision, students receive training in generic skills as part of the centrally organised Researcher Development Programme (RDP). Research, Innovation and Enterprise Services (RIES) offers a series of training events including webinars (e.g., in publishing, presenting at conferences, preparing for the viva) in order to accommodate distance learners. The University is currently setting up a new University-wide Doctoral College that will pull the activities of RIES together with other training events offered in each Institute. The majority of the forthcoming RDP provision will be delivered online using expertise gained through Wales Academy for Professional Practice and Applied Research experience in developing communities of practice. This reflects strong student preference for distance-based opportunities, as well as the current experiences of online provision with COVID19, and a commitment to flexible provision in support of equality and diversity considerations. In this regard, UWTSD has an effective student support system in place on every campus, which is equally available to research students. They are supported by the Learning Support Team within the Student Services which provides comprehensive support for students at all levels with specific learning difficulties including one-to-one support for disabled students.

3. Income, infrastructure and facilities

As noted above, the unit has increased its research infrastructure since 2014 by arranging its research activities around research centres. A priority in this regard has to been to both support existing long-term research infrastructures (e.g., CIC, CIRIC), develop these through new collaborative arrangements as the research landscape evolves (e.g., ATiC) and establish new centres to build capacity that is responsive to new challenges and opportunities (e.g., CBM, MDRC). As the University's strategy places equal emphasis on research and impact, income generation is not solely based on basic and applied research, but equally on securing resources for organised programmes of research-based knowledge exchange. This includes project work, consultancy, continuing professional development and commercial contracts. In this respect a summary of total grant income awarded (rather than drawn down) within the REF period totals £15.6m. In accordance with accounting rules, the value of much of this research and knowledge exchange activity as supported with structural funds from the EU (ERDF, ESF) and Erasmus +, is not recorded as research income in HESA Table 5, although these are a major source underpinning research in the University.

Cerebra Innovation Centre established in 2004, in a collaborative arrangement with national charity Cerebra and UWTSD. The centre is joint funded to offer creative design solutions to children with neurodevelopmental conditions, with an annual grant from the national charity Cerebra (PI Head, total £213k). Cerebra fund a team of product design engineers while UWTSD and Cerebra continue to co-invest in physical infrastructure (design studio, workshop / equipment, materials and office space). Director (Prof Walsh) and Design Manger (Associate Professor, Head) are employed and funded by UWTSD. A revenue sharing scheme is in place for royalties generated from the IPR licencing of CIC originated designs, which is reinvested into RD&I activity (see REF3-Head).

The Assistive Technologies Innovation Centre was established in 2015, building upon the former Institute of Sustainable Design, a joint venture led by UWTSD (formerly Swansea Metropolitan University) and Cardiff Metropolitan University (2011-2015) with £1.3m in the current REF period. ATiC is currently engaged in a four-year partnership with Cardiff University School of Medicine, Swansea University Medical School and the Life Science Hub Wales, through the ERDF and Welsh Government funded £33 million *Accelerate* programme established in 2018, to generate economic impact in the Life Science Sector in Wales. Total UWTSD budget is £4.6m.

The Wales Centre for Advanced Batch Manufacturing (CBM) was established in 2014 and is a leading authority in additive manufacture specialising in industry focused research, product development and batch manufacturing. Originally established as a joint venture between the now merged University of Wales, and UWTSD, the centre was established by Prof. Brown, building upon the success of earlier infrastructures on which he led (e.g., PDR, Cardiff Metropolitan University). The Centre attracted very significant investment in 2018 with £1.72m in funding secured from Welsh Government (WEFO / ERDF) for the RD&I *Advanced Design Engineering* operation. This team has worked with over twenty SMEs in the area of additive manufacturing technology adoption. The Centre is also currently running two large CPD programmes with funding from the European Social Fund. *Industry 4.0* (£2.12m) and *International Innovation Masters* (£2.3m) which are delivered alongside the research-based ADE, as part of a suite of MADE projects. These are extending CBM's research reach and interaction with industry in Wales.

In the area of contemporary arts practice, we have secured funding for two AHRC projects, *CX Group Therapy* Project (Co-I Ingham) *Cross-pollination: Re-valuing Pollinators through Arts and Science Collaboration* (PI Liggins, £36k, with additional co-financing from the Arts Council Wales of £19.5k) and *Throb*, also with funding from the Arts Council Wales (PI Williams, £25k). Consultancy and contract income, largely in the Architectural Glass Centre has seen further income of (£70k). A key strategic priority for developing research impact has also been to develop funded collaborative research and knowledge transfer opportunities with industry, the public sector and communities, both in the UK and Internationally. We have secured European funds from the Culture Programme for a craft based making project, *Craft Hub* (PI Doolan, £93.6k); two Erasmus + strategic partnerships in the *European Open Design School for Sustainable Regional Development* project, (Co-I Doolan, £85k), and the *Arts and Humanities Enterprise Hub* (PI Doolan, £100k). Further funding from the Ireland Wales Interreg programme has been secured for the *ACT* project (PI C Holtom £375k) and the *CATALYST* project (PI Holtom, £730k), as detailed in Part 4.

Specialist research infrastructure and facilities

Since 2014 the University has made significant capital investment in developing the research infrastructure in Art and Design. Swansea College of Art has benefitted from a £14m investment in the ALEX Design Exchange (opened Aug 2014) which accommodates the Cerebra Innovation Centre along with a range of technical facilities to support PGR. Within the totals reported above, the Assistive Technology Innovation Centre has received £1.1 m in capital investment building upon £500k investment in the Institute for Sustainable Design. ATiC's User Experience (UX) Laboratory includes research systems for behavioural observation and analysis, psychophysiological measurement, bio-mechanical motion capture and analysis, 3D scanning and computer aided modelling, visualisation and virtual simulation. These are augmented by extensive additive and computer-controlled prototyping systems for new product development and testing. In 2019 Noldus recognised this as its first Reference Laboratory in the world in 2019 (out of the 9000+ it supplies). The Centre for Batch Manufacturing has seen a capital investment of over £1m for equipment. Facilities comprise of technology platforms including additive manufacturing in both metals and polymers, 3D Scanning, CMM Metrology, Reverse Engineering, Precision CNC Machining, Carbon Fibre Layup, Low Volume Manufacturing and Non-Destructive Testing.

2021-2025

Looking forward over the next 5 years the next phase of infrastructure development will be a further investment of £1.4m in Swansea College of Art in developing new Creative Industries and Art Enterprise facilities in the former BBC Building in Swansea and £8m in a new Innovation Matrix to support applied research in design and innovation aimed at addressing the UK industrial strategy Grand Challenges.

4. Collaboration and contribution to the research base, economy and society

Collaborations

Staff in each research centre are involved with applied research and knowledge exchange programmes, designed to deliver impact. Centres work collaboratively with academic, public and private partners to deliver economic, health, cultural and societal benefits. We also seek to achieve impacts at an international level through collaborations with our Europe-wide network of academic and creative industries partners. The work of CIC for example builds upon UWTSD's record of delivering RD&I in the field of health and social care. In this regard staff currently engage with a number of regional health boards in South Wales, notably Hywel Dda, Cwm Taf and Cardiff & Vale as well as numerous medical and assistive technologies businesses. Likewise, through its successful collaborative RD&I activities ATiC has developed a reputation for its ability to deliver effective applied research to address real healthcare challenges across its network of connections with University Health Boards, research bodies and other funded partners over the past three years that will ensure the long-term sustainability of its research impact. For example, ongoing projects led by Stokes & Hagerman are supporting the deployment of digital whiteboards with Cwm Taff Morgannwg University Health Board (CTMUHB) and the NHS Wales Informatics Service (NWIS), who will work with ATiC to explore the barriers and enablers for its full deployment across the rest of the UHBs and NHS Wales. As a direct result of this project's impact and collaborations with industry partners also working with the health board in fields such as VR therapy.

Jenkins has been invited to sit on the CTMUHB R&D Committee. This is a result of the impact of research in the field of respiratory medicine and the vital contribution ATiC made to several Covid-19 challenges set by NHS Wales and Welsh Government (Business Wales) to address the critical shortfall in essential medical products, such as Non-Invasive Ventilator (NIV) masks and ventilators during the first wave of the pandemic. Hywel Dda University Health Board have also incorporated ATiC as a key partner in their five-year plan (2021/26). ATiC will partner with their new Clinical Engineering, Innovation and Research (CEIR) team to support companies to develop and gain rapid regulatory approval from the Medicine's & Healthcare Products Regulatory Agency (MHRA) for CE marking of new medical products and health monitoring technologies. This partnership will include a variety of initiatives such as secondment of research staff between CEIR and ATiC, collaborative R&D projects in fields such as respiratory medicine, development of bespoke assistive devices, usability engineering evaluations of medical products and joint funding applications.

Responsiveness to national and international priorities

ATiC's applied research activity directly addresses the UK Government's Industrial Strategy grand challenge of an Ageing Society and the Welsh Government's A Healthier Wales: Plan for Health and Social Care. Key priorities are (i) improved population health and wellbeing; (ii) better quality and more accessible health and social care services; (iii) higher value health and social care; and (iv) a motivated and sustainable health and social care workforce. With the shared challenges of an ageing population, ATiC has also developed an international strategic partnership with the Universal-Care Design Laboratory (U-CDL) in Wuhan University of Technology, establishing the UK-China Care Design Research Partnership in 2019. The similarities between research groups are reflected across other departments at both institutions, a synergy that will facilitate new potential for interdisciplinary research collaborations to develop across art, design, engineering, science and technology, and are seen in the Centres' broader support for impact.

Impact

The focus on health and wellbeing at Swansea College of Art has encouraged collaborations between artists and health practitioners or mental health specialists. Williams' Arts Council Wales project *Throb* (32-SW3), for example, was a collaboration with Professor Nick Ossei-Gerning, Cardiologist at University Hospital of Wales, Cardiff, exploring the issue of sexual dysfunction, male vulnerability and male perceptions of female sexual autonomy. The particular focus of the underpinning research in the project was the medical condition of erectile

dysfunction, which effects one in two men over 50, and can signal underlying health conditions including heart disease. peripheral arterial disease and depression. Addressing these issues, the project produced a series of debates, exhibitions and performances that combined painting and drawing installations, music, poetry and theatre installation. These artistic responses developed new models for artists and medical practitioners to frame debate, discussion and understandings on how erectile dysfunction has affected individuals and partners, and how that is understood by artists, the medical profession and society at large. Similarly, the art/science collaboration *DreamsID* (32-JL2) was further developed during the first national coronavirus lockdown (March to July 2020), in which Lockheart and her collaborators at the Swansea University Sleep Lab ran nine fortnightly *Lockdown Dreams* events online for NHS staff and other keyworkers. Each event reached audiences of around 250 participants, and explored changes in sleep patterns. During the pandemic many people (esp. frontline workers) were dreaming more or remembering more of their dreams, and the looming threat of the virus may have affected the nature of the dreams themselves. DreamsID adapted quickly to the need for this online forum as a way for NHS key workers to understand the ways in which dreams can alleviate distress, and lead to greater empathy, social bonding and achieve therapeutic outcomes.

Achieving broader health and well-being impacts are central to the Cerebra Innovation Centre's activities and research output. While Head and the CIC team have worked with hundreds of children and their families since 2014 to either produce new assistive devices, or modify others, outputs 32-RH2 (triathlon devices for brain injured children), 32-RH3 (tandem seated surfboard for disabled use) and 32-YRG1 (optimised solution for a bespoke helmet service) typify the broader impacts achieved by the Centre. The tandem seated surfboard is used at multiple locations and allows wheelchair-bound users to participate in surf sports, bringing proven benefits for inclusion, physical health and mental wellbeing. Four of the seated surfboards were distributed to various specialist surf schools; Surfability, various Wave Project locations, the Mae Murray Foundation and Sean's Club in Japan. The development of the board and its safe use subsequently informed international standards for disabled surfing and enabled the co-developer, Benjamin Clifford, to achieve accreditation with the Welsh Surfing Federation to train surf instructors in disability surfing. The board is frequently reported in the national media (e.g., the BBC's Country File and DIY SoS) contributing to public understanding of participation in sport by differently abled children. Similarly, the assistive triathlon equipment was displayed in the National Museum of Wales for six months and has allowed disabled children to participate in multiple events (e.g., Cardiff and Swansea Triathlon, Superhero Series triathlon) and multiple UK and international marathons, with well documented health outcomes. Similar impacts have been achieved regarding hippotherapy, where horse-riding is a well-documented intervention for children with physical and neurodevelopmental conditions. The collaborative project between Head (CIC) and Rendon Guerrero (ATiC) developed an optimised service for the production on bespoke helmets. This has increased participation for Cerebra clients as many children with conditions such as cerebral palsy, autism and craniosynostosis have unique and non-conventional head shape and size, and are often excluded from activities requiring protective headwear as off-the-shelf models have a poor fit and do not offer adequate protection.

Knowledge Transfer

Such impact and knowledge transfer activities are central to each centres' long term research strategy and business plan, and the unit as a whole has established a very successful portfolio of projects since 2014 to reach and interact with diverse organisations, industries, and publics. The Creative Industries Research and Innovation Centre (CIRIC) is a key component of this knowledge transfer strategy being established in 2005 to build a sustainable knowledge exchange framework for researchers to engage with external businesses and collaborative partners and to extend the research base. Since 2014 it has delivered a stream of very successful knowledge transfer projects. At the European level, CIRIC pursued a successful strategy of participation in European cooperation and knowledge transfer through engagement in the EU's Erasmus+ programme, under Key Action 2 Strategic Partnerships (Cooperation for Innovation and Exchange of Good Practices). The *Arts and Humanities Entrepreneurship Hub*, led by Doolan, is an alliance of fourteen partners from seven European countries who work together to jointly research, design, test and disseminate entrepreneurial training for arts and

humanities staff and students. This ongoing project will lead to the creation of an open-access website to complement the creation of seven entrepreneurship hubs to provide long-term support for art and design graduates. *Craft Hub* and *DeuS*, led by Doolan are also multi-partner EU funded projects aimed at boosting creativity and enterprise amongst art and design practitioners by highlighting the transformative power of design and craft. *DeuS* is shaped around the Open Design School, the pillar project of Matera 2019, European Capital of Culture. The Open Design School is a design laboratory using a peer-to-peer approach, where professionals of any discipline work together sharing knowledge and expertise and testing the design solutions with the local community. The project is a partnership representing the following European countries - Austria, Denmark, Finland, Italy, Lithuania, Malta, Netherlands, Slovakia, and the United Kingdom. *Craft Hub* is funded by the Creative Europe programme with the aim of supporting 'at risk', 'established' and 'emerging' craft practices across partners and stakeholders in Wales, Scotland, Germany, Greece, Denmark, Norway and Portugal. *Catalyst*, led by Holtom, is a five partner Ireland-Wales transnational cooperation project (Interreg) involving centres in Wales and Ireland. This project focused on wellbeing and sustainability and has fed into the work of ATiC as well as seeding the development of legacy collaborations with our Irish partners.

Metadesign Research Centre

Established on 2019, the Metadesign Research Centre (MDRC) is a vehicle to support and develop interdisciplinary research across the University. The University's commitment to Metadesign began with the appointment of Professor of Practice John Wood in 2018. This is supported through a formal programme of research seminars and hub meetings which facilitates knowledge exchange between researchers from across UWTSD as well as from other collaborating universities (although the planned programme of events has been delayed by the Covid 19 pandemic). Metadesign employs regenerative design thinking and making tools for the needs of humanity, with the health and sustainability of our planet as the key stakeholder. These theoretical and intuitive principles are embedded within the research strands across all provision and will impact significantly on the growing research culture at post-graduate level. The particular focus for the MDRC Wales is to work with the Wellbeing of Future Generations (Wales) Act (Welsh Government, 2015) and to engage with the environmental legacy and knowledge situated within the Welsh language. The Journal of Writing in Creative Practice (Intellect) was co-founded and co-edited by Lockheart and Wood (2007-present), and the WritingPAD network, directed by Lockheart, are now housed within MDRC. In this, as it develops, MDRC will be interdisciplinary and connect writing in creative practice, science and art using design as the bridge to enable collaborations, connections, novel tools, processes and outcomes.

Indicators of wider influence

Staff in the submitting unit make contributions to their research bases and are recognised by their peers. These contributions are important ways to ensure the ongoing engagement with national and international colleagues and to build up research networks. The indicators listed below represent just some examples. Lockheart is the co-founder and co-editor of the Journal of Writing in Creative Practice, co-founder and director of the Writing Purposefully in Art and Design (Writing PAD) network. She is a peer reviewer for the Journal of Art, Design and Communication (and has been specialist reviewer for the journal of Design and Culture and Journal of Design History. Williams is a member of the Visual Arts Board, Arts Council of Wales and AXISWEB. Members have won numerous prizes and awards, for example the Henry Moore Artist Award Scheme, Royal British Society of Sculptors Bursary Award and Wakelin Award (Duncan), the Shpilman International Prize for Excellence in Photography, the ING Unseen Talent Award and Arts Council of Wales Production Gran (Moule), Arts Council of Wales Major Arts Award and Wales Arts International Funding (Williams). Invited keynotes, include Cornell University for the Cross *Pollination Project* (2019); Nagoya University of the Arts, Japan (Lockheart) and the British Society for Sexual Medicine Annual Conference (Williams). Duncan and Webster were invited curators for The Swansea Open, Glynn Vivian Art Gallery (2019).