Institution:	**Heriot-Watt University**
Unit of Assessment:	**D34 Art and Design: History, Practice and Theory**

a. Context

Research in Textiles and Design focuses on technology and design and the interface between the two. Partnerships with industry and private sector practitioners thus spans everything from multi-national technology companies to sole traders creating unique products and processes nationally and internationally. Established in 1883, the Scottish College of Textiles was at the forefront of traditional textiles knowledge that informed new skills for cutting-edge textile technologies. Today knowledge exchange, based on these core principles, has built on our heritage and regional position with the Textiles Industry. We have created a well-defined set of mechanisms to ensure and accelerate the reach and significance of our research to partner companies across a range of sectors such as manufacturing of smart garments, medical products, yarn and knit manufacturers and garment designers, through to specialist textile companies in the wearable electronics (Selex/Es, a major multinational defence company, MiroLink, healthcare SME) as well in the luxury market (Todd and Duncan, a premier cashmere yarn manufacturer, Gore). Today, the Unit has significant expertise and a unique position in the interface of technology and design, and its services to industry combine the best of both.

b. Approach to impact

Our aim is to support the development and evolution of the textiles sector, and promoting enterprise and forging links between industry and the academic world is central, and our focus fivefold;

1) Creation and leadership of initiatives to bring the (mostly fragmented) textiles manufacturing companies to realise the benefits of engagement with design and textile research expertise;

2). Outreach and direct support for small companies (SMEs) to help them grow and diversify;

3) Support medium and large companies by innovating (nanotextiles, wearables, SMART) and working in partnership with key companies in the supply chain;

4) Support designers to deepen their specialist and creative practice for new processes and products; and

5) Lead in flagship collaborative research and development of new products and processes; (Multi-scale integrated Modelling for High Performance Materials (£1.76M, TSB, TP/5/MAT/6/I/HO558L); Novel Micro Channel Membranes for Controlled Delivery of Biopharmaceuticals (£657K, TSB, TP/4/B1016/I/22246); Integration of CFD and CAE for Design and Performance Assessment of Protective Clothing (£650K, EPSRC, K3043B,); and EU FW6 DigiTex £240K)). This is achieved in part through formal structures that reflect our overall ethos. Examples are:

A) The Scottish Academy of Fashion, an SFC Horizon funded project (£220K), developed a series of high profile design and technology industry led projects with companies such as Mackintosh, Todd & Duncan, and Beggs of Scotland.

B) South of Scotland Business Solutions, an ERDF/SFC 3 year fully funded project with the remit of engaging businesses (sole trader to SME) in the Scottish Borders (£1.2m). The School invested in the development and implementation of an industry engagement strategy and a new post in Business Development (2010 $360Kto support continuation of the activity through creation of Scottish Innovation and Design, an in house vehicle to facilitate engagement with industry. This engagement is very much tailored to suit the needs of each business and can take the form of training, consultancy, facility hire or short to medium term research to help with a particular issue. Examples: technical training in design programming with Hawick Knitwear; 'No Cotton Denim' or 'Wooden Denim' addressed green energy issues specifically water usage and carbon emissions. Since our successful project with WRAP in 2012 and the initial national press coverage, we have had extensive publicity including interviews on ITV Scotland and Radio Free Europe; and an Arts Foundation nomination for a materials innovation fellowship with the Cloth Workers Foundation for £10K.

C) RIFLEX an industry led research facility in technical textiles (Stylios, Sun, McIntyre) with an international reach and close collaboration with multinational companies (e.g. Gore, Croda, Unilever, Selex/Es) which provides a springboard enabling the convergence of technology with

design. Collaboration with the textile industry spans 30 years (Stylios); 1984-1999 (COMIT, Bradford U; wool/worsted/clothing industry) and 1999-2013 (RIFLEX, HWU; technical textiles industry). In technical textiles we have built the foundation of organising a disperse and new industrial sector in early 2000 through the TechniTex Partnership (DTI; 2000 -2008) which we led, and since 2008 until present directly through RIFLEX by increasing the competitiveness of what is now a vibrant sector (Technical textiles is now £3B yearly to UK economy) through innovation by working in industrial partnerships and directly with companies in commercial projects (Selex/Es, MiroLink) as well as in speculative research (psychotextiles, nanoyarns).

D) Leadership of 'Creativity, Design and Innovation' an internal initiative to connect design to engineering and science with University investment of £500K in joint PhD studentships.

E) The vision for innovation in textiles has grown from the early academic partnerships and industry collaborations that were developed through RIFLEX and the Scottish Academy of Fashion. We are the Technical Textiles relay (TechniTex Ltd, Stylios, board director) that connects government with industry (Technology Strategy Board, BIS, Materials Knowledge Transfer Network). A Scotland-wide consortium formed with representation across HEIs, the Scottish Textiles & Leather Association with SE Textiles Team, is currently in discussion with the Scottish Funding Council to realise this joint approach for the sustainability of the industry.

F) Three projects in partnership with Creative Scotland and the Creative Arts Business Network have been undertaken. Con-text (2011), a series of six-month funded residencies to support new business ideas and development; Re-side (2012), international exchange residencies for designer/ makers from Scotland and India, and Re-source (2013), the development of the School as a Creative Hub for small business networks and product development.

c. Strategy and plans

Our strategy is to build on the success of the formal mechanisms described above to develop new and deepen existing partnerships in order to retain our position with the Textiles industry as the partner of choice and to develop understanding of the value of research in our user community; to support that through extending our networks and through development of staff and graduate skills and to continue to be recognised as the natural leader of new industry-focussed research and knowledge transfer.

The school will continue to be at the forefront of research in nanofibres, PsychoTextiles and Wearable Electronics. Our work in enabling the conversion of nanofibres to nanoyarns is fundamental to the revival of the UK's textile and garment manufacturing industry and it is recognition of this expertise that Lord Alliance has invited Stylios to attend a meeting in connection with his revival strategy. Our innovative PsychoTextiles research is leading designers by connecting the changing properties of SMART Textiles with brain activity, enabling designs to be effective and life-enhancing. The School's work with Wearable Electronics sees the miniaturisation of electronics coupled with low energy allowing them to be unobtrusively portable on the skin or clothing paving the way to another step change in the way we communicate. We will continue to address industry challenges through projects which can compete for research funding from a broad range of sources, seeking out funding pathways that encourage and enable impact generation. We engage users early in the research process, ensuring that all types of stakeholder are involved. In order to manage the process effectively, we will formulate impact strategies for each project, which identify known and potential stakeholders and routes to engaging with them over the course of the research, from shaping questions to discussing and disseminating findings. We will also identify the most relevant methods, from the provision of expert 'in person' advice or access to our facilities, including our archive, to the production of design exemplars (including digital communication), exhibitions, articles in professional journals, conferences, keynotes and the mainstream press.

Our approach relies on our continued investment in maximising the potential of various media (exhibitions, showcases and print, broadcast and online) and services to reach audiences in different ways and to make our resources as useful and user-friendly as possible. We will work with both external experts through our design and technology networks and with our Honorary Professors such as Eley, to enhance our knowledge exchange activity and ensure impact is fully realised.

Targets for the coming period include conducting regular knowledge exchange events and

programmes to cement our reputation at the interface between technology and design in Scotland, the UK and internationally, including the on-going industry engagement proposals focused on innovation, and a bid with University of Glasgow to sustain and extend the South of Scotland (SoSBus/SID) initiative through proposals to emerging opportunities such as Horizon 2020. The discovery of the conversion mechanism of nanofibres to yarns (Stylios and Luo patent W02013/030522) is an exciting new possibility for a step change of our industry. A UK-wide consortium is already taking shape to progress this area. The lead in developing wearables for the healthcare market will continue with more product possibilities such as wearable weather stations for military, sports and recreational markets. This work will continue to engage designers and engineers.

The School will continue to develop its successful applications to Creative Scotland, recently winning a proposal supported by the Harris Tweed Authority to develop 'creative futures' for knowledge exchange for the innovation of new products. The distinctive heritage of the craft of making is central to this collaboration and is an exciting partnership of two of the oldest textile organisations, working together to develop innovation in support of the economy and cultural identity. Through its education, research and development activities with the international textile sector, the School has a solid track record of achieving successful collaborations which have led to the creative development of industry personnel, products and business outputs and a global alumni. The School will continue to develop capacity among early career researchers through CPD activities, 'kick-start' grants and participation, at all stages, in knowledge exchange events and projects. We will continue to promote our senior academics as experts, building on the success of, for example, Stylios in leading the Technical Textiles Faraday or Harley in her work with UNDP or with the 2012 South of Scotland Business Showcase, which led to publication of "The Scottish Book". Recent appointments [le Guennec, Jardine] will further develop the cultural agenda for textiles through heritage and archival networks, and will contribute to national initiatives such as the V&A Dundee. To ensure our graduates maintain our reputation for impact we have moved to a strong focus on Research informed learning with input from all Research active academic staff from across the School to support the MA/MSc awards and include 'Innovation and New Applications' and 'Strategic Management of Innovation' Excitingly, our International patents mentioned have laid the foundation for greater collaboration in the creative, design and technology process for the domestic and technical markets but with potential applications in aerospace, automotive, shipping and civil architecture. A new company has been set up; nanoyarns Ltd, drawing on expertise in the University's Research and Enterprise Services unit, will take the research from the lab to the market place.

d. Relationship to case studies

The case studies included in this submission provide a broad overview of the types of impact the School has realised, typify its strategic approach to doing so, reflect our wide range of methodologies and partners and demonstrate that we achieve at the interface of design and technology from a user perspective. They demonstrate that innovations in this traditional area (textiles) can have significant impacts even on high-tech sectors projects and can address societal issues. The studies are representative of a larger body of work by the School with both large and small companies.

Commercial engagement underpins the work of, for example, Stylios in 'Smart Textiles and Garments' which brings together both technical and design expertise to develop new technology and has led to formation of an Industry Club which engages with research at its earliest stages. Balancing that, 'Chromatic Materials at the Design/Technology Interface' is design led but integrates science and technology expertise to assure delivery. Both engaged over 40 companies from a range of sectors.

The case studies demonstrate that institutional support for School impact has allowed our key academics to participate in and influence international research challenges. Overall, this has strengthened our global networks and stimulated interest in our work outside the UK. Reciprocally, projects such as these have informed routes to impact development for subsequent research proposals across the School.