Institution: University of Leeds

Unit of Assessment: D32

Title of case study:
Creation and Growth of NIRI Ltd: An international consultancy business, designing new products for the industrial, healthcare and consumer sectors

Period when the underpinning research was undertaken:
2003-2018

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Stephen Russell	Professor	2006- present

Period when the claimed impact occurred:
2014-2020

Is this case study continued from a case study submitted in 2014? Y/N

1. Summary of the impact (indicative maximum 100 words)

In 2005, following external business angel investment, NIRI Ltd was spun-out by the University of Leeds to commercially develop Professor Russell's research on nonwovens, creating innovative products. NIRI's external impact is reflected by the rapid growth of its global client base of SMEs and PLCs (>450 projects completed for >200 clients), multiple new product launches and annual sales revenue in excess of [text removed for publication]. NIRI's co-funded joint ventures have led to market leading products such as SurfaceSkins to combat the ca. 4.1 million cases of healthcare-associated infections in the EU each year.

2. Underpinning research (indicative maximum 500 words)

Research by Professor Russell (Professor of Textile Materials & Technology, University of Leeds) has focused on the design and manufacturing of nonwoven materials and particularly structure-property relationships. In a series of papers, underpinning basic research work, Russell examined the fundamental relationships between the structural design of nonwoven fabrics and the associated directional permeability, capillarity and liquid absorption. **[1,2]** By studying the effects of controlling fibre arrangement, fibre dimensions and porosity in nonwoven fabrics, it was discovered that liquid handling behaviour in multiple directions could be manipulated, directly impacting fabric performance **[2,3]** In 2006, Russell in his capacity as Technical Director at NIRI Ltd working in partnership with engineers at Zelo Creative Ltd further developed understanding of the liquid handling behaviour of volatile liquids (alcohols) stored within nonwoven fabrics, to control 3D transport within the internal structure and minimise the evaporation rate. This led to the design of a new type of multilayer fabric/polymer film composite capable of retaining and internally distributing, large volumes of alcohol-based antibacterial fluid, for the purpose of killing pathogenic bacteria on contact. The development work led to a family of international patent applications produced by Russell and the team, including: Surface Mountable Delivery Device, US 2007135424(A1), 29 Nov 2007; Liquid or gel delivery devices US20180169281A1; Delivery device US20150117932A1 and US9867891B2. The research and development culminated in the commercial development and international launch of SurfaceSkins products, a range of patented hand hygiene devices containing EN1500 alcohol and other actives that enable on-contact, self-disinfection of door push plates in hospitals.

3. References to the research (indicative maximum of six references)

1. Mao N.; Russell S.J. (2003) Modelling Permeability in Homogeneous Three-Dimensional Nonwoven Fabrics, *Textile Research Journal,* 73, 11: 939-944. http://dx.doi.org/10.1177/004051750307301101
2. Mao N., Russell S.J., (2003) Anisotropic Liquid Absorption in Homogeneous Two-Dimensional Nonwoven Structures, *Journal of Applied Physics*, 94(6), 4135-4138. http://dx.doi.org/10.1063/1.1598627
3. Mao N., Russell SJ., (2008) Capillary pressure and liquid wicking in three-dimensional nonwoven materials. Journal of Applied Physics, 104, 034911, https://doi.org/10.1063/1.2965188
4. Russell SJ, Tipper MJ, Rathod MKC, Walker AD, Scott-Harden SGJ, Surface Mountable Delivery Device, Patent Application: WO2007135424 (A1), 2007-11-29.
5. Russell SJ, Scott-Harden SGJ, Walker AD, Fowler CE, Delivery Device, US Patent: 9,867,891, 2018-1-16.
6. Russell SJ, Scott-Harden SGJ, Fowler CE; Neill S, Liquid or Gel Delivery Devices, Patent Application: US2018169281 (A1), 2018-06-21.

4. Details of the impact (indicative maximum 750 words)

Following external financial investment from two business angels, NIRI Ltd was set up in 2005 as a University of Leeds spin-out company to commercialise research by Professor Russell leading to development of new nonwoven products. As co-founder of the Company, Russell was seconded by the University from start-up to act as NIRI's Technical Director and assist with the Company's growth (50% FTE from 2005-2018 and then 20% FTE from 2018 onwards). From start-up, the Company has grown a global client base of 200+ SME's and PLCs, has completed over 450 projects and is achieving annual revenues in excess of [text removed for publication]. **[A]** The company employs 20 highly qualified staff and has been profitable from the first year of trading. In 2017, the Company moved to a dedicated 10,000 sq ft. site in Leeds and in 2018 established its first overseas division (NIRI LLC), based in the USA. NIRI's technical consultancy services have directly enabled numerous SMEs and global PLCs to launch improved or new products, growing their market share and positively impacting consumers. NIRI's consultancy work is conducted under strict confidentiality and therefore a full list of companies is not included, however, the international client base directly benefitting from NIRI's products and services include the defence industry, food and beverage, hygiene and the healthcare sectors, as well as large consumer products and retail brands **[B]**.

In addition to growing a successful technical consultancy business, NIRI has co-funded joint ventures with other innovation companies, focusing on commercial product development. One such development directly linked to Russell's underpinning research, as referenced in Section 2, is SurfaceSkins.

Up to 80% of infections are known to be transmitted by hands, and SurfaceSkins are designed to self-disinfect in the time it takes for another user to contact the surface **[C]**. The European Centre for Disease Protection and Control (ECDC) estimates that ca. 4.1 million patients acquire a healthcare-associated infection in the EU each year, directly resulting in 37,000 deaths, and contributing to another 110,000 deaths p.a. About 20-30% of these cases are preventable by better infection and control procedures **[D]**.

SurfaceSkins technology was designed and developed by NIRI in partnership with industrial design consultants, Zelo Creative Ltd and led to the formation of separate company, Surface Skins Ltd: http://surfaceskins.com/. Following recent investment in UK manufacturing facilities, worldwide [text removed for publication] have been achieved across Europe, The Middle East, Asia, Australasia and Africa and the supply of SurfaceSkins is underway. **[E]** The business employs [text removed for publication] people and in 2018, appointed a new CEO to open up international markets. Underpinned by Russell's research on liquid handling behaviour in composite nonwoven fabrics, SurfaceSkins Ltd are a range of innovative hand hygiene devices that help to reduce the transmission of Healthcare Associated Infections (HCAIs) in critical areas such as hospitals. The products are compression-activated self-disinfecting surfaces that clip-fit directly on to existing door handles and push plates, delivering antibacterial liquids immediately to the surface on contact. SurfaceSkins are designed to keep the surface free of bacterial contamination and be replaced after 1000 activations or 7 days of use. Since 2014, as a new clinical intervention aimed at reducing transmission, SurfaceSkins have undergone independent clinical testing led by The Leeds Teaching Hospitals NHS Trust, which reported significant reductions in surface contamination. SurfaceSkins significantly reduced bacterial contamination by >90% up to six days in use, compared to existing doorplates used by hospitals. **[F,G]** The clinical impact of the product was heightened further by the approximate doubling in the use of alcohol hand gel dispensers by healthcare workers, following the installation of Surfaceskins doorplates in two operating theatres. **[H]** Since 2014, a new 'custom' Surfaceskins product has also been launched, that gives customers the ability to print hygiene messages, branding or third-party advertising on to the self-disinfecting surface to generate an offset income. This has enabled SurfaceSkins to diversify into the food preparation, advertising, bar and restaurant, coffee, dental and cruise ship markets. The strong international interest is reflected by SurfaceSkins winning the prestigious 2019 RISE Innovation award in the USA. **[I]**

5. Sources to corroborate the impact (indicative maximum of 10 references)

A: Annual Accounts of the Nonwovens Innovation and Research Institute Ltd. available from the Managing Director and Finance Director (confidential).

B: Letter from the Managing Director of the Nonwovens Innovation and Research Institute Ltd (confidential).

C: SurfaceSkins Ltd Company Website: 'Product Data' file supplied from this page : https://surfaceskins.com/videos-images-downloads/

D: European Centre for Disease Prevention and Control webpage: https://ecdc.europa.eu/en/about-uswho-we-aredisease-programmes/antimicrobial-resistance-and-healthcare-associated-infections

E: Press article: https://www.yorkshirebusinessdaily.co.uk/2019/01/09/enterprising-ceo-appointed-to-open-doors-for-revolutionary-yorkshire-hygiene-company/

F: Refereed Journal Article: E.L. Best, P. Parnell, M.H. Wilcox, The potential of alcohol release doorplates to reduce surface contamination during hand contact, Journal of Hospital Infection, Volume 97, Issue 4, 2017, pp. 424-429 https://doi.org/10.1016/j.jhin.2017.07.027

G: Press articles:

1 'International innovation award for infection control technology' in Hospital and Healthcare Management (online): saved May 2020.

2 'SurfaceSkins steps up door pads production in fight against killer hospital infections' in Express (online), 20.06.2018: saved May 2020.

3 'SurfaceSkins help improve hand hygiene in hospital theaters, study says' in Nonwovens Industry (online), 12.11.2019: saved May 2020.
4 'SurfaceSkins wins RISE innovation award: Push pads and pull handles help prevent spread of germs' in Nonwovens Industry (online), 30.09.2019: saved May 2020.
5 'SurfaceSkins infection control technology nominated for prestigious IDEA19 achievement award' in Texdata International (online), 06.02.2019: saved May 2020.
6 'New textile material provides protection in many high-risk situations' in AZO Materials (online), 6.10.2017: saved June 2020.
7 'Self-disinfecting device keeps hospital doors germ free' in Springwise (online), 13.10.17: saved May 2020.

H: Refereed Journal Article: Wilcox M, Dyche A, Service evaluation of alcohol-release door plates: an addition to hand hygiene, Journal of Hospital Infection, Volume 103, Issue 1, 2019, pp. e97–e100 https://doi.org/10.1016/j.jhin.2019.04.023

I: Press article: https://www.innovationintextiles.com/rise-highlights-transformative-fabric-technologies/