

<b>Institution:</b> University of Bath		
<b>Unit of Assessment:</b> C24		
<b>Title of case study:</b> Playing With Fire - Enhancing the Health & Fitness of UK Fire and Rescue Service Personnel		
<b>Period when the underpinning research was undertaken:</b> 2012-2018		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
James Bilzon	Professor, previously Head of Department	May 2008 – present
Martyn Standage	Professor, previously Reader	September 2002 - present
Keith Stokes	Professor, previously Head of Department and Reader	February 2002 - present
Andrew Siddall	Research Associate, previously Lecturer	September 2011 – January 2017
<b>Period when the claimed impact occurred:</b> 2015-2019		
<b>Is this case study continued from a case study submitted in 2014?</b> N		
<b>1. Summary of the impact</b>		
<p>Research at the University of Bath sponsored by the Chief Fire Officer's Association (CFOA) has significantly impacted on Physical Employment Standards (PES) for the UK Fire and Rescue Services (FRS). We engaged with a range of stakeholders to implement PES to ensure the physical competence, health and safety of UK firefighters. The new procedures provide policy guidance to all 46 UK FRS, affecting approximately 44,000 operational firefighters, who attend approximately 725,000 incidents per year, while protecting the UK population. Our research developed valid and reliable tests and standards, fitness management processes and guidance documents. Implementation improved average cardiorespiratory fitness by 9.4% and reduced the proportion of firefighters failing their annual fitness assessments by 53%. An independent economic evaluation revealed an 88% reduction in lost duty days and a net saving of between GBP16,000,000 and GBP17,000,000 per annum for the sector.</p>		
<b>2. Underpinning research</b>		
<p>The researchers who contributed to these impacts include three members of academic staff (Professors Bilzon, Standage and Stokes, 2012-Present), and a post-doctoral researcher (Dr Siddall, 2012-2016), and the research was co-developed with researchers from the FireFit Steering Group (Stevenson and Turner). The aim of this research was to identify and quantify physical demands of critical firefighting tasks, enabling the development of legally defensible physical employment standards (PES) for the UK Fire and Rescue Services (FRS). This is essential in ensuring that personnel possess the physical capabilities to perform their role safely and effectively, thereby enhancing operational performance and safety of employees and the public they serve. Prior to this, evidence for PES did not exist.</p> <p>This series of projects has been supported by grants of approximately GBP225,000 from the Chief Fire Officer's Association (CFOA) and the London Fire Brigade (LFB). As our research was funded directly by government agencies that have a stakeholder interest, the route to impact was immediate. The research activities are best captured under six sub-headings, which map on to our primary research outputs (RO):</p> <p><b>i) Task Analysis (2012):</b> We developed a robust approach to analyse and identify the most physically demanding operational tasks undertaken by UK firefighters and to determine minimum acceptable job performance. A novel process and guidance methodology were published, emphasising the need to engage a Technical Panel of subject-matter experts and</p>		

a Stakeholder Panel of senior staff, to ensure organisational ownership and engagement. Five generic firefighting task simulations were identified and endorsed [RO1].

**ii) Physical Demands Analysis (2013):** A representative sample of 62 UK firefighters completed these tasks and metabolic and cardiovascular strain were monitored throughout. Four tasks were endorsed as valid operational simulations by  $\geq 90\%$  of participants. Based on these demands, we determined that minimum cardiorespiratory fitness standards of  $42.3 \text{ ml.kg}^{-1}.\text{min}^{-1}$  and  $36.8 \text{ ml.kg}^{-1}.\text{min}^{-1}$  were commensurate with safe and efficient firefighting performance for operational firefighters and incident commanders, respectively [RO2].

**iii) Muscular Strength and Endurance (2014):** A further three criterion firefighting tasks, recognised to require significant upper body muscular strength and endurance. Fifty-one volunteers performed the ladder handling tasks and three corresponding gym-based surrogate tests. Analyses of test sensitivity and specificity of the surrogate tasks identified that a 35kg seated shoulder press, a 60kg rope pull-down and 23 repetitions of a 28kg rope pull-down represented minimum standards to ensure safe and effective performance [RO3].

**iv) Firefighting Simulation Test (FFST) (2015):** Based on criterion tasks, a FFST test was designed to provide simple means of assessing firefighter fitness. Data were obtained from 68 firefighters to reveal a high degree of validity and test-retest reliability. Maximum test completion time of 11:11 mm:ss was commensurate with safe and efficient firefighting and associated with the cardiorespiratory fitness standard of  $42.3 \text{ ml.kg}^{-1}.\text{min}^{-1}$  [RO4].

**v) Fitness Management (2017):** Finally, we integrated tests and standards into a practical, efficient fitness management procedure, where individual risk could be managed based on level of certainty of operational fitness – using a traffic light principle. Developing procedures in this way ensured that tests and standards could be successfully incorporated into organisational policies and procedures, ensuring rapid knowledge translation and impact [RO5].

**vi) Health and Wellbeing (2013-2017):** In 2013, a national survey was distributed and a sample of 4,564 FRS personnel responded. Subsequent analyses identified physical activity, sleep and smoking as independent determinants of wellbeing, obesity and chronic disease. Health and Fitness Advisors are using this evidence to implement personalised work-place intervention strategies to enhance the health, fitness and wellbeing of personnel [RO6].

In summary, we identified minimum acceptable performance on a range of critical and essential criterion firefighting tasks and, based on the demands of those tasks, identified surrogate physical employment tests and standards that accurately predict firefighting performance. We went further in developing an alternative field-based assessment of operational fitness and developed a fitness management process and guidance documents to support implementation of an integrated approach.

### 3. References to the research

[RO1] Stevenson, R, Siddall, A, Turner, P & Bilzon, J 2016, 'A task analysis methodology for the development of minimum physical employment standards', *Journal of Occupational and Environmental Medicine*, vol. 58, no. 8, pp. 846-851.

<https://doi.org/10.1097/JOM.0000000000000812>

[RO2] Siddall, AG, Stevenson, RDM, Turner, PFJ, Stokes, KA & Bilzon, JLJ 2016, 'Development of role-related minimum cardiorespiratory fitness standards for firefighters and commanders', *Ergonomics*, vol. 59, no. 10, pp. 1335-1343.

<https://doi.org/10.1080/00140139.2015.1135997>

[RO3] Stevenson, R, Siddall, A, Turner, P & Bilzon, J 2017, 'Physical employment standards for UK Firefighters: minimum muscular strength and endurance requirements', *Journal of*

*Occupational and Environmental Medicine*, vol. 59, no. 1, pp. 74-79.

<https://doi.org/10.1097/JOM.0000000000000926>

**[RO4]** Stevenson, RDM, Siddall, AG, Turner, PJF & Bilzon, JLJ 2019, 'Validity and Reliability of Firefighting Simulation Test Performance', *Journal of Occupational and Environmental Medicine*, vol. 61, no. 6, pp. 479-483.

<https://doi.org/10.1097/JOM.0000000000001583>

**[RO5]** Stevenson, R, Siddall, A, Turner, P & Bilzon, J 2020, 'Implementation of Physical Employment Standards for Physically Demanding Occupations', *Journal of Occupational and Environmental Medicine*, vol. 62, no. 8, pp. 647-653.

<https://doi.org/10.1097/JOM.0000000000001921>

**[RO6]** Turner, P, Siddall, A, Stevenson, R, Standage, M & Bilzon, J 2018, 'Lifestyle behaviours and perceived well-being in different fire service roles', *Occupational Medicine*, vol. 68, no. 8, OM-17-OP-207.R4, pp. 537-543. <https://doi.org/10.1093/occmed/kqy110>

#### Grants

**[1]** Chief Fire Officer's Association (CFOA), Sep 12 to Oct 14, GBP104,000.

**[2]** Chief Fire Officer's Association (CFOA), Oct 14 to Mar 16, GBP70,000.

**[3]** Chief Fire Officer's Association (CFOA), Mar 16 to Apr 18, GBP15,000.

**[4]** London Fire Brigade (LFB), Mar 18 to Nov 18, GBP35,048.

#### 4. Details of the impact

*"The partnership between the National Fire Chief's Council, the FireFit Steering Group and the University of Bath has allowed us to develop, validate and implement evidence-based physical employment standards across the UK Fire and Rescue Services. The work has transformed our focus on occupational fitness and has already increased the fitness standards of our operational firefighters, enhancing their health and the organisation's ability to manage those who need to improve their physical capability for safe and effective long-term employment"* Chair of the FireFit Steering Group (FFSG) **[SE4]**.

Impact has been achieved nationally and internationally through: (1) introduction of national policy and guidance pertaining to annual fitness assessments of UK Fire and Rescue Services (FRS) personnel; (2) design, validation and implementation of service level fitness management processes and procedures; (3) delivery of educational symposia and online resources for health and fitness advisors and; (4) dissemination to national and international practitioner conferences and workshops. Beneficiaries include National Governing Bodies (Chief Fire Officer's Association, Government Joint Working Group), International Governing Bodies (e.g. Singapore Civil Defence Force), the Fire Brigade's Union, 46 UK Fire and Rescue Services, their health and fitness advisors, approximately 44,000 operational firefighters and the public they protect while attending approximately 725,000 incidents per year.

Based on research commenced by Bilzon and colleagues in 2012, minimum cardiorespiratory fitness standards were recommended for operational firefighters and supervisory incident commanders in 2016. These standards were immediately accepted and implemented. New policy and guidance for performing these tests was immediately communicated via the Chief Fire Officer's Association (CFOA) website and in 2016, official national best practice guidance for all FRS was issued **[SE1]**. Shortly after this, Bilzon was invited to present the findings and recommendations to a Home Office National Joint Council (NJC) for Local Authority Fire and Rescue Services, who were producing a Firefighter Fitness Best Practice Guide **[SE2]**. Bilzon's presentation is acknowledged throughout the report and, in particular, Section 3, where he produced national policy on fitness testing regimes **[SE2]**.

Between 2014 and 2015, further work was conducted to develop tests of muscular strength and endurance and validate the FireFighter Simulation Test (FFST). Our research recommendations were endorsed by the Chair of the FireFit Steering Group (FFSG) and the Stakeholder Panel. These research findings and recommendations were officially communicated to approximately 300 senior delegates during a Special Symposium at the 2016 FireFit Annual Conference [SE3]. Importantly, this marked the first occasion that the Fire Brigades Union had publicly endorsed our research and associated recommendations [SE4].

Professor Bilzon received an 'outstanding partnership' award from the Chair of the FFSG. We published our final report and recommendations, together with a proposed fitness management process [SE5]. This was followed by a range of media events, including interviews with the BBC Points West and BBC Radio Bristol [SE6], ensuring that the wider UK public were aware of the new tests and standards.

It became apparent that CFOA needed to consider the consistency between the new annual fitness assessments and the National Firefighter Selection Tests (NFST) previously implemented across the UK. The FFSG Chair commissioned Bath to meet with the authors of NFST report and draft a short consultancy document, providing specific recommendations necessary to integrate the two processes. In light of our research, changes were made to the NFST in 2017 to incorporate our strength tests and changes made to the guidance to new applicants to inform them on how best to prepare for the NFST and beyond [SE7].

The London Fire Brigade (LFB) confirmed that they perform a number of firefighting tasks differently, primarily due to the nature of urban firefighting. Following the same methodology and principles, we were able to collect new data with LFB in September 2017 and make specific recommendations for urban firefighters, including a modified cardiorespiratory fitness standard and FFST assessment. These recommendations have been fully implemented and acknowledged [SE4]:

*"we thank you for your flexibility in...the development of an alternative FFST for urban firefighting, including the London Fire Brigade".*

In 2019, an independent survey was conducted by the FFSG to assess the impact of the national guidance since the previous survey in 2011 [SE8]. The percentage of FRS adopting the recommended minimum fitness standards had increased from 76% to 95%. This was corroborated from the survey of fitness advisor opinions which identified that 95% of FRS had changed their fitness policy to reflect the new standards and procedures, indicating high uptake of the new policy [SE8]. Additionally, the proportion of FRS proactively removing firefighters with a substandard level of physical fitness increased from 62% to 95%, enhancing the safety of all concerned. Importantly, 81% of fitness advisers felt that the new CFOA guidance had improved how firefighters with low levels of physical fitness were being managed [SE8].

Latest fitness data demonstrate that the average cardiorespiratory fitness of UK firefighters has improved from 46.3 ml.kg<sup>-1</sup>.min<sup>-1</sup> to 49.3 ml.kg<sup>-1</sup>.min<sup>-1</sup> (9.4%) since implementation. Over 68% of fitness advisers also felt that the standards had increased the levels of physical fitness in their service [SE8]. The improvement in physical fitness has reduced the proportion of firefighters failing the fitness assessment by 53%. Consequently, the number of lost duty days due to 'capability' has decreased by 88%, leading to a net national saving for the sector of between GBP16,000,000 and GBP17,000,000 per annum, as evidenced by an independent economic evaluation [SE9]. The Fire Fighters Charity has also confirmed the use of the new standards in the rehabilitation of injured personnel [SE10]:

*"...we use the standards as part of an assessment and fitness development for those seeking to return to operational duties".*

**5. Sources to corroborate the impact**

**[SE1]** Chief Fire Officer's Association Publications (2016). Managing Physical Fitness in the UK Fire and Rescue Services. <http://www.cfoa.org.uk/firefit>

**[SE2]** Home Office (2016). Firefighter Fitness Best Practice Guide. National Joint Council (NJC) for Local Authority Fire and Rescue Services and Department of Communities and Local Government (DCLG) Report. (<http://www.cfoa.org.uk/11714>)

**[SE3]** Bilzon et al. (2016). Physical employment tests and standards for UK FRS. Special Symposium, FireFit Annual Conference. (<http://www.cfoa.org.uk/21702>)

**[SE4]** Letter from Chair of the FireFit Steering Group, 26 February 2020.

**[SE5]** Development of physical employment standards for the UK Fire and Rescue Services (FRS). Final Customer Report, November 2017.

**[SE6]** Press and media coverage: Media coverage of the new physical employment standards for firefighters including BBC 1 Points West December 2016.

**[SE7]** Physical employment tests and standards for the UK Fire and Rescue Services: Integration and recommendations. Consultancy Report, November 2017.

**[SE8]** Stevenson and Bilzon (2019). Presentation to FireFit Annual Conference.

**[SE9]** Economic Impact Assessment. Warwick Economics & Development Ltd., November 2020.

**[SE10]** Letter from Chief Executive of The Fire Fighters Charity, 17 September 2019.