

Institution: Robert Gordon University		
Unit of Assessment: UoA 3 - Allied Health Professions, Dentistry, Nursing and Pharmacy		
Title of case study: Body size of UK Offshore Workers: implications for health, safety and practice		
Period when the underpinning research was undertaken: 2013-2015		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Dr Arthur Stewart Mr Robert Ledingham	Role(s) (e.g. job title): Senior Researcher; Reader KTP Associate	Period(s) employed by submitting HEI: 2005 – 2020 2013 - 2014
Period when the claimed impact occurred: 2014 - 2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words)		
<p>This award-winning research informed the Civil Authorisation Authority (CAA) in mandating changes to North Sea helicopter operations concerning body size and emergency escape. Following RGU's 3D scanning survey of offshore workers, the industry body 'Step Change in Safety' commissioned a strategy for measuring the entire 75,000-strong workforce. This means that each person's body size is now directly input into the vantage personal identity system, matching seat allocation to size-designated seats across nine aircraft types. This study thus enabled the implementation of a critical legislative change designed to reduce the risks of fatalities in helicopter operations in the North Sea.</p>		
2. Underpinning research (indicative maximum 500 words)		
<p>Global obesity has trebled since 1984's survey on body size and shape of offshore workers, making the data obsolete and creating problems for the design of critical infrastructure, safety systems, and workers' health.</p> <p>RGU's size and shape survey with Oil & Gas UK showed how offshore workers had increased in size and differed from a general population. Scanned body shapes revealed risk factors for workers' health and safety-critical areas adversely affecting larger individuals' capacity for evacuation. Implementing a 'size standard' informed by the study became enshrined in law in 2015.</p> <p>Funding of £137,831 from the Technology Strategy Board for the KTP with OGUK was augmented by £7,533 and in-kind from 20 industry sponsors at industry safety briefings, where the risks of the unknown body size of offshore workers were presented. The project won the Ewan MacDonald Prize for Excellence in Occupational Health Audit or Processes, 2013; and the coveted William Floyd Award for Best project for innovation in ergonomics in the UK, 2018.</p> <p>RGU's Benchmarking of novel portable 3D scanners preceded the main study at stakeholder premises, heliports, and one offshore platform.</p> <p>Quota-sampling across seven weight categories ensured a representative sample within a daily weight fluctuation (1.1kg). 588 individuals each provided seven 3D body scans, yielding 26 multi-</p>		

dimensional measurements. The dataset compiled in percentile format was licenced to the industry as a design standard and for OGUK income generation.

The dramatic size increase and obesity prevalence of offshore workers exceeded that of the general population¹. Observed girth increase at the neck, chest, and waist depicted a shape centralisation indicative of health-harming visceral fat, and disease risk². The study revealed how such an enlarged and centralised body shape make it extremely challenging for workers to pass one another in a narrow corridor in an offshore installation evacuation scenario³, and identified which body measurement best predicted successful escape from a helicopter emergency exit⁴. It also revealed that larger individuals could become critically buoyant when submersed in water due to trapped air in their survival suits⁵. The range of body types revealed a physique clustering, where self-selected suit size did not always correspond with individual body shape⁶.

Preliminary data from 210 individuals were presented to the Helicopter Safety Passenger Size Working Group following the CAA mandate in the wake of a fatal accident in 2013, which identified body size as a critical factor in helicopter escape. Stewart identified anatomical measures that best predict escape capability and threshold values to estimate the prevalence of extra-broad individuals unlikely to egress through a minimum escape exit. This established protocols for replicating critical measurements across the workforce, including shoulder breadth and chest depth dimensions.

A measuring programme for the 75,000-strong workforce was implemented with Step Change in Safety. This licensed 88 trainers to teach approximately 300 measurers to assess shoulder breadth in a standardised way, thereby quality-assuring these measurements.

This identified workers as 'standard' or 'extra-broad', carrying industry-enforced restrictions on aircraft seating, thereby preventing large persons from blocking smaller individuals' egress path.

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

1. **Stewart, A.**, Ledingham, R., Furnace, G. & Williams, H. Nevill, A. (2017). Shape change and obesity prevalence among male UK offshore workers after 30 years: new insight from a 3D scanning study. *American Journal of Human Biology*. 00:e22992 doi.org/10.1002/ajhb.22992
2. **Stewart, A.D.**, Ledingham, R.J., Furnace, G. & Williams, H. Nevill, A.M. (2016). Defying geometric similarity: shape centralization in male UK offshore workers *American Journal of Human Biology*. Doi: 10.1002/ajhb.22935
3. **Stewart, A.**, Ledingham, R., Furnace, G. & Nevill, A. (2015). Body Size and ability to pass through a restricted space: Observations from 3D scanning of 210 male UK Offshore Workers. *Applied Ergonomics* 51, 358-362. DOI: 10.1016/j.apergo.2015.06.017
4. **Stewart, A.**, Ledingham, R., Furnace, G., Schranz, N. & Nevill, A. (2016). The ability of UK offshore workers of different body size and shape to egress through a restricted window space. *Applied Ergonomics* 55, 226-233. DOI: 10.1016/j.apergo.2015.11.005.
5. **Stewart, A.**, Ledingham, R., Furnace, G., Williams, H. & Coleshaw, S. (2017). Survival suit volume reduction associated with immersion: implications for buoyancy estimation in offshore workers of different size. *Ergonomics*, 60, 844-850. DOI 10.1080/00140139.2016.1188219.
6. **Stewart, A.**, Ledingham, R., Williams, H. (2016). Variability in body size and shape of UK Offshore Workers: a cluster analysis approach. *Applied Ergonomics*, 58, 265-272. DOI: 10.1016/j.apergo.2016.07.001

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

Reach and Significance

RGU provided the offshore industry with an up-to-date and accurate size survey of its workforce and an enduring capability for conducting future surveys as required¹. Such data have informed installation designers, survival suit designers, helicopter manufacturers, and the UK's Health & Safety Executive's review of lifeboat capacity⁷. Following the CAA mandate, the measuring programme implemented in conjunction with Step Change in Safety culminated in a series of train-the-trainer events, which licenced 88 trainers from the UK, The Netherlands, Poland and Norway to train approximately 300 measurers. Between them within three months, they measured the shoulder breadths of 100% of the 75000-strong UK offshore workforce, each of whom must travel to offshore installations by helicopter, fully achieving the requirement and target set out by the CAA.

Policy Impact (UK & Europe)

With effect from 01 April 2015, the CAA prohibited helicopter operators from carrying passengers on offshore flights, except in response to an offshore emergency, whose body size, including required safety and survival equipment, is incompatible with push-out window emergency exit size. Originally mandated for UK operations only via the issue of a CAA Safety Directive, all these measures have now been underpinned through incorporation in the European Air Operating Rules published by the European Aviation Safety Agency⁶.

Economic Impact

Step Change in Safety estimated the theoretical full cost of measuring the workforce at £15 million, but in reality the cost to the industry was reduced to approximately £1 million because of the advantage created by offshore medics not charging for measuring³.

According to Les Linklater, Executive Director of Step Change in Safety *"working with RGU was vital to ensure the success of Step Change in Safety's passenger size project, and the safety of the offshore workforce". By defining a simple, sustainable measurement criteria and together developing the Train the Trainer methodology, the industry was able to meet the deadline and avoid costs of £14 million.*"

Health and Safety Impact

RGU's size and shape study raised awareness of the need to quantify the size increase of offshore workers to identify this as a risk, potentially saving lives in emergency escape scenarios. This has brought a range of health and safety measure changes to the industry, including informing the design of survival suits, which has been impacted due to the demonstrable changes in body size that may not be accommodated by available suit designs⁶. Ill-fitting suits perform poorly at maintaining body temperature because cold seawater enters through the neck and wrist seals⁷.

Furthermore, the RGU study is mentioned on three occasions in the CAA's report of 20th February 2014⁴, which followed the loss of an aircraft in Shetland in August 2013 with four fatalities. It specifically makes reference to reviewing minimum exit size, informing the increased size of exits and the possibility of restricting flights and seat choice for some workers next to small exits.

Robert Paterson, Oil & Gas UK Health and Safety Director at the time of the study noted several safety aspects in addition to those of the CAA, including design and health aspects. He specifically commented that the industry was fortunate that the RGU study was so well advanced at the time of the fatal helicopter accident⁶. The visibility of the research to the industry was maintained via a number of conference presentations, most notably an invitation to present the study to ministers at the Scottish Parliament in January 2015 in an event entitled 'Research with Impact'. The long-awaited evidence that confirmed the fears that offshore workers' health was threatened by their

shape and increased size added impetus to the health promotion initiatives underway in order to remedy the challenge of maintaining a healthy lifestyle offshore.

Mick Borwell, health and safety director with Oil & Gas UK, added: *“Many offshore facilities were designed more than 40 years ago based on size information of offshore workers available at that time and which we now know to be very different today. The findings from the research will be invaluable to those designing future offshore safety equipment, survival clothing and space and accommodation requirements offshore.”*

Awards

In May 2013, the research won the Ewan MacDonald Prize for Excellence in Occupational Health audit or processes by the Society for Occupational Medicine.

Further recognition of the significance of its impact, this study received The William Floyd Award for outstanding and innovative contribution to ergonomics and human factors in 2018, by the Chartered Institute of Ergonomics & Human Factors.

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

1. Ledingham, R., Lamb, M., Aleksandrova, G. & Stewart, A. (2015). Size and Shape of the UK Offshore Workforce 2014: A 3D scanning survey. Robert Gordon University. ISBN 978-1-907349-10-2.
2. Ledingham, R., Furnace, G., Lamb, M. & Stewart, A. (2015). Size and Shape of the UK Offshore Workforce 2014: Data from the 3D scanning survey. Oil & Gas UK. £150 for download <https://oilandgasuk.co.uk/product/size-and-shape-of-the-uk-offshore-workforce/>
3. Helicopter safety video by Scottish Enterprise <https://www.youtube.com/watch?v=fOASglwQcFE&index=3&list=PLkBW6ktGgwqrukC7vY0HTz9uxjR3QT5dY>
4. UK Civil Aviation Authority (2014). Strategic Review of Offshore Helicopter Operations 20 February 2014 Civil Aviation Authority (2014). CAP1145 : Civil Aviation Authority – Safety review of offshore public transport helicopter operations in support of the exploitation of oil and gas. <https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=6088>
5. UK Civil Aviation Authority (2019). Safety Review of Offshore Public Transport Helicopter Operations in Support of the Exploitation of Oil and Gas. Progress Report – 2019 <https://publicapps.caa.co.uk/docs/33/CAP1877.pdf>

6. Statement from the Health and Safety director of Oil & Gas UK at the time of the study.

“The RGU Size and Shape of Offshore workers Study (2013/14) has made a number of contributions to both the safety and health of the offshore workforce arising from that work, and will continue to do so in the years to come. It was fortunate that the study work was well advanced at the time when the UK Civil Aviation Authority made a number of new requirements following a helicopter crash in 2013. Following the fatal loss of a helicopter off Sumburgh Airport, Shetland islands on 23 August 2013 with 4 fatalities, the UK Civil Aviation Authority (CAA) launched a rapid review of offshore helicopter safety. On 20 February 2014 the CAA published the results of their review in a report (CAP1145)⁴ which included an intention to prohibit helicopter operators from carrying passengers whose body size was incompatible with the push-out window emergency exit size. The RGU study was instrumental in providing a basis for determining that the relationship between shoulder width and the diagonal dimension of the window exit was the most reliable ‘compatibility’ test. This resulted in shoulder measurements being undertaken for all offshore workers, and armbands being issued to certain individuals to ensure they use only certain specific seats. Helicopter OEMs (original equipment manufacturers) and helicopter operators have shown interest in the study data. Historically the weight of a person had been used to determine the seating layout arrangements and numbers of seats in the offshore lifeboats (TEMPSC - totally enclosed motor-propelled survival craft). HSE (the offshore safety regulator) planned to review their TEMPSC guidance as the RGU study showed the average offshore worker was now much

wider. Survival suit manufacturers and suppliers have also shown interest in the data for application in the design of next generation of survival suits, with particular reference to ensuring wrist and neck seals are effective. There were also indications that the companies involved with the design and specification of installations were looking at the data in respect of corridor widths, escape stairs and muster point dimension. Lastly there was some anecdotal evidence that some installation operators were starting to look more carefully at the offshore diet and the potential for the inclusion of health-related eating criteria in future contracts with the offshore catering contractors.”

Robert Paterson

Links 7-10 demonstrate prolific exposure to the industry workforce and governance, and the wider public. Printed coverage was estimated to equate to £0.25m by RGU's communications team.

7. <http://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-31849823>
8. <https://www.energyvoice.com/video-2/101474/video-the-north-sea-size-and-shapes-impact-on-helicopter-escape-potential/>
9. <http://news.stv.tv/north/1342561-north-sea-a-safer-place-thanks-to-research-into-size-of-oil-workers/>
10. <http://www.scottishenergynews.com/bigger-broader-and-taller-offshore-workers-are-19-heavier-today-than-in-1980s/>