

Impact case study (REF3)

Institution: Edinburgh Napier University		
Unit of Assessment: Unit of Assessment 24 – Sports and Exercise Sciences, Leisure and Tourism		
Title of case study: Mountain Biking Innovation: Delivering economic and societal benefits.		
Period when the underpinning research was undertaken: July 2005 - May 2019		
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:
Professor Geraint Florida-James	Professor	Aug 2000-ongoing
Dr Tom Campbell	Lecturer	Sept 2015-ongoing
Dr Lesley Ingram-Sills	Lecturer	Sept 2019-ongoing
Dr Mark Taylor	Lecturer	Feb 2008-ongoing
Period when the claimed impact occurred: January 2010 - July 2020		
Is this case study continued from a case study submitted in 2014? N		
<p>1. Summary of the impact (indicative maximum 100 words) Research by Edinburgh Napier University has played a pivotal role in developing and establishing models of support to deliver economic benefit through innovative knowledge transfer activities. The establishment of the world's first open innovation centre for mountain biking has delivered 87 innovation focused events, facilitated 161 collaborations, engaged with 245 businesses, facilitated 65 academic support searches and 43 student projects. The work carried out at the Centre has resulted in: the world's first Government sponsored National Strategy for MTB Innovation; 9 new MTB businesses being launched; increased investment and turnover in new MTB businesses; establishment of the Scottish Bike Cluster and strategic partnerships with cycling and manufacturing industry bodies.</p>		
<p>2. Underpinning research (indicative maximum 500 words) The outbreak of foot and mouth in Scotland in 2001 had a devastating effect on the remote and rural economies of Dumfries and Galloway and the Scottish Borders. In response to the problem, Government agencies came up with an area plan to develop 7 mountain biking sites across the region to encourage tourists to return. The Global Adventure Tourism market grew 195% between 2010 and 2013 to USD263billion (Adventure Trade Travel Association: Market Study 2013), whilst in Scotland there was an increase of 18% in mountain bike tourism with an accompanied GVA of GBP54million per annum (between 2008 and 2015) (Frontline Report). The expanding mountain bike industry valued globally at USD64billion per annum by 2025 (Bike Europe, 2018), is historically very limited within Scotland and hence an opportunity to stimulate the economy through innovation within the mountain bike industry was grasped.</p> <p>Between 2003 and 2010, research lead by Professor Florida-James (Professor of Applied Sport Sciences, started employment 2000) developed innovative methods of conducting research in difficult applied performance environments and the effects of performance on the immune system [O1,O2,O3]. This work crucially included developing mobile field labs and techniques to allow intact immune and human response data to be collected at remote mountainous locations. Additionally, Edinburgh Napier University has been at the forefront of research in mountain bike innovation since the early 2000s when Florida-James commenced work in the discipline. Initially using bespoke methods based on the research conducted between 2003 and 2010 [O1,O2,O3] the team provided performance consultation services to individual athletes, and secured contract work for Scottish Cycling (2010-2015: GBP46,000)[P1] delivering support to national MTB teams.</p> <p>In 2010 Florida-James completed research on physiological contributions to successful downhill mountain bike performance, whilst applied research work in cycling continued (between 2012</p>		

and 2016) on sleep disruption and the immune system [O4] and demands of enduro mountain bike racing (between 2016 and 2019). The latter work, resulted in the first ever peer reviewed publications on enduro MTB discipline [O5, O6], building on the techniques developed in the earlier outputs [O1, O2, O3]. Research methods and techniques of on the hill data collection were only made fully public in 2018/19 when competitive advantage was seen to be minimal [O5, O6], particularly around the use of high frequency accelerometers to measure bike and component performance, and hand arm vibration exposure. Within this research a bespoke accelerometer mount was constructed, and crucially for the first-time data was transformed and analysed to meet the analysis requirements of hand-arm vibration exposure in compliance with the international standard. Hand-arm vibration syndrome (HAVS) is a recognised industrial disease induced by excessive exposure to vibration through occupational tasks involving vibrating machinery. The team showed that MTB racing could be potentially harmful if vibration exposure was not considered and perhaps mitigated. This applied research and consultancy allowed Florida-James to forge strategic partnerships with Government support agencies and in 2014 the internationally leading Mountain Bike Centre of Scotland (MTBCOS) [P4] [P9] was created, with partners Scottish Cycling, Scottish Enterprise and lead by Florida-James.

Assistance occurred on the immune response with Ross and Black of Edinburgh University (2005) and McFarlin, University of Houston (2009), whilst Whyte, British Olympic Medical Centre (2005) assisted on sport science aspects. All other authors on outputs were Napier staff or students. Guy, Wilson and Malone contributed on the immune response components, Gray to the sport science components, and Taylor to the engineering and vibration components. Simpson, Ingram, and Kirkwood were PhD students for whom Florida-James was Director of Studies, whilst Bartlett, Booth and Cunningham were Napier undergraduate students at the time.

The classical ergonomics research approach of the Mountain Bike Centre of Scotland has been refined to offer services to the commercial sector, which resulted in the Scottish Government further funding MTBCOS to contribute to The Strategy for Scottish Mountain Biking 2019-2025, including authoring the Innovation Strand of the Strategy. Additionally, the MTB Partnership secured GBP19million in the Heads of Terms Agreement (July, 2019) of the Borderlands Regional Growth Deal, to develop a full economic case to build an Innovation Hub, Bike Park and Trail Lab in the Scottish Borders to further support their research and knowledge transfer activities.

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

O1-O6 have all been through competitive and robust peer review prior to publication. **O1, O2, and O4** have numerous international citations in further research.

[O1] Simpson, R. J., Wilson, M. R., Black, J., Ross, J. A., Whyte, G. P., Guy, K., & Florida-James, G. (2005). *Immune alterations, lipid peroxidation, and muscle damage following a hill race*. *Applied physiology, nutrition, and metabolism*, 30, 196-211. doi:10.1139/h05-115

[O2] Simpson, R. J., Gray, S., & Florida-James, G. (2006). *Physiological variables and performance markers of serving soldiers from two "elite" units of the British Army*. *Journal of sports sciences*, 24, 597-604. <https://doi.org/10.1080/02640410500230811>

[O3] Simpson, R. J., Bartlett, D. B., Booth, S., Florida-James, G. D., & McFarlin, B. K. (2009). *Resting Blood Lymphocytes Are Activated by Autologous Serum After A 40km Cycling Time Trial: 542*. *Medicine and science in sports and exercise*, 41(Supplement 1), 7. <https://doi.org/10.1249/01.mss.0000353277.01938.3c>

[O4] Ingram, L. A., Simpson, R. J., Malone, E. M., & Florida-James, G. (2015). *Sleep disruption and its effect on lymphocyte redeployment following an acute bout of exercise*. *Brain, Behaviour, and Immunity*, 47, 100-108. DOI:10.1016/j.bbi.2014.12.018. **Submitted in REF2.**

[O5] Kirkwood, L. A., Taylor, M. D., Ingram, L. A., Cunningham, J., Malone, E., & Florida-James, G. D. (2018) *Physiological characteristics and performance in elite vs non-elite enduro mountain biking*. *Journal of Science and Cycling*, 6(2), 13-2. <https://doi.org/10.28985/171231.jsc.09>

[O6] Kirkwood, L. A., Taylor, M. D., Ingram, L. A., Malone, E., & Florida-James, G. D. (2019). *Elite mountain bike enduro competition: a study of rider hand-arm vibration exposure*. *Journal of Science and Cycling*, 8(1), 18-25. DOI: 10.28985/1906.jsc.04. **Submitted in REF2.**

Funded Projects

[P1] Mountain Biking Consultancy Project. 11 Jan 2010 - 31 Jul 2015. Scottish Cycling. £46k (Florida-James, Ingram).

[P2] Performance Testing of Scottoiler Active Fluid System. 16 Jul 2012 - 30 Nov 2012. Sporting Chance Initiative- Interface. £5k (Florida-James, Ingram, Campbell).

[P3] Scottoiler Focus Groups and Field Trials - 2 Jan 2013 - 31 Aug 2013. Scottoiler (Scotland) Ltd & Scottish Enterprise. £10,475 (Florida-James, Ingram, Campbell).

[P4] Mountain Bike Centre of Excellence. April 2014-June 2019 £470k. Scottish Funding Council. (Florida-James).

[P5] Mountain Bike Suspension Optimisation. 3 Feb 2015 - 31 Jan 2016. Interface Voucher project. £5k. (Florida-James).

[P6] Mountain Bike Suspension Set Up product. 15 July 2016- 18 May 2017. Interface Follow On Voucher project. £5k Florida-James

[P7] Efficacy of the descent master training machine. 22 Jan 2018 - 21 May 2018. Interface Voucher project. £5k. (Florida-James, Campbell)

[P8] BikeSenz: getting to grips with cyclists' comfort. 7 Aug 2019 - 10 Jul 2019. Interface Voucher project. £5k. (Campbell, Florida-James)

[P9] Scottish Mountain Bike Strategy Delivery 2019-2025 4 Jan 2019 - 31 Mar 2020. Scottish Government £92.5k. (Florida-James)

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

Research by Edinburgh Napier University has played a key role in developing and establishing models of support to deliver economic benefit through innovative knowledge transfer activities. The creation of the world's first open innovation centre for mountain biking has delivered 87 innovation focused events, facilitated 161 collaborations, engaged with 245 businesses, facilitated 65 academic support searches and 43 student projects. The work carried out at the Centre has resulted in: the world's first Government sponsored National Strategy for MTB Innovation; 9 new MTB businesses being launched; increased investment and turnover in new MTB businesses; establishment of the Scottish Bike Cluster and strategic partnerships with cycling and manufacturing industry bodies.

Impact on government strategy and the rural economy

In June 2014, Florida-James secured investment from the Scottish Funding Council (SFC) to create the MTB Centre of Scotland (MTBCOS) in the rural Scottish Borders. It is a physical centre with a full-time Business Development Manager, a part-time administrator and input of staff from Napier pro rata. From market research to product development, knowledge transfer, testing and product launches, MTBCOS assist businesses to capitalise on one of Scotland's fastest growing adventure sports. MTBCOS is a centre for open innovation and has an extensive partnerships network which allows companies, both product and service based, access to national and international markets, **[C2, C3, P4]**. In total SFC invested GBP470,000 in this work; (between 2014 and 2019). In 2019 the Scottish Government invested an initial GBP92,500 (total of GBP277,500 to 2023), with MTBCOS given the specific task of delivering the Innovation Strand of the Scottish Mountain Bike Strategy 2019-2025 **[P9, C3]**. Scottish Cycling's Developing Mountain Biking in Scotland project (DMBinS) is tasked with overseeing the national strategic framework for mountain biking in Scotland **[C3]**.

Florida-James contributed to the 2016 refresh of the framework and then lead on the "A leader in MTB Innovation" strand of "The Strategy for Scottish Mountain Biking 2019-2025". This Strategy is the first of its type in the World, is funded by the Scottish Government and it was Fiona Hyslop MSP, Cabinet Secretary for Culture, Tourism and External Affairs, launching the Strategy at the MTBCOS who stated in her Ministerial Forward to the Strategy that: "**Scottish Mountain Biking is already impacting on our economy with £105m GVA generated from mountain biking activity in 2015 alone.**" **[C3]**. As a result, Florida-James was invited to sit on the board of the Mountain Bike Consortium, a multi-agency consortium of Scottish Government Stakeholders and Sporting Body representatives tasked with overseeing the delivery of the Strategy (2019-2025). Within the Consortium, Florida-James has materially influenced the strategy of growing a cycling industry and economy within Scotland, as evidenced by his co-authorship and input into the ongoing business plans for the MTB Innovation Centre and Trail

lab of the Borderlands Regional Growth Deal (GBP19million) [C2, C3] for which he was also invited to sit on the Borderlands MTB Project Board.

Economic and Commercial Impact

The first commercial MTB research project (GBP5,000) led by Prof Florida-James (with contributors PhD students Ingram and Campbell) was for SME Scottoiler (Scotland) Ltd and its success attracted follow on funding (GBP10,345) from the company (70%) and Scottish Enterprise (30%) [P3]. As explained by Nick Muddle, Director of Sales and Marketing at Scottoiler Ltd [C1]: ***“Initially Scottoiler Solutions was interested in working with Professor Florida-James from the research work he had previously carried out in the field with mountain runners and the novel research techniques he had developed whilst working with elite mountain bike athletes.”*** [O1, O2, P1]. ***The commissioned research work that Professor Florida-James undertook for us demonstrated the efficacy and efficiency of our product in a mountain bike setting. The research of Professor Florida-James has been instrumental in the development of this side of the business. The impacts arising from the work have been significant for the company.***

The research for Scottoiler Solutions into the efficacy of an automatic bicycle chain lubing solution and system led to:

- ***New investment in the company of £734,000***
- ***The launch of a new brand and 11 new products from September 2016***
- ***The creation of a new product development pipeline***
- ***The launch of a new sister company Scottoiler Sport Solutions Ltd in 2016***
- ***Creation of 4 new roles within the company.***
- ***Marketing and publicity of the product and company globally and in a new sector, including sponsorships with 3 high profile elite racing teams”***

The outputs [O4, O5, O6] on physiological demands on the athlete and bike response, measured both in the lab and in the field, resulted in methods that were employed by the team lead by Florida-James to complete 6 Innovation research projects [P5][P6][P7][P8] with start-ups and SMEs. Contributions came from Dr Campbell, started 2015 (post PhD) Dr Ingram-Sills, started 2019 (post PhD) and Dr Taylor (started 2008). This body of work, in addition to Scottoiler’s new company launch and automatic chain lube product resulted in the following companies being started and products created: Forge Bikes (optimised full suspension bike; 2015); SusMyBike (MTB suspension set up product) RevoRoute (Descent Master MTB Training product, 2018); BikeSenz (ergonomic comfort grips, 2019). An example of the success of these products comes from Lewis Buchanan, Professional MTB Racer, who is quoted as ***“Since I started using the Descent Master it’s really helped stabilise my shoulders and allowed me to gain more control when holding onto the handlebars”***.

The impact of the work of the team at Edinburgh Napier University has been acknowledged by key Government stakeholders Scottish Enterprise (SE). Scottish Enterprise’s independent consultants (Frontline) reported in 2015 that access to research and the academic team (at Napier) had enabled: ***“nine businesses to develop new products; nine businesses to establish a new business partnership; and six businesses to access a new market. Increased turnover of £108k for 4 businesses and export sales of £50k from one company were also acknowledged in that report to be as a direct result of the work with the MTBCOS.”*** [C2]. Moira Forsyth, (Specialist, Sector Innovation Services, SE) stated that ***“The current work of MTBCOS and partners in the proposed location for the new innovation centre of Innerleithen has already had striking economic and societal impact which is now being recognised in the mountain bike industry as reported in the 2020 Mountain Bike Rider (MBR) article- “How Mountain Biking saved Innerleithen”. [C5]. “The work within the local community and businesses of the MTBCOS and partners has been integral to this change in fortunes for the town and the new Innovation Centre project could not have been developed were it not for the innovative research and product development undertaken at Edinburgh Napier University led by Prof Florida-James.”*** [C2].

Recognition of Impact Activities

The impact of the Napier research work has been recognised by: Scottish Enterprise's invitation to co-create the Scottish Cycling Industry Cluster (2018) [C2]; and the National Manufacturing Institute for Scotland's (NMIS) invitation to MTBCOS to become a full Network Partner (2020). Prof William Ion, NMIS Networks and Alliances Lead, University of Strathclyde stated that **"Due to the research and innovation work carried out by the MTBCOS and its impact on developing the Scottish Cycling Industry Cluster, it was a natural sectoral partner for NMIS."** [C6]. Cycling Industries Europe (CIE) invited MTBCOS to become a founding member of this prestigious cycling trade association (2018), the only University to receive such an invite. Cycling Industries Europe (CIE) represents many of the EU and the world's leading cycling companies and supporting organisations. Its members are global leaders, together with the suppliers of equipment, accessories and services that support these markets. As stated by the CEO of CIE: **"MTBCOS was invited to be a founding member of CIE in October 2018. This was because MTBCOS represented a unique skill set and research knowledge base in the industry, being only one of a very small number of cycling related centres of excellence in innovation and a business incubation clusters in the whole of Europe."** [C4].

Sector innovation events have been organised and lead by the MTBCOS in Scotland including: *"The Circular Economy & the Cycling Industry"*; *"Engineering Opportunities in Cycling"*; two European MTB Innovation Summits supported by Cycling Industry Europe and Scottish Enterprise, whilst MTBCOS hosted the inaugural CIE Brussels Summit at Scotland Europa, Brussels [C4]. These events attracted attendees from private sector companies and academia from across Europe. Innovation roadshow clinics have been organised pan Scotland, as well as 24 focus groups, 24 market research surveys for 21 companies with 1980 responses since 2014. 17 companies were supported to go to the Eurobike trade show in August 2016 with additional international revenue impact put at GBP570,000 for that year as a result of this work. The above engagement in disseminating the research work of MTBCOS with the cycling public and industry is important as this developed ongoing relationships to create further impact. As put by Nick Muddle, Director of Sales and Marketing at Scottoil Ltd as **"(MTBCOS) continued, to publicise the findings of the research and showcase the product, including supported trips to EuroBike Trade Show and facilitation of introductions to professional athletes and teams. This attracted a significant external investor in the product."** [C1].

Awards

Business to academic partnership of the year award. Scottoil. Scottish Mountain Bike Awards 2016.
 Product Innovation of the Year. Scottish Mountain Bike Awards 2018 (SussMyBike - SMB Flow)
 Product Innovation of the Year. Scottish Mountain Bike Awards 2019 Revoroute- Descent Master)
 Innovative Educator of the Year. Bright Red Triangle Awards (2019). Edinburgh Napier University.

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

- [C1] Letter from Scottoil Ltd stating the commercial impacts of Napier research (July, 2020)
 [C2] Statement from Scottish Enterprise stating the impactful benefits of Napier research (Aug 2020) Specialist, Collaborative Innovation Services, SE.
 [C3] Statement from Scottish Cycling stating the impactful benefits of Napier work. (September 2020) Head of Developing Mountain Biking in Scotland (DMBinS), Scottish Cycling.
 [C4] Statement from Cycling Industries Europe stating the impactful benefits of our work. (April 2020). CEO of Cycling Industries Europe.
 [C5] Article in MBR "How Mountain Biking saved Innerleithen."
<https://www.mbr.co.uk/news/how-mountain-biking-saved-innerleithen-396588>
 29 April 2020
 [C6] Letter from Prof William Ion, National Manufacturing Institute Scotland (NMIS) Networks and Alliances Lead, University of Strathclyde