Institution: Edinburgh Napier University

Unit of Assessment: 14 – Civil and Construction Engineering

a. Context

This Unit of Assessment (UoA) covers staff from two distinct research institutes aligned with the School of Engineering and the Built Environment, within the Faculty of Engineering, Computing and Creative Industries. The two distinct aspects of the UoA's research are covered by the Transport Research Institute (TRI) and the Centre for Geotechnics (within the Institute for Sustainable Construction).

The research in this unit of assessment has commercial, social, economic, regulatory and environmental impact. The significance of this impact is evident from the extent to which our research has been taken up and influenced practice, policy and welfare, as described below.

The Transport Research Institute (TRI), through its size and multidisciplinary nature, has a significant and wide ranging impact. It is recognised worldwide for its maritime research. TRI has been engaged with public and private stakeholders seeking to develop, for example, the first green sea corridor in the North Sea Region, jointly enhancing the commercial and environmental aspects of international freight operations. This work interfaces with the development of Dryports – inland container facilities that support the ports – work which underpins South East Scotland Transport Partnership (SEStran) investment in real infrastructure.

Impact from the Centre for Geotechnics, which operates within the Institute for Sustainable Construction, is evidenced by a continuing utilisation of the HBM model in the analysis of landfill behaviour in Canada. This work was previously the focus of a Defra funded project in conjunction with Golder Associates and reported on in 2008.

The social aspects of our research are also evident in research focussed on for example transport planning, policy and implementation. This was established as a theme for research over a decade ago. From this base, a social science perspective on Transport Studies both in and outwith Scotland has been established. A major product of this relationship has been the Transport and Society book series published by Ashgate Publications.

A combination of commercial, social and regulatory benefits have derived from new approaches to the analysis of regulation, supply and appropriate tariffs in taxi and private hire car markets. This work has been taken up by UK and Ireland governments and the cities of Atlanta, Seattle, Nashville and San Diego – an area of research that is described in detail in one of the case studies. This expertise has also led to promotion of the use of shared door-to-door public transport, such as buses and taxis, where service provision is determined by user demand – a mode that is exceptionally useful in rural areas, engendering social inclusion and increased efficiency in public resources. The taxi team (led by Cooper) set up, and operated for 4 years (2005-2009) the T2E Transport to Employment network in the Scottish Highlands, which was an award winning project, allowing rural populations to access low-cost transport to work. This initiative had significant social impacts on the rural communities it served.

The international impacts of the UoAs research are significant. UoA staff are working with the Mitsubishi Research Institute on the design of roadside facilities in Kenya and Pakistan to incorporate the social aspects of transport provision. We are also working with the World Bank on gender and rural infrastructure, and with the Department for Transport on social exclusion, ethnicity and road user charging.

In other areas research plays a critical role in contributing to climate change goals through emerging low carbon technologies and green vehicles. UoA staff are engaged as consultants on energy-related projects, the role of transport in achieving greenhouse gas emission reductions, through better engine management, regenerative braking systems and electric vehicles. In 2012,

Scottish Government Transport Minister Keith Brown officially opened new electric car charging points set up at Edinburgh Napier University's Craiglockhart, Sighthill and Merchiston campuses.

Transport economics, both in terms of public accounts and private finance, is another important research theme. In particular, advice on pricing structures and associated demand has been given to public and private-sector bodies. For example, the EU-funded DIFFERENT project which investigated differential pricing across several modes of transport – air, rail, shipping, private car - in cities with road pricing and freight traffic on tolled highways, was led by TRI. Our research has have provided economic appraisals of new transport links and infrastructure investments for Clyde Waterbus, as well as several proposed ferry links between Scotland and Europe. In all these studies cost benefit analysis of both commercial, social and environmental benefits are delineated. Another recent project, for Virgin Trains, looked at the amount and value of work done by commuters while travelling by train and whether employers should be paying for rail tickets as a result. This research explores personal preferences and the human response to travel.

b. Approach to impact

Staff members from the UoA are involved in various outreach and public engagement activities. In January 2013 in association with Shetland Arts and with support from Creative Scotland, the National Theatre of Scotland organised 'Ignition Open Day' a public event that focussed on the pros and cons of the automobile. On behalf of Edinburgh Napier University, Professor Muneer made a presentation on 'Sustainable Transport' that encompassed the work profile of his research group: http://www.nationaltheatrescotland.com/content/default.asp?page=home_Ignition

CIC START ONLINE was an ERDF funded project that promoted Innovations for Sustainable Building Design and Refurbishment. The project was delivered from 2009 - 2013. The project aimed to embed sustainable building design and refurbishment into practice. The project assisted Scottish small and medium sized enterprises (SMEs) to develop and test innovations at testing facilities of the project partners' institutions. CIC Start Online attracted over 2,230 members until the end of February 2013 and its interactive online webinars have been watched across the United Kingdom and in 53 other countries.

More recently, social media have been recognised as an effective means of enhancing the impact of our research activity. Examples include:

a) Energy cooperatives video: http://www.youtube.com/watch?v=5HvfvnWcBt4
b) Solar Energy video: http://www.youtube.com/watch?v=y2MravYP7hQ&feature=c4-overview-vl&list=PLFED1B47C7FB42D80
c) Webinar # 19 - 13th April 2012: Solar PV on Fairfield Housing Cooperative (in collaboration with Fairfield Housing Cooperative). http://www.cicstart.org/content/webcasts/213/
d) Webinar # 23 - 29th May 2012: Achieving Higher Heat Pump COP through the use of Roof-top thermal solar collectors (in collaboration with European Energy Centre).

Other activities which reflect our approach to impact include TRI Director's (Cullinane) visit to Department of Transport in Melbourne, Australia, to discuss port and freight logistics, technology improvements, trucking and rail at an event organised by the Ministerial Freight Advisory Council.

UoA staff have been instrumental in encouraging outreach events. For example, in 2012 a taxi outreach event was held at the Royal Highland Showground. The day comprised of workshops based on current taxi research themes, including: taxi tariff - meter rates, planning, modelling and GIS; and vehicle design and accessibility. The event, which attracted 98 visitors, was rounded off with a trial of accessible vehicles, as well as a demonstration on disability needs.

Given that the key to continuing impact is an up-to-date awareness of the needs of industry and the consumer, both TRI and the Institute for Sustainable Construction boast large and active advisory boards. These have been key to horizon scanning and early identification of new opportunities, and putting in place effective steering during the course of a project.

Where appropriate commercial spinout is possible. There is a precedent within the School of Engineering and the Built Environment. We reported to RAE2008 that Cardiodigital, a spin out company specialising in the time-frequency domain analysis of NDT pile testing, turned to medical signal analysis. Cardiodigital has since been sold to Covidien, a $10 billion global healthcare products leader. (http://investor.covidien.com/phoenix.zhtml?c=207592&p=irol-newsArticle&ID=1184934&highlight)

c. Strategy and plans

The on-going strategy of UoA14 is to increase the number and types of impact through applied and 'contract' research. Recognising that the institutes have strong links with industry (mainly small to medium sized enterprises) the strategy is to increase these links and to extend them to include larger international companies and the wider community.

The research institutes and centres within which civil and construction engineering research takes place all value the importance of external impact and uptake. They will continue to make resources available to allow staff to develop and to enhance the many forms of impact highlighted in sections a) and b) above. Impact in terms of uptake calls for engagement between researchers and users/problem holders. A taxi studies outreach workshop, in conjunction with the Transport Research Board, planned to be held in Washington DC in 2014 has already about 150 delegates registered.

In the longer term, another excellent vehicle for such engagement and creation of impact is the Knowledge Transfer Partnership scheme. Edinburgh Napier has been very successful in this regard, being heralded as an exemplar of best practice in 2012 by the Scottish Funding Council (SFC) commissioned Report '*Analysis of the Knowledge Transfer Grant Strategies and Annual Reports'*. In May 2013 the Thin Membrane Isolator was further developed as part of a KTP, which was classified by the Technology Strategy Board as 'outstanding' and nominated for the national KTP awards 2013.

Over the next assessment period greater emphasis will be placed on recording the impact of research activities via end of project reports, the annual personal development review process and research committee structures.

d. Relationship to case studies

Case studies presented as a part of this submission are:
1. Enhancing taxi transport policy and practice in the UK and internationally.
2. Development of thin membrane isolators for attached housing enhancing building performance, wellbeing of occupants, resource efficiency and reducing costs.

The taxi impact case study highlights how research has influenced international regulatory authorities. A wider market approach to taxi analysis has created a strand of research that has caught the attention of taxi regulators. The market model has been applied across the US and Canada in specific city projects, including Boston, Chicago and Toronto, and has underpinned policy prediction by the International Association of Transportation Regulators, the North American taxi regulatory authorities, and the Transport Research Board.

The Thin Membrane Isolators impact case study is a good example of how engagement with problem-holders and targeted delivery of outcomes has grown and been instrumental in delivering significant downstream benefits and cost savings. As mentioned in the case new regulations designed to offset noise and vibration transmission were set to increase new dwelling build costs. Over the following years, compound thin layers were found to limit these vibrations and were subsequently developed. Later, it was found that these isolators also offered good thermal performance.