University of Strathclyde Engineering

CONFERENCE

2020 Scotland's Climate Group

Sustainability and resilience of buildings, settlements and the natural environment: Research, practice and support for social innovation

CONFERENCE REPORT

23rd April 2015

DEPARTMENT OF ARCHITECTURE

University of Strathclyde, 75 Montrose Street, Glasgow

CHAIR: Professor Branka Dimitrijevic, Director of Knowledge Exchange, Department of Architecture

SPEAKERS:

Dr Lori McElroy, 2020 Climate Group
Clive Mitchell, Scottish Natural Heritage
Professor Ashraf Salama, Head of Architecture, University of Strathclyde
Professor Milan Radosavljevic, University of the West of Scotland
Malcolm Fraser, Malcolm Fraser Architects
Dr Richard Bellingham, Institute for Future Cities, University of Strathclyde
Katherine Lakeman, Scottish Environment Protection Agency
Jamie Cooke, The Royal Society of Arts
Professor Joe Clarke, Mechanical and Aerospace Engineering, University of Strathclyde
Elizabeth Robertson, Electronic and Electrical Engineering, University of Strathclyde
Cyril Dyer, Future City Glasgow
Chris Cook, Linlithgow Natural Grid, University College London

Image: Detail from Stabilising the Delta by Marianne Keating and Cara Shields

CONFERENCE REPORT

Introduction

The conference 'Sustainability and resilience of buildings, settlements and natural environment: Research, practice and support for social innovation' was organised by the Department of Architecture of the University of Strathclyde and supported by the 2020 Climate Group. It brought together researchers and practitioners from different disciplines with the aim to share recent research and practice findings, discuss what future research is required and how social and entrepreneurial innovation can be supported in communities to increase the sustainability and resilience of buildings, settlements and the natural environment. The complexity of sustainability and resilience of the built and natural environment called for knowledge exchange between researchers in different disciplines, government agencies, learned societies, professional associations, and interested community groups and individuals.

Ahead of the conference, the speakers and delegates were sent several questions about potential forms of support for social innovation, appropriate dissemination routes, knowledge dissemination enablers, governance and partnership frameworks, big data for social innovation and decision-making tools for different users. Some responses were included in the presentations and others were provided during the discussion or by email. This report includes the executive summary of the conference outputs, followed by the conference programme, questions raised ahead of the conference, speakers' biographical notes, summaries of the presentations and the presentations in PDF format.

Feedback from the conference speakers and delegates indicated that the multidisciplinary approach to discussing sustainability and resilience was welcome, and that similar multidisciplinary conferences on other complex themes of interest to researchers and practitioners in different disciplines should be organised in the future. The Department of Architecture will respond to this feedback by organising another multidisciplinary conference in early 2016. We believe that this and future multidisciplinary conferences on complex topics, which bring together researchers and practitioners, will increase understanding of the needs for future research.

Professor Branka Dimitrijevic
Director of Knowledge Exchange, Department of Architecture
Associate Dean Knowledge Exchange, Faculty of Engineering
University of Strathclyde

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Sustainability and resilience of buildings, settlements and the natural environment: Research, practice and support for social innovation

EXCUTIVE SUMMARY

The conference programme aimed to stimulate a dialogue between researchers and practitioners involved in the sustainable development of the built and natural environment. The conference focus was on how research and practice can support social innovation and what tools can enable the application of systems thinking in the decision-making of different users related to the planning of the sustainable development of the built environment and caring for the natural environment. This summary highlights the key messages (and key words), related research questions from the speakers' contributions (included as summaries and presentation slides in this report) and answers to the discussion questions sent ahead of the conference to the speakers and delegates.

Global and local context

Clive Mitchell (Scottish Natural Heritage) pointed out that the conference theme raised the question of **governance**: who is making what decisions on whose behalf and in whose interests? His talk set the scene for the research questions addressed by the conference by asking: What are places for? People or profit? What is the scale of the public participation and role in decision-making? How are private, market and public interests negotiated and mediated? Clive concludes that 'making better places is a political matter at least as much as it is a technical one'.

As the conference introduction talks set out the wider context, Professor Milan Radosavljevic (University of the West of Scotland) addressed the environmental, social and economic aspects of the resilience of settlements. Milan highlighted the growing **complexity** of and the reliance on sometimes distant resources for running the systems developed by modern societies which make them more vulnerable in critical situations. Less complex, robust systems which rely on locally available resources increase resilience.

The relevance of the conference theme in the globalized world and some examples of regeneration and revitalisation of urban heritage in the Middle East were presented in the talk by Professor Ashraf Salama (Head of Architecture, University of Strathclyde). The presentation concludes with a framework which adopts the premise that built heritage cannot be seen in physical terms only; it is not just a place, but also a **cultural process**. Preservation of local identity and heritage can be achieved if interventions are sensitive to the cultural context and aim to preserve it.

In relation to the Scottish context, Dr Lori McElroy (2020 Climate Group) presented examples of **working together** through the 2020 Climate Group to support actions for climate mitigation and adaptation, including centralised access to knowledge resources on retrofit of buildings (Retrofit Scotland) and projects for the sustainable reuse of buildings.

Planning

Planning aspects that increase sustainability and resilience were considered in the presentation by Dr Richard Bellingham (Institute for Future Cities, University of Strathclyde). Managing **growing urbanisation** while addressing demographic, social and climate change issues are current challenges. The focus is on creating 'future cities' which have a thriving economy and good quality of life with reduced environmental impact. The nature of the challenges and opportunities are different internationally. In Europe and the USA, the rates of growth of cities are typically slower but the cities themselves are older, with greater legacy issues. In regions such as Asia Pacific where the greatest growth in relative and absolute terms is forecast, the issues are ones of scale and pace of growth, with countries such as India and China creating new cities 'from scratch'.

Malcolm Fraser (Malcolm Fraser Architects) highlighted the need to broaden the thinking about the sustainability of buildings as related only to energy consumption by considering the '**material and cultural energy'** embodied in existing buildings. Malcolm outlines the 'good practice code' developed by his practice and used on its projects to create more sustainable existing and new buildings. The code was applied on the renovation of the historic, eighteenth century Old Royal High School in the Old Town of Edinburgh in 2013, now used by the Edinburgh Centre for Carbon Innovation. This is the first listed building *anywhere* to achieve BREEAM's top "Outstanding" certification.

Environmental aspects

Environmental impacts, mitigation and adaptation actions, and a transition to new economic and energy systems models to increase resilience were the topics of several presentations. Although Katherine Lakeman (Scottish Environment Protection Agency) was not able to personally present her contribution to the conference, the presentation is included in this report. It explains how the resilience of communities to flooding can be developed through effective **land use planning** and provides information on SEPA's services to date as a consultee on planning applications. It points out the need to mainstream climate resilience into sustainable place-making agenda and to develop innovative solutions to communicate issues to all stakeholders and to foster public engagement in order to identify solutions.

Jamie Cooke (The Royal Society of Arts) focused on the need for a more efficient use of natural resources by **designing-out waste** and highlighted the initiatives and projects in Scotland which support a transition to a circular economy and remanufacturing. The RSA is looking for partners to support future research on the economic impacts of specific systems by, for example, developing tools for brokerage between producers and entrepreneurs, and identifying opportunities for circularity in practice.

Professor Joe Clarke (Energy Systems Research Unit, Mechanical and Aerospace Engineering, University of Strathclyde) explained how energy systems simulation tools can assist communities to plan **low carbon energy** provision by applying whole systems thinking and including thermodynamic considerations on proposed schemes. Joe highlighted the need for more appropriate design tools and an agreed approach to performance assessment that enables the ready comparison of different proposed schemes in terms of the range of relevant issues that affect stakeholders.

The development of a **'civic' energy sector** is one of the topics of the research project 'Distributing Power', presented by Elizabeth Robertson (Electronic and Electrical Engineering, University of Strathclyde). Elizabeth pointed out that a distributed energy system opens up new avenues for financing energy transition, but challenges incumbent utility business models. It is possible to meet 50% of final electricity demand in the UK using distributed generation by 2050, but new infrastructures and emerging technologies are key, as are strong demand reduction and demand-side participation and management. The research provided a new understanding of the potential for participation in the energy transition by actors who have played only a passive or marginal role in energy system change.

Social aspects

Cyril Dyer (Future City Glasgow) explained how the Future City Glasgow project will enable **citizens' involvement** in creating Glasgow's future. The project supports innovation by **providing data** related to crime prevention, health, energy and transport. It motivates data providers by aligning with their goals and aspirations. Community engagement is supported through provision of community maps and data which enable the development of apps for mobile devices and analytics required for community projects.

Chris Cook (Linlithgow Natural Grid; Institute for Security & Resilience Studies, University College London) presented community actions in Linlithgow for transition to sustainable living. Chris highlighted the need to ensure resilience through responsible management of natural resources, **capability and capacity building of communities**, and **robust financial systems**. Linlithgow's decentralised Natural Grid project is based on the 'Least Carbon Fuel Cost principle' which entails minimum carbon fuel input for a given output of electricity, heat or power, as well as investment in renewables for heat and transport, and energy efficiency. The aim is to ensure **energy security** and **reduce carbon emissions and energy cost**. Chris also provided answers to seven conference questions within the presentation.

Panel discussion

As an introduction to the panel discussion, Professor Branka Dimitrijevic (Architecture, University of Strathclyde) suggested that, considering the anticipated wider availability of data on natural and human systems, there will be a growing need for decision-making tools tailored to the needs of different users (e.g. global, national, regional and local governance structures and agencies, organisations, institutions, businesses, community groups and individuals) to enable effective use of data. **Social innovation** will be supported if communities have access to data related to the local, social, economic and environmental context as well as to **decision-making tools**. Such tools should also be developed for other users in governance, industry and business. Novel models of knowledge sharing between universities and a range of end-users of research outputs should be explored to increase research impact.

The panel discussion included some answers to questions raised ahead of the conference about support for social innovation (included in the report), and some answers are presented below.

Future research

Some suggestions for future research were related to the focus of the presented projects (and included in the slides). Other suggestions, reflecting the research and practice expertise of the attendees, were as follows:

- studies that follow or comply with NICE guidance on the benefits of interventions on physical health and the environment (including social and community aspects)
- how to develop the capability of, OR deliver useable insight (research) to a community so as to improve the way it behaves, and influence the way it decides
- research into core community issues as this will become even more relevant in the digital age
- risks assessment to ascertain the hazard, exposure and vulnerability level of the people, properties and the environment
- low carbon design and evaluation for the entire life-cycle of buildings
- what works in current governance frameworks, and how they might be best developed to foster and enable more social innovation

Support for social innovation through research outputs

- Examples of comments often made are 'we can't involve everyone' and 'what if we raise expectations and people say things we disagree with or can't act on'? Can researchers help us to dispel these myths…?
- Area Partnerships are a very powerful tool in considering the needs and investments of an area.
- Engaging the community through a different approach to architectural construction which delivers improved quality buildings, with instructions to occupants for how to maintain a healthy building.

Dissemination routes

- Perhaps it would be useful to bring together findings on what works for different groups?
- Having a tailored push/pull mechanism into the City is by far the most effective way of getting the right information to the right people when they need it.
- Through government, international organisations, municipality, local council, media, various community associations and also through trans-boundary or bilateral cooperation.
- Pecha Kucha style events, workshops with activities (in contrast to research dissemination through presentation), the RDP events such as 'Problem solving' could be a useful example.

Enablers of knowledge dissemination

- There needs to be a collaborative effort.
- Community groups, social media and the government.

Governance structures to support social innovation

- At the fine-scale (neighbourhoods) levels at which communities function and not so large that it becomes impossible to make sense of the connections at play.
- Area Partnerships; Health Partnerships; Community Area Partnerships
- International collaboration and partnership throughout the world should be developed to support social innovation.

'Big data' for social innovation

- The key thing is to be clear about the problem, and then work out the data needed ('big' or 'small'). Data is not dispassionate: it represents issues framed in particular ways. We should be more candid in our framing of issues alongside our quest for data.
- Value chains are the most important aspect of understanding what big data is needed. You would need to understand the value chains within each of the subsystems or ecosystems. Once you are cognisant of those systems you can then identify the data that contributes to that field.
- Disaster Risks assessment data
- Quality of built environment (energy usage, building types and sizes, occupancy schedules). Opportunities for adaptation rather than demolition of buildings.

Decision-making tools

- Depends on the context (the place and the problem at issue). It would be good to have a resource to gather what worked, giving information on factors that enabled success.
- Understanding data portfolios and their use as well as the classification of data is vital for people so they are able to contextualise.
- Interactive, multi-layered and multi-disciplinary.

CONCLUSIONS

The conference provided a platform for knowledge exchange on a topic of interest to different disciplines to raise awareness of recent research outputs from academics at the Faculty of Engineering of the University of Strathclyde, and of the actions and practice related to sustainability and resilience of the built and natural environment in Scotland. The discussion and feedback on the questions raised at the conference have highlighted potential future research themes and actions which will support social innovation and which should increase research impact through the collaboration of researchers with social innovators, businesses, local councils and government agencies.

The conference report is published on the website of the Department of Architecture of the University of Strathclyde to enable dissemination of the conference outputs to researchers and practitioners nationally and internationally. The Department of Architecture plans to organise similar multi-disciplinary research conferences annually to stimulate research collaboration between different disciplines and increase understanding of the context and the needs of the society for future research. We believe that the knowledge exchanged and the insights gained through similar conferences inform research and will increase its impact on practice.

PROGRAMME

9:00 Registration
9:30 Welcome on behalf of the University/Faculty of Engineering
9:40 Introduction, Professor Branka Dimitrijevic, Director of Knowledge Exchange, Department of Architecture

CONTEXT

9:50 Strengthening the resilience of the built and natural environment in Scotland: The 2020 Climate Group actions to engage businesses and researchers, Dr Lori McElroy, 2020 Climate Group
10:10 Considerate use of the natural capital: Landscape management and biodiversity for a more sustainable relationship of the natural and built environment, Clive Mitchell, Scottish Natural Heritage
10:30 Approaches to Recycling Urban Heritage in Globalizing Contexts: Lessons Learned from Emerging Cities, Professor Ashraf Salama, Head of Architecture, University of Strathclyde
10:50 Resilience of settlements: environmental, economic and social aspects, Professor Milan Radosavljevic, School of Engineering & Science, University of the West of Scotland
11:10 Refreshment break

PLANNING ASPECTS

11:30 Big Data for decision-making on urban planning, Dr Richard Bellingham, Institute for Future Cities, University of Strathclyde
11:50 Integration of new developments in the natural and built environment, Malcolm Fraser, Malcolm Fraser Architects

ENVIRONMENTAL ASPECTS

12:10 Delivering resilient communities through effective land use planning, Katherine Lakeman, Scottish Environment Protection Agency
12:30 Great Recovery Project in Support of Circular Economy, Jamie Cooke, The Royal Society of Arts
12:50 LUNCH

CLIMATE CHANGE AND ENERGY SECURITY: A TRANSITION TO LOW CARBON LIVING

13:30 Assessing the potential for renewable energy provision in settlements, Professor Joe Clarke, Mechanical and Aerospace Engineering, University of Strathclyde
13:50 Distributing Power: A transition to a civic energy future, Ms Elizabeth Robertson, Electronic and Electrical Engineering, University of Strathclyde

SOCIAL ASPECTS

14:10 Enabling the Citizens' Involvement in Creating Glasgow's Future, Cyril Dyer, Future City Glasgow
14:30 Beyond Cities: Community Actions for Transition to Sustainable Living, Chris Cook, Linlithgow Natural Grid, Senior Research Fellow, Institute for Security & Resilience Studies, University College London
14:50 Coffee/tea

PANEL DISCUSSION

15:10 INTRODUCTION: Using systems thinking to increase the sustainability and resilience of the built and natural environment, Professor Branka Dimitrijevic, University of Strathclyde
15:30 PANEL DISCUSSION – Exploring the future research agenda to support social innovation for sustainable living: What governance frameworks and partnerships should be developed to support social innovation? What 'big data' do communities and innovators need to enable development of innovative solutions? What tools should be developed for different users to enable the use of a systems approach in decision-making on governance, planning, infrastructure systems and development of innovative solutions? ... and other research themes identified by the speakers in relation to their research and/or practice, and suggested by the conference delegates.
16:30 Summary and thanks
16:45 Close

SPEAKERS

Professor Branka Dimitrijevic, Department of Architecture, University of Glasgow

Branka Dimitrijevic is a Professor at the Department of Architecture, University of Strathclyde in Glasgow. She has a BSc in Architecture and Urban Planning, an MSc in Revitalization of Architectural and Urban Heritage and a PhD in History of Architecture. Branka's international professional experience and research include history of architecture, sustainable architectural design, urban planning and reuse of architectural and urban heritage. Branka's recent research interests include social innovation and integration of low carbon infrastructure in the built environment following her engagement in multidisciplinary, multi-institutional academic/industry knowledge exchange projects delivered between 2009 and 2014 in Scotland.

Dr Lori McElroy, 2020 Climate Group

Dr Lori McElroy is an Environmental Engineer with a Masters in Design from Glasgow School of Art and a PhD in Mechanical Engineering from the University of Strathclyde. She has spent the last 25 years working in practice and research, and has published extensively on sustainability, energy and environmental issues in the built environment. Her recent work is focused on awareness raising, knowledge transfer and capacity building in order to improve the quality and performance of the built environment, through the provision of support and advice to the construction industry and its clients and in particular working with people and communities to make the most of the places they live in. Lori is head of sustainability and outreach projects for Architecture and Design Scotland, and is based at The Lighthouse in Glasgow.

Clive Mitchell, Scottish Natural Heritage

Clive has worked for Scottish Natural Heritage for about 20 years where he has had a number of roles from geologist to Area Officer (in Orkney), policy and now strategy development. Among other things, he has worked on 'Better Places for People and Nature', Natural Heritage Futures and policy development for climate change, energy and the natural heritage. In his current role he has a direct interest in public service reform and working with others to make places better for nature and people. Since much of that is about behaviour change he has been led naturally in to the work on values, beliefs and hence motivations and capacity for change. He is interested in the relationships between agency and structure, and the ways in which infrastructure and institutions (the material world), society and the individual characteristics together shape behaviours. In 2005/06 he was seconded to the UK Sustainable Development Commission to lead the team on climate change, energy, transport and buildings policy. Clive also works for the Open University where he has been an Associate Lecturer for 19 years. He currently tutors modules on the environment and a geology project course which includes how to manage risks arising from low likelihood high impact events and relating past environmental change to our understanding of current events. He has also tutored field courses in the Scottish Highlands as well as courses on environmental policy and Earth systems. He also sits on WWF Scotland's Advisory Group.

Professor Ashraf Salama, Head of Architecture, University of Strathclyde

Ashraf Salama is Professor of Architecture and Head of Architecture at the University of Strathclyde. He came to Strathclyde with a wealth of international experience and a distinguished record in academic research, teaching and research-based consultancy in the Middle East, UK

and the USA. He was a reader in Architecture at Queens University Belfast and the founding head of the school of architecture at Qatar University. Ashraf is a Fellow of the Higher Education Academy, Chief Editor of the International Journal of Architectural Research (IJAR), Associate Editor of Open House International (OHI), and he serves on the scientific boards of numerous international journals and associations. He has a record of over 150 articles in the international refereed press and has contributed 16 book chapters and authored and co-edited nine books. Ashraf's research focuses on design pedagogy, architectural and urban identity and urban transformations in Middle Eastern Cities. His latest research grant —funded by Qatar National Research Fund— involves typological transformations of housing in multi-cultural societies in the gulf region

Professor Milan Radosavljevic, School of Engineering & Science, University of the West of Scotland

Milan is Professor in Civil Engineering and Assistant Dean for Research and Enterprise in the School of Engineering and Computing at the University of the West of Scotland. He sits on the Board of the Slovenian International Institute for Transdiciplinary Research on Critical Infrastructures. He is currently leading one of the most detailed post-disaster evaluations in Slovenia and he sits on the advisory board for the Scotland's first ever Venturefest. He is a Visiting Professor at the Faculty of Civil Engineering of the University of Ljubljana and has made contributions on various courses at institutions around the world, including the Norwegian School of Management, Tallinn University of Technology in Estonia, University of Ljubljana in Slovenia, Shandong University in China, Brno University of Technology in Czech Republic. Milan has also developed, run and chaired numerous executive courses and Oil & Gas industry conferences in the UK and abroad. He is invited Professor and supervisor in the Laing O'Rourke Centre for Construction Engineering and Technology at the University of Cambridge. He led research on London Olympics Programme Management on behalf of the Chartered Institute of Building (CIOB) and the then Olympic Delivery Authority (ODA), and is one of the three lead editors for the forthcoming 1st Edition of the Code of Practice for Programme Management.

Dr Richard Bellingham, Institute for Future Cities, University of Strathclyde

Richard Bellingham has a B.Sc. in Fuel and Energy Engineering, an MBA and Project Management qualifications. Specialising in energy policy, sustainable cities and sustainable energy issues, he is currently directing the Institute for Future Cities. He has significant experience of research on attitudes and behaviours to energy and was responsible for writing the Sustainable Glasgow strategy. He was formerly Head of Energy Policy for the Scottish Government.

Malcolm Fraser, Malcolm Fraser Architects

Malcolm Fraser's architectural studio is based in the Old Town of Edinburgh and is celebrated for its ability to understand and promote the culture and vigour of a place. Buildings for art and culture, community-focussed social and commercial housing and the joyful renewal of historic buildings have all brought life to towns and communities. The practice's buildings are multiple award-winning while the work demonstrates a consistent philosophical approach to the integrity of the built environment. Fraser teaches, and holds public roles, most recently leading the Scottish Government's Town Centre Review.

Katherine Lakeman, Scottish Environment Protection Agency

Katherine Lakeman has worked with SEPA since 2006 with a focus on delivering environmental outcomes through their planning advisory role. She has a particular interest in how the planning system can address climate change issues and has led on joint Agency initiatives in this area. Prior to this she worked in the development planning functions of local authorities in England for 15 years and as a senior environmental consultant for Leicester City Council.

Jamie Cooke, Head of the Royal Society of Arts Scotland

Jamie Cooke is the Head of RSA Scotland, the Scottish arm of the Royal Society for the encouragement of the Arts, Manufactures and Commerce. He has been with the RSA since 2010, and leads on developing the RSA's activity and presence in Scotland through research, projects, events and collaboration. Particular areas of interest include Public Services and their connection to those who use them; the role of design across society, but particularly in relation to the development of circular economy approaches; science; and the role of cities within Scottish economic and civic life. Prior to working for the RSA, Jamie ran a national project engaging ethnic minority communities with civic and democratic processes, which built on previous work in electoral participation, education and the arts. He sits as a board member for organisations in the fields of digital manufacturing and inclusive living, and is a keen user of social media – follow him @JamieACooke on Twitter! Jamie lives in Bishopbriggs with his wife, two children and cat, and enjoys time with his family, sport, good food and even better wine.

Professor Joe Clarke, Mechanical and Aerospace Engineering, University of Strathclyde

Joe Clarke is the Director of the Energy Systems Research Unit and BRE Centre of Excellence in Energy Utilisation at Strathclyde. His research addresses the role that building energy simulation can play in helping to reduce energy demand, accelerate the take-up of renewable energy technologies, mitigate environmental impacts and improve human well-being.

Elizabeth Robertson, Electronic and Electrical Engineering, University of Strathclyde

Beth Robertson is a Research Assistant at Advanced Electrical Systems research group of the Electronic and Electrical Engineering Department at the University of Strathclyde. Beth's principal research interests include multiple energy carrier energy system modelling and optimisation techniques as well as the reduction of emissions and increased efficiency in the energy sector through the integration of (distributed) low carbon energy sources. From 2008 to 2012, Beth was a member of the EPSRC funded Transition Pathways consortium developing SiTIESS – Simulation Tool for Integrated Energy System Studies – before joining the EPSRC funded Realising Transition Pathways project to continue her research alongside consortium interdisciplinary research, including investigating 50% distributed low-carbon electricity generation in the UK.

Cyril Dyer, Future City Glasgow

Cyril Dyer is a leading business transformation professional. Cyril's working life spans Asia, Europe, Africa and the US leading both organisational and cultural change programmes. His specific interest is the role of technology to enable transformational change. Cyril is currently leading the Future City Glasgow 'open' data efforts. Cyril has held a number of executive roles in the UK, Europe and Asia. Cyril's clients have included some of the largest global companies including Mitsubishi, Panasonic, AXA, Aviva, BT, NTT, IBM and Canon. Cyril has presented at many industry seminars and delivered key note presentations, most notably for the Japanese

Government (Ministry of Economic Trade & Industry), topic: Impact of Software & Systems Engineering and Product Development. When he isn't at the office Cyril spends time cycling, golfing, and learning something new. He is currently learning to play the piano. Andrew Carnegie is a major influence in his thinking.

Chris Cook, Linlithgow Natural Grid, Senior Research Fellow, Institute for Security & Resilience Studies, University College London

Chris has been involved in the regulation and development of markets and enterprises for 25 years, including six years as a director of a global energy exchange. Since then he has been working in the area where the internet, enterprise and markets converge. In recent years he has been working mainly in Scotland with Nordic Enterprise Trust (NET) – with seed funding from Innovation Norway - to develop new partnership-based enterprise models and related financial products and services. Since 2011 he has been a Senior Research Fellow at the Institute for Security & Resilience Studies at University College London.

CONFERENCE INTRODUCTION

Professor Branka Dimitrijevic, University of Strathclyde

SPOTLIGHT ON SOCIAL INNOVATION

Along with the research and practice related to sustainability and resilience, this conference aims to draw attention to social innovation as a growing phenomenon in a connected and globalised world. Social innovation is defined as problem-solving and social change achieved through the activism of social groups, organisations, communities and individuals who initiate and maintain new forms of engagement to contribute to more sustainable living by strengthening resilience in relation to the economic, social and environmental context. The outputs of social innovation can be innovative products, services and/or activities which contribute to sustainable living.

Social innovation is relevant to sustainability and resilience because it can faster address emerging problems or opportunities by mobilising collective knowledge, skills and voluntary activities. It develops the self-reliance of communities and individuals, and it could increase the impact of research, policies and practice through engagement with receptive groups or individuals. Therefore, researchers, politicians and practitioners should seek ways to engage with innovators in their society.

An example of quick social response to an emerging crisis was the financial crisis in 2007-2008 which increased public debt in the United Kingdom from 30% of GDP in 2002 to 80% of GDP in 2014. The financial crisis triggered a sharp rise of gross household savings in the United Kingdom from less than £1 million at the start of 2008 to over £20 billion in 2012. This was a social response to the changing economic context through personal adaptive measures.

Individuals and community groups can act faster in a changing context than political and governance structures if they have access to the information and decision-making tools needed for personal and community actions to increase resilience against external threats. This raises questions on what information should be made easily available to individuals and community groups to increase understanding of:

- local resources and capabilities which could be used to make a transition to more sustainable living
- potential local vulnerabilities to economic, social and environmental threats
- decision-making tools which support social innovation for sustainability and resilience
- governance systems which facilitate social innovation?

Answers to the above research questions will assist in supporting decentralised decision-making and harnessing the capabilities and resourcefulness of individuals and communities to undertake timely and appropriate adaptive actions in a changing economic, social and environmental context.

Strengthening the resilience of the built and natural environment in Scotland: The 2020 Climate Group actions to engage businesses and researchers

Dr Lory McElroy, 2020 Climate Group

Scotland's 2020 Climate Group was set up in 2009 to demonstrate leadership and collaboration in the business sector to meet Scottish Government carbon reduction targets by 2020. The aim was to engage the private sector, businesses and others who have a moral obligation to climate change mitigation but who did not have a single mechanism through which to deliver. It aims to:

• help ensure that all sectors of Scotland's economy and society contribute fully to achieving Scotland's target of a 42% reduction in greenhouse gas emissions from 1990 levels by 2020, and

• be a critical friend to Scottish Government to ensure the public and private sector support each other in working towards a low carbon Scotland.

The Group has committed to:

• supporting projects that directly reduce CO2 emissions or which enable CO2 emission reductions elsewhere;

• mobilising resource – to support CO2 emission reductions;

• disseminating information – to wider networks, by sharing best practice, learning and preventing repetition of work;

• exemplifying and promoting examples of best practice;

• leading creative discussions – allowing difficult conversations not being held elsewhere, to happen in a 'safe' space where people and organisations are free to talk.

The 2020 Group works across various sectors - from the built environment to transport to finance to behavior change - sharing information, insight and expertise. The focus of this paper was the work of the Built Environment sub group, which covers private, public, domestic and non-domestic buildings, and focuses on improving the performance of existing buildings, zero carbon new build, and creating a market where low carbon design approaches and technologies can thrive.

Retrofit Scotland

Key activities of the Built Environment Group include Retrofit Scotland - a web-based repository of Case Studies and techniques for the effective retrofitting of existing buildings, which emerged from the Scottish Government's Sustainable Housing Strategy Group's recognition that we lacked

sufficient knowledge of the state of the existing stock, and which energy efficiency measures were most appropriate in which situations.

The *raison d'être* for Retrofit Scotland stems from the fact that as the existing building stock is being replaced at only 2% per annum - 80% of buildings that will be in use in 2050 are already here, so we need to focus our efforts on what exists in order to meet our climate change commitments.

In addition, 700,000 of Scotland's 2.2 million households remain in fuel poverty. Notwithstanding those people living in new and old properties who don't spend over 10% because they can't afford to - with the result is that they live in under-heated homes - and improvements to these homes will result in improved comfort levels - but may not result in reduced Carbon emissions.

Retrofit Scotland is committed to collating materials from across Scotland - from successful and unsuccessful retrofit projects undertaken in the last 20 years. The method of storage of material for this material is critical - it has to be located somewhere where it will be unaffected by changes in political administration, the structure of the civil service and funding streams (which come and go).

Currently retrofitscotland.org contains over 100 case studies. These include energy related projects but also studies that explore wider issues such as lifestyle on actual performance and issues relating to choosing the right materials for the job – for example, in terms of avoidance of condensation risk and selecting materials for historic and conservation projects.

Opinion on the best way to tackle the retrofitting of domestic buildings in particular remains divided – from the suggestion that we should adopt a blanket 'area-based', fabric first approach to investment; to more community driven approaches, including a focus on behavior change; to the idea of a more specific 'construction-based', not 'house type' approach. Current interventions are often unsympathetic to the original, adversely impacting on the design intent and not contributing to the future resilience of the building in terms of its ability to respond to future climate change.

For all but iconic buildings, there has been a tendency to take an easy way out - by using a standardised approach that masks the original completely or by demolishing - on the grounds that they are 'too difficult' to deal with - from asbestos to inflexible concrete frame construction, to leaky structures to a deliberate political agenda to rid us of the culture that gave us these buildings. But it is impracticable to demolish these buildings for social, environmental and economic reasons. Some investors and developers will require more convincing than others - and current Government procurement approaches and the charging of VAT on materials for refurbishment do not help the case for investment.

However, the alternative is the risk that we could lose a whole era of our architectural heritage.

Investing in natural assets for a better built environment, wealth creation and wellbeing

Clive Mitchell, Scottish Natural Heritage

The main theme of the conference - *how research and practice can support social innovation and what tools to enable the application of systems thinking in decision-making of different users in planning of the sustainable development of the built environment and in caring for the natural environment* – raises questions about governance. Who is making what decisions on whose behalf and in whose interests?

In making decisions about places we should be clear about some basic questions such as 'what are places for?', 'who are they for?' and 'whose places are they?' The answers to these questions shape the way that issues are framed and how explicit are the power relations that are at play.

Many of the ideas for making better places are not new. They have been well-known for at least 100 years. Patrick Geddes's mantra was 'work – place – folk'. The more pertinent question is why it remains such a challenge to create decent places for people to live and work in. The issues here are more political than technical.

Nature emerges from power relations acting across society over time. Places also emerge from power relations. Some of the more ugly and unwelcoming places emerge from a number of factors but include short term business models used by developers (borrow, build and leave – developers seldom locate their businesses or less still live in the developments that they create), poor decision-making by elected representatives and, at least in the 1950s-1960s, a degree of professional hubris among planners. One way of looking at this is that developers have been able to off-load the environmental and social consequences that emerge in some developments onto the public sector (who approved the developments 20-30 years before).

A good measure of a sustainable place is one that makes people healthy. This was the motivation for improving places in the 19th Century, but the health challenges of the 19th Century (mainly communicable diseases) have been replaced by a different set of health challenges in the 20th and 21st Centuries (non-communicable diseases), many of which are associated with inactive lifestyles and poor diets. The dominance of the car in driving urban design since the 1950s is an important factor here.

Much of what makes for better places is in the public interest and lies in the public domain. But what does this mean in practice. In his 2004 book *The decline of the public – the hollowing out of citizenship*, David Marquand offers a useful distinction between the public, private and market domains:

- In the private domain, interests are dominated by family and kinship ties
- In the market domain, access to goods and services is determined by access to economic resources (power and wealth)
- The public domain is a dimension of social life, inseparable from the public interest. It is where citizenship, equity and service thrive. In it, access to services is based on need (not personal ties, power, wealth). It is a place of human flourishing, characterised by rights and duties. It is always contested through active citizenship *among equals.* It is a

meritocracy. Trust is essential. It includes fair trials, welcoming public spaces, clean water, rights of way, free public libraries, nature, clean air and much that makes live worth living.

Although the boundaries between these domains are fuzzy and porous, they can provide a useful check on whether the public domain, and public interest, is being enhanced or corroded by decisions and the power relations behind them. If the private domain intrudes on the public domain, then nepotism and favouritism are likely; and if the market domain intrudes, then commodification, profiteering and marked inequalities in the distribution of costs and benefits are likely.

If 80% of the environmental costs are pre-determined at the design stage (Jamie Cooke, quoting The Design Council in this conference) – the same is arguably true for the environmental and social consequences of policy. Part of the solution to this, at least for anything in the public domain, must lie in involving people in the design and delivery of goods and services that matter to them: co-production.

Greenspace and green networks can contribute to a wide range of social and economic benefits, but only if they are designed, delivered and managed with people and those benefits in mind. The idea that nature itself is interconnected, interdependent (and indivisible) has a long history in many cultures, and was articulated by Patrick Geddes among others. But in conservation as with other aspects of the public domain, a long tradition of reductionism has fragmented the professional view of the world (e.g. in conservation nature is divided into 'priority habitats and species', protected areas with their 'features of interest' and the 'wider countryside). This often leads to polarisation (e.g. nature *or* people; health *or* the economy) and pitching interests in competition that could – or should – be in harmony. This professional, fly-eyed view of the world contrasts with our experience as citizens, experiencing whole places. The interconnectedness of place and scale was thoroughly explored by Christopher Alexander and others in *A Pattern Language* in 1977 and argued that communities could only function at a fine scale of 5,000-10,000 people. It is easier to make sense of the myriad connections that bind places together at finer scales.

Nature should be woven into the fabric of places, from the bricks and mortar onward.

Nature contributes to all of the outcomes in the Scottish Government's National Performance Framework which, taken together, describes wellbeing. Businesses rely, directly or indirectly, on the management of natural resources; workers who have access to high quality natural environments are more creative and more productive and outdoor learning can enhance children's education, inquisitiveness, adventure and development; nature provides natural gyms and places where social contact enhances physical activity; good quality natural environments contribute to good physical and mental health but poor quality natural environments exacerbate cycles of deprivation; connecting with nature helps people to connect with wider ('bigger-than-self') social and environmental issues; and, contact with nature contributes to fulfilling lives for all ages. All of these benefits would flow from a more holistic, integrated approach to the design and delivery of public services.

Places are about wellbeing and, along with social and individual factors, shape our behaviours for better or worse.

To conclude, and to set the scene for the research questions addressed by the conference, I return to the simple questions posed at the outset. What are places for? People or profit? What is the scale of public participation and role in decision-making? How are private, market and public interests negotiated and mediated? Making better places is a political matter at least as much as it is a technical one.

Recycling Urban Heritage in Globalizing Contexts: Cases from Emerging Cities

Ashraf M. Salama, PhD., Professor and Head of Architecture, University of Strathclyde

This presentation aims to articulate a discussion on approaches to recycling urban heritage as a form of sustainable practice. It involves four parts; each of which addresses a key topic and contextualizes the next. The first is premised on the fact that the global south has its own peculiarities, variations, and diversities. It argues that architecture and urbanism in the global south have become one of the major research topics in world-leading academic institutions.

As part of the global south, the context of the Middle East is introduced in the second part together with the underlying factors that shaped its built environment. These factors were identified in terms of building material, construction technology, governance, and planning approach.

Within the context of these factors, two heritage recycling cases were identified in the third part: Fareej al-Bastakiya in Dubai, UAE and Souq Waqif (the standing market) in Doha, Qatar. As culture/commercial-led regeneration projects, they were discussed in terms of original features, aspects of deterioration, and improvements undertaken as part of urban regeneration and revitalization efforts.

The discussion of these aspects demonstrates that this type of regeneration efforts, while commercially successful, may contribute to social polarization since they attract affluent users and tourists. As well, they may lead to spatial polarization as these areas gain attention in terms of facilities, access and connectivity, amenities and infrastructure at the expense of other areas of the city.

In response, the presentation concludes with a framework, which adopts the premise that heritage cannot be seen in physical terms only; it is not just a place, but also a cultural process. The framework builds on the notion of lived-perceived-conceived approach to recycling heritage as part of urban resilience that requires key tools and investigation mechanisms.

Resilience of settlements: environmental, economic and social aspects

Professor Milan Radosavljevic, School of Engineering & Science, University of the West of Scotland

Introduction

Resilience can be interpreted differently and like many other social constructs it has been defined in numerous ways. Regardless which definition we take as the basis of our understanding of resilience, it all revolves around some form of continuity. One can think of complex interconnectedness between continuity of life, business continuity, operational continuity and continuity of all human activities in general. Interruptions to any continuities can be undesirable at best but they are often devastating, depending on their severity, type and length. They can come in the form of man-made or natural disasters that can affect continuity of several or all human activities. Urbanisation has led to concentration of those activities in geographical locations with human communities - human settlements of different sizes and characteristics. Communities can thus be found in small isolated settlements or larger urban areas and conurbations. These are increasingly dependent on a growing number of networked infrastructures and technologies to achieve the key societal goals: inclusiveness, safety, resilience and sustainability (United Nations, 2012). It is not a surprise then that communities of all sizes are concerned about their capacity to maintain and in the worst case scenarios recover continuity in the face of adversity. However, while providing the necessary support, complexity of the networked infrastructures and technologies are also making them more vulnerable.

Complexity of Human Settlements

Early settlements were infrastructure-poor. Individuals and small groups of individuals were taking direct responsibility for water supply, food and shelter. Distribution channels as we know them today were more or less non-existent. Transport networks were the first examples of outsourced infrastructure being built and maintained by groups outside of the core community. However, for good or for bad, modern society has almost entirely outsourced and infrastructured necessary elements for maintaining community life. This infrastructuring of survivability has touched every aspect of our lives. There is a complex networked infrastructure around food supply as modern humans no longer hunt or gather food. The same applies to water supply, waste water treatment, transport networks, communication, energy supply and even shelter (*i.e.* large housing developments have mostly replaced an individual self-build approach). We live in settlements that are supported by complex and often interconnected infrastructures. Each of them is crucial for maintaining continuity but ironically their complexity and increasing number are making us far more vulnerable to any interruptions of continuity. When a disaster strikes, each of these infrastructures is initially subject to damage propagation followed by our assessment and efforts to achieve full recovery (*see* Figure 1).

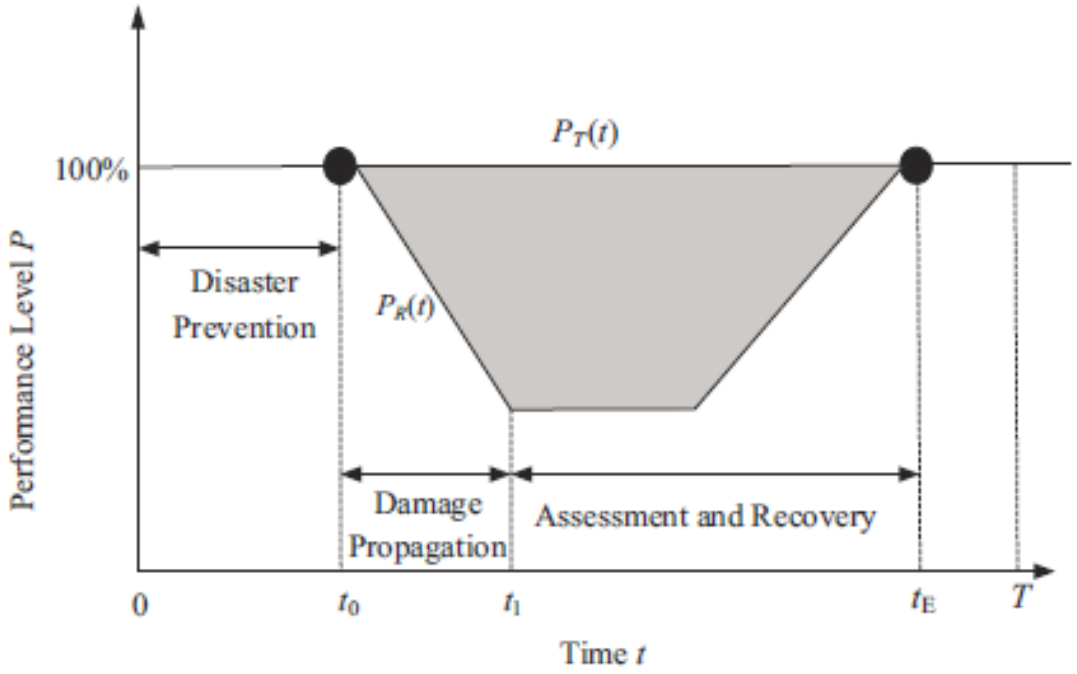

Figure 1: A three-stage resilience analysis framework for urban infrastructure systems (source: M Ouyang, L Dueñas-Osorio, X Min; *Structural safety*, 36, 23-31.)

While in the past being reactive could have locally disastrous consequences, complex infrastructures of modern settlements demand careful planning to avoid jeopardising lives of millions or even dozens of millions of people. Continuous assessment and reassessment of potential disasters, their immediate impact, long-term consequences, required resources and community structures form part of the planning to prevent disasters. The continuous planning is performed for each infrastructure (*i.e.* diagram in Figure 1 exists for every single infrastructure at all desirable levels – local, county/state, country, region) but not in isolation since loss of performance of one infrastructure without any other external factors may lead to loss of performance of another infrastructure (*e.g.* electrical infrastructure vs. telecommunications infrastructure). Figure 1 indicates that loss of performance depends on the severity of impact, length of time of damage propagation, length of time needed for assessment and recovery, interdependencies between infrastructures in the affected area and so on. For example:

- Localised and mild earthquakes may lead to localised and partial loss of performance but a devastating regional earthquake may lead to a complete loss of performance in very large geographical areas;
- Damage propagation may be sudden leading to an immediate loss of performance or progressive, which also depends on the length of impact (*e.g.* 2-minute earthquake vs. hurricane force winds over several hours or days);
- Depending on the scale of disaster its severity and impact, assessment and resulting recovery may take a few hours, few days or even many months;
- Affected areas may be geographically remote with a single infrastructure or a metropolitan area with dozens of interconnected and interdependent infrastructures.
- Apart from looking at infrastructure technologies, all of the above require investigations of environmental, economic and social aspects of resilience of settlements.

Environmental Aspects

From the community resilience point of view, remote geographical areas rarely suffer from a cascading effect of infrastructure failures that affect urban areas even if they are struck by devastating disasters because they host no or only a very small number of relatively uncomplicated man-made infrastructures. The problem of urbanised areas with complex and interdependent man-made infrastructure networks is that the cascading effects may be more devastating than the original disaster(s) that caused them. Nuclear disaster in Fukushima is an example of a cascading effect in full action. The original disaster was a 9.0 magnitude earthquake off the eastern coast of Japan. The power plant was designed to withstand such powerful earthquakes but its power supply was not designed to withstand the resulting tsunami that caused a complete loss of power in the plant (including on-site generators), which then caused the still ongoing nuclear disaster. There would be no nuclear disaster where it not for the man-made nuclear power plant. The devastation caused by the tsunami would still be widespread but not even remotely as problematic as it is now. The key lesson from the Fukushima disaster is that by inadequate planning, humans are potentially designing-in cascading disasters in the built environment with impacts far worse than the potential natural disasters. The immediate question is whether Fukushima power plant should be built on the shores of the largest ocean and in one of the most earthquake-prone zones in the world. The same applies to other constituents of the built environment elsewhere (*e.g.* housing developments on flood plains, rapid urban growth in most earthquake affected areas, shortening of waterways leading to a loss of total available volume for flood waters, etc.). In essence, the most recent disasters show that planners perhaps pay (too) little attention to the potential cascading effects. Natural environment in close proximity to Fukushima (and Chernobyl), the two worst nuclear disasters ever, will be unused for generations and it is about time we start asking questions whether certain types of technologies should be adopted in the first place.

Economic Aspects

Widespread destruction, loss of performance and other discontinuities have a direct economic impact. It often takes years to bring the affected area to their full performance and analysing the aftermath of major disasters uncovers some residual economic effects that often unravel over many years and are not always well understood. The residual demographic imbalance is one of the effects, which can only be fully assessed in retrospect. By disasters most affected areas are frequently first abandoned by young professionals and working families, two most productive age groups. Their group behaviour perhaps requires further detailed study but depending on the nature of the disaster, its frequency, devastation and other factors, families and professionals sometimes return to their homes although they often seek permanent refuge in geographic areas that have been less affected by recent disasters. Disaster zones are less frequently abandoned by vulnerable groups (*e.g.* elderly, children, people with special needs) who by themselves cannot support economic revival of a disaster-struck area. This is why perhaps one of the most important outcomes of recovery operations is to enable the revival of productive human capital that can regenerate the affected economy. Social structures that underpin the recovery efforts are therefore vital for economic recovery.

Social Aspects

The relatively recent study conducted by NCCARF and James Cook University in Australia shows just how important these social structures are.

"…individuals, households, organisations, communities and governments all interact in a systemic manner to support or impede resilience." (Boon et al, 2003)

They have adopted Bronfenbrenner's bioecological theory to demonstrate how a complex interplay of community microsystem, mesosystem and macrosystem in a timely fashion lead to self-reinforcing community resilience. In effect, resilient communities show unwavering capacity to recover continuity in the face of adversity at all levels. Systemic structuring at micro, meso and macro levels enables them to go through the worst disasters because they design-in resilience into the very core of the social fabric. While they seek refuge from life-threatening conditions, such communities do not abandon their geographical areas even after repeated disasters because of their preparedness for the worst. Their responses are carefully planned, tailored to address the needs of every age group and are continuously re-evaluated to ensure their effectiveness. In the worst case, they know what is coming and in the best case, they prepare themselves to avoid cascading effects. In this sense, social aspects of community resilience underpin all other aspects. While humanity is directly responsible for designing-in cascading disasters and inappropriate actions which may lead to economic hardship when disaster strikes, social structures that we create for the very functioning of society are also the ones that can prevent them (*e.g.* develop relevant technologies, preparedness and response mechanisms, norms, standards and so on). Investigating all other aspects of resilience of settlements in isolation from social aspects is thus inadequate. Development of the social structures and underlying norms is sometimes reactive and short-lived but mostly they have emerged over many generations because of a continuous threat of the same type of disasters (*e.g.* repeated earthquakes, volcanic eruptions, flooding, etc.). In my view, more research is needed to understand the historical background of these developments to prevent damaging and short-lived interventions in social structures that may have developed over decades or even centuries.

Conclusions

Nature is capable of recovering from all types of disasters but man-made built environment has changed this for good. Human communities live in different kinds of settlements and try to maintain continuity of life, business continuity, operational continuity and continuity of all human activities in the face of adversity. Although one can focus on a number of aspects, the impact disasters can have on surrounding environment, our economies and the very social fabric that makes communities what they are, represents, in my view, some of the most important aspects societally-responsible researchers should be investigating. Furthermore, social structures in particular need our attention because they are the ones that underpin resilience of settlements. Their historical origins and continuous evolution is sometimes taken for granted and bypassed for the sake of developing potentially better although often short-lived 'solutions' and innovative social structures that are yet to stand the test of time.

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Building sustainability and environmental approach

Malcolm Fraser, Malcolm Fraser Architects

At the heart of "Sustainability" is the need to make best use of our precious environmental resources. But for too long the broad sweep of what "resources" means was set aside for a narrow focus on energy supply – the amount of heat and electricity a building consumed. As a consequence the tendency developed, in considering good sustainability practice in the built environment, to assume that old buildings, built with a solidity and integrity that we get nowhere near today, should be demolished and sent to landfill sites, to be replaced by shiny, new ones with better insulation and updated heat generation, and with some green gizmos bolted-on.

We are starting to realise the folly of forgetting the material and cultural energy embodied in our existing buildings. Malcolm Fraser Architects has been at the forefront of moves to promote a quieter – less rowdy and blustering – conservation-based approach to sustainability, where the interests of the conservation and sustainability sectors – previously thought to be entirely opposed – are united. Twenty years of practice which has fused the repair and renewal of historic buildings with the construction of new, to best contemporary "green" practice, culminated in the Edinburgh Centre for Carbon Innovation, a business and innovation centre for the low carbon economy, led by the University of Edinburgh and renewing the historic, eighteenth century Old Royal High School in the Old Town of Edinburgh. Opened in 2013 this is the first listed building *anywhere* to achieve BREEAM's top "Outstanding" certification (BREEAM being the world's "longest established and most widely used method of assessing, rating and certifying the sustainability of buildings). Given that some buildings strive to express their "Sustainable" credentials by being styled to look like green spaceships, festooned with gizmos and, sometimes, set in business parks that are accessed, primarily, by cars, this represents a radically different direction for sustainability.

While the ECCI benefited from the University's District Combined Heat and Power infrastructure – as well as the fact that most of the historic interiors had long been stripped out – lessons learnt from this and other projects inform Malcolm Fraser Architects approach to all existing buildings. The practice believes that most existing certification schemes have been drawn-up for new buildings and fit existing ones poorly, and that many encourage expensive and inappropriate moves that sometimes bear a tenuous relationship to the simple, good-sense view of "sustainability" that should prevail. The practice therefore follows, on all projects (whether augmented by certification or not) its own "good practice" code, encompassing:

- Use: the intensification of existing uses or, if no longer viable, the introduction of appropriate new ones that work with the fabric of the building, rather than require its butchering;
- Access: the setting of buildings where they are easily reached on foot or by bicycle and public transport;
- Repair: the conservation and renewal of existing fabric using appropriate traditional techniques;
- Extension: new-built extensions and insertions constructed of materials that lock-in carbon, are natural and non-toxic and, if necessary, can be simply recycled;

- The Basics: improved thermal performance and draught-proofing, with ventilation as necessary to maintain healthy fabric and natural ventilation wherever possible, and awareness of sunshine and orientation;
- Primary Heat Source: all options weighed;
- Buildings that smell good: breathing wall technology instead of toxic membranes;
- Flexibility in use: adaptable spaces and updateable information technologies;
- Simplicity in use: minimised manuals; and, overall,
- a joyful approach to renewal and heritage: old buildings appreciated for the lives they have lived and the life yet to come, and how they have grown and adapted to suit those lives.

Environmental Approach

Fabric upgrades – It is particularly challenging to upgrade the fabric of the Observatory and Transit House (see Building Control section), but where practical the airtightness of the spaces will be improved through air tightness taping and draught proofing to the existing sash and case windows, always bearing in mind the building's designed requirement to breathe through ventilated floor, wall and roof voids.

Passive Strategy - The buildings adopt a largely passive environmental strategy minimising the use of mechanical systems and naturally ventilating spaces wherever possible. Solar gain will be harnessed in winter and shaded from high summer sun and thermal mass, particularly in the subterranean gallery, will be exploited to ensure a steady response to temperature – avoiding the peaks and troughs of temperature experienced throughout the year.

Insulation - To new buildings, where practical insulation materials with a high 'decrement delay' (time taken before re-emitting heat) are included within the outline specification to reinforcement the beneficial effects of thermal mass on the internal environment. Where insulation is below ground level, an expanded rather than extruded polystyrene insulation will be used as it has much higher environmental credentials and reduces reliance on petrochemical products in building insulation. A preference towards using wood-fibre insulation wherever possible due to its vapour open, breathable qualities, will be maintained.

Further detailed investigation of the best insulation type for each condition and effect on the services building model will be required in due course.

General Specification of Materials and Finishes - The outline specification for internal and external materials (described previously within this Architect's Report) have been selected for their aesthetic, functional durability, environmental and cost credentials (including life cycle). Materials are, where possible, locally sourced, natural, non-toxic, recycled and recyclable, although not necessarily simultaneously.

Examples of significant materials within the outline specification include:

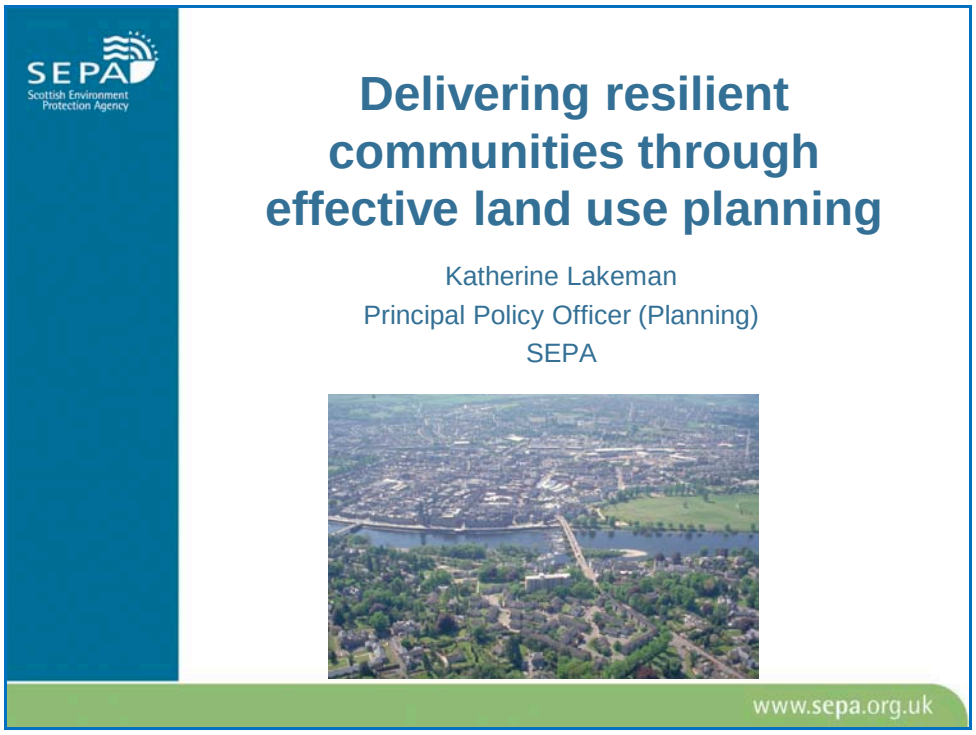
- Stone: Scottish (Fife) sourced natural material with long life span
- Bronze: 80% copper 20% tin, with up to 60% of the copper being 100% recycled (depending on timing of sourced copper material)
- Insulation: Timber fibreboard forms part of the insulation/ vapour control layer to new external walls and roofs where possible.
- Linoleum + refurbished timber floor: Two natural and/ or reused materials proposed as floor finishes.

- No pvc, mdf or high VOC content products specified throughout.
- All timber to be FSC certified.

Delivering resilient communities through effective land use planning

Katherine Lakeman, Scottish Environment Protection Agency

Please see the presentation.



Great Recovery Project in Support of Circular Economy

Jamie Cooke, The Royal Society of Arts

"Waste really is a design flaw"

For us at the RSA (the Royal Society for the encouragement of the Arts, Manufactures and Commerce) this quote from Kate Krebbs of ANDC perfectly sums up our motivation with the Great Recovery project, a design driven project focused on developing new economic and manufacturing practices. We live in a world of growing resource scarcity, with knock on implications for volatile prices and insecurity of access, yet our manufacturing practices still see huge wastage of materials. The UK alone is estimated to have over 80 million 'old' mobile phones sitting in drawers across the country, each of which contains gold, rare earths and other scarce materials; yet the push towards always having the latest model continues to drive a throw away economy and society. Supply chains stretch across the globe too complex to fully map, meaning that the provenance of our materials is unclear – people die in brutal conflict in the Democratic Republic of Congo partly fuelled by global demand for tantalum.

The Design Council estimated that approximately 80% of environmental costs from a product are determined at the design stage, yet design students and practitioners are often not consciously addressing this point. The Great Recovery is an RSA-led project, supported by the then Technology Strategy Board, which sought to address this gap. At the RSA we believe design thinking is a crucial methodology to approach complex problems with, particularly in a space such as this. The first step of the project was to take a group of designers to a waste dump, to show them the fate of the products they had designed, many of which were being thrown out within a year of purchase. Designers invest a huge amount of time, energy and skill in the products they are creating – to see that they had such a short lifetime with the consumers is an eye-opening experience.

Out of this, the Great Recovery team have developed a system of tear down workshops, supported and expanded by research and network building, which bring designers, commissioners, consumers and others together to take apart products and to start to consider how redesign for re-use might work. In Scotland, supported by Zero Waste Scotland, we have run an initial series of events across the country exploring these concepts and starting to identify opportunities for redesign within industries such as food and drink, and the oil and gas sector. We are in the process of developing one business idea which was started at one of the workshops, and are open to other opportunities.

The circular economy and a move to redesign for re-use has huge potential for Scotland's economic success as well as its environmental goals, with estimates that it could offer up to £3 billion of materials savings in certain sectors, and potential for job and business creation in new areas. To seize this opportunity, the RSA believes that certain resources need to be in place – further research into economic benefit opportunities from circular economy practices; increased collaboration between academia, business and organisations such as the RSA; creation of brokerage opportunities to link existing producers of 'waste' materials with entrepreneurial

responses and individuals; and commitment from government to support circular economy approaches through procurement and supply chains.

The circular economy, and redesign for re-use, is not a hippy concept, but rather a robust way of increasing Scotland's economic success alongside our national goals of becoming a greener society. Working collaboratively, we at the RSA believe the opportunities are there in Scotland – the question is, are you going to work with us to capture them?

Assessing the potential for community low carbon energy provision

Professor Joe Clarke, Energy Systems Research Unit, Mechanical and Aerospace Engineering, University of Strathclyde

Fiscal measures are used to promote the deployment of low carbon energy supplies at all scales. Examples include the Renewables Obligation, Renewable Energy Feed-In Tariff, Renewable Heat Incentive and Green Deal.

Targets backed only by such measures are leading to problems such as unreliable systems, an increased demand/supply gap, a worsening cost burden, unintentional impacts such as fuel poverty, inappropriate infrastructure and a disaffected population.

With so many technology options available, effective solutions will require whole systems thinking and a means to impose thermodynamic considerations on proposed schemes.

Energy systems simulation provides a way to provide this capability and thereby cater for the underlying complexity. The embedding of the approach in practice is perhaps the only way to achieve solutions that operate effectively in practice. This notion gives rise to the maxim “if you can’t simulate it, don’t build it”.

Simulation tools provide rational support for many present needs and aspirations: energy efficiency measures deployment; improved comfort and air quality; demand management; renewable technology integration; hybrid systems design; smart grid operation; and the like.

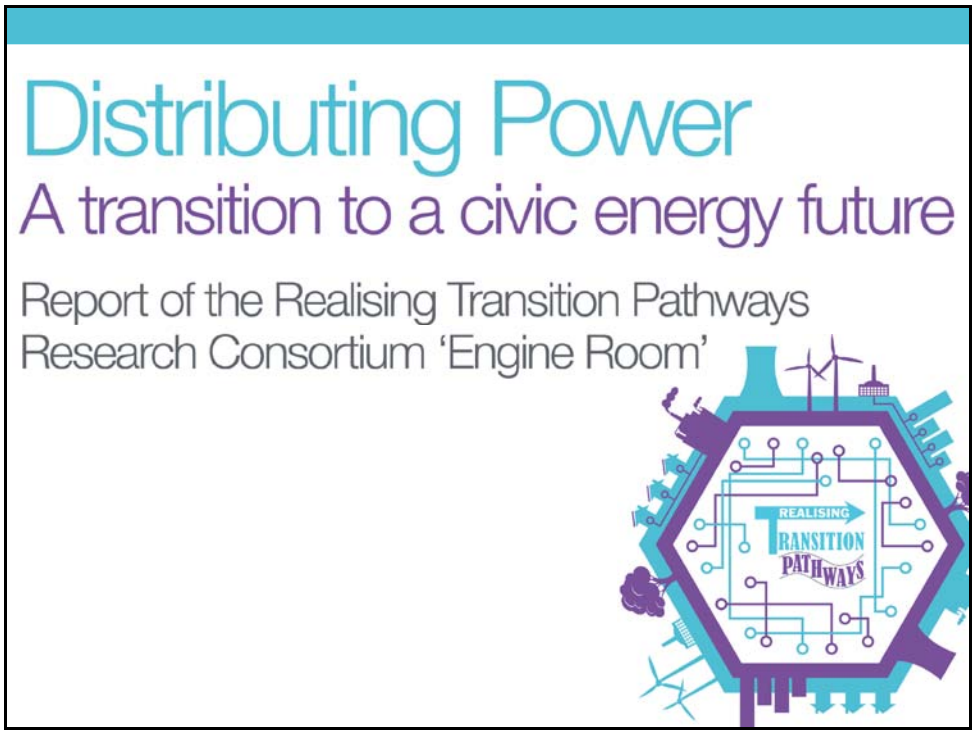
The technology can be used to automatically size the components of hybrid systems (comprising, for example, heat pumps, wind turbines, photovoltaic components, district heating networks and/or combined heat and power plant). Once sized, any system can then be assessed in terms of relevant cost and performance aspects such as energy use, comfort conditions, emissions and power quality.

In conclusion, industry would benefit from more appropriate design tools and an agreed approach to performance assessment that enables the ready comparison of different proposed schemes in terms of the range of relevant issues that affect stakeholders.

Distributing Power: A transition to a civic energy future

Elizabeth Robertson, Electronic and Electrical Engineering, University of Strathclyde

Please see the presentation.



Enabling the Citizens' Involvement in Creating Glasgow's Future

Cyril Dyer, Future City Glasgow

Please see the presentation.

Beyond Cities: Community Actions for Transition to Sustainable Living

Chris Cook, Linlithgow Natural Grid, Senior Research Fellow, Institute for Security & Resilience Studies, University College London

The aim of my action-based research at the Institute for Security & Resilience Studies at University College London is to identify and implement at community level optimal legal protocols and instruments which will lead to sustainable living through the achievement of independence, security and hence resilience.

I conducted a geographic review to identify organising principles of existing successful protocols and instruments ('what works') and a historic review of protocols and instruments ('what worked'). The results of my research and life experience then informed community action undertaken in my home town under the title of *Linlithgow Natural Grid.*

Aim & Organising Principles

The aim of Linlithgow Natural Grid (LNG) as an unincorporated association is for Linlithgow to be independent in energy, and hence attain energy security and resilience.

The organising principles of LNG are:

- Least carbon fuel cost - for a given use of the heat, electricity and power to minimise the use of carbon fuel, which is objectively measurable using an energy metric;
- Least human cost - subjective metrics are required to measure happiness and well being.

Method

A target area was mapped and analysed by energy use in the built environment (excluding transport), and suitable interventions were identified with a view to addressing the reduction of energy use in 'hot spots' identified within the target area.

A programme of stakeholder consultation took place to identify the key stakeholders in terms of energy users, land-owners, and public/private institutions. In simple terms these were Council, Community & Commerce.

Protocols & Instruments

Based upon 30 years' experience of legal and financial matters, and my geographic and historical review I am applying the following consensual and associative production sharing and risk sharing 'social contract' protocols as frameworks for (Peer to Asset) development and operation of productive assets and (Peer to Peer) economic interaction.

- Capital Partnership - a protocol for the sharing of usufruct (ie production or rentals) of a productive asset held in common by a custodian. Payment by the asset user in money or money's worth is shared proportionally with a manager/curator and the balance is available for Peer to Asset investment.
- Guarantee Society – a protocol for the sharing of risk whereby sellers of goods & services extend mutually assured credit to buyers. Both buyers and sellers pay for the use of the system and for the use of the guarantee. A neutral service provider member manages risk through pooling resources and reserves.
- Prepay Credit – a promise accepted by a producer or seller from a user or buyer which the promissor accepts when presented in payment for his own goods and services. Note that the promissor has no obligation to deliver either money or goods & services, and that the purpose of the above protocols is to provide frameworks of trust within which performance may be assured

(Note: - such agreements remain in use in Islamic finance but predate Islam by millennia. Moreover, prepay credit is an instrument which predates modern instruments: bank debt; derivatives; & equity).

Outcomes

Among the outcomes of communities based upon social contracts with an organising principle of least carbon fuel and human cost are housing and energy provided as a service. The maximisation of use value over time of productive assets rather than profit maximisation of commoditised asset transactions favours transparency, collaboration and stability in the interests of all stakeholders on the premise that a lesser %age of something is preferable to 100% of nothing.

The decentralised/distributed production and delivery of goods and services delivered by ***Natural Grid*** physical infrastucture tends towards functional independence eg housing independence, energy independence & food independence and hence to community resilience and sustainability.

Using systems thinking to increase the sustainability and resilience of the built and natural environment

Professor Branka Dimitrijevic, University of Strathclyde

The complexity of the Earth Summit Agreements on sustainable development at the UN conference in Rio in 1992, initiated proposals for applying a systems approach in planning the actions outlined in the *Agenda 21*, an action plan for sustainable development. The partly overlapping circles which represent environmental, social and economic systems are often used to indicate the need for systems thinking in the planning of sustainable development. However, the most robust one is the largest among them, the environmental system, which can significantly affect human systems.

Two successful approaches in engaging with political structures and communities to address global problems have been developed and widely adopted. While the approach proposed by the American economist Jeremy Rifkin in his book 'The Third Industrial Revolution' (2011, Palgrave Macmillan, New York) focused on how to influence governments to make a transition to a low carbon economy, the approach proposed by the independent British activist Rob Hopkins in his 'The Transition Handbook' (2008, Green Books, Totnes), turned to communities and individuals with the aim of initiating social innovation which will lead to more sustainable living.

Jeremy Rifkin's vision of 'the third industrial revolution' was endorsed by the European Parliament in 2007, the UK Government's White Paper on Energy in 2007, and United Nations Industrial Development Organization (UNIDO) in 2011. Rifkin's vision includes five pillars that will reduce carbon emissions from energy generation and use: renewable energy, buildings that contribute to energy generation from renewables, energy storage, ICT energy distribution systems and electric vehicles. In 'The Zero Marginal Cost Society' (2014, Palgrave Macmillan, New York), Rifkin explored how the 'Internet of Things' and 'collaborative commons' might lead to a more democratic organisation of social and economic life. The 'Internet of Things' serves as an enabler in this process of change by continually feeding 'Big Data' in real time to all potential users to support better informed and timely decision-making.

Hopkins' focus was on communities and bottom-up actions which can address global problems and meet local needs such as local generation of energy and food production, different organisation of healthcare, use of local building materials, reduction and reuse of waste, and other activities that communities might initiate according to their social, economic and environmental context. Hopkins' book has inspired the establishment of community groups, Transition Towns, worldwide. In Scotland, there are 11 'official groups', over 35 'active communities' and over 25 communities that 'show interest in this area'. One of the Transition Towns is Linlithgow, a town of 15,000 people located between Glasgow and Edinburgh. At this conference, Chris Cook presented one of the projects they have been developing for more sustainable living in Linlithgow.

Jeremy Rifkin's workshops with businesses in the USA informed his vision of the 'third industrial revolution' which was supported by many governments and thus became the basis for top-down action. A vision of a bottom-up approach to sustainable development through social innovation is explored in Rifkin's book 'Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons and the Eclipse of Capitalism'. Rifkin points out that the 'collaborative commons' are the oldest form of social interaction and organisation of economic and social life, and draws attention to the rise of a 'collaborative commons' as the dominant model for organising economic life. The contemporary commons is where billions of people engage in the deeply social aspects of life: charities, religious bodies, arts and cultural groups, educational foundations, amateur sports clubs, producer and consumer cooperatives, credit unions, health-care organisations, advocacy groups, housing associations, etc., and it is expanding and becoming stronger with the Internet.

'Repair cafés' are an example of a new social innovation which contributes to sustainable development. The idea is simple – people who have objects in need of repair meet in a café with people who know how to repair them. The idea was developed by the journalist Martine Postma, and the first repair café was opened in Amsterdam in 2009. Their website offers a manual on how to start a repair café; the idea has spread to 16 countries to date, and there are 19 repair cafes in the UK. The 'Hackerspace', 'hacklab', 'makerspace' or 'hackspace' is another social innovation which enables peer learning and knowledge sharing through workshops, presentations and lectures. In 2009, London Hackspace**,** a community-run workshop was opened. It has facilities and equipment for electronics, 3D printing, craft, laser cutting, woodwork, metalwork, biology, amateur radio, robotics, etc. Should the 'hackerspace' model be explored to see whether it could be adapted for knowledge sharing between universities and community groups, businesses and innovators to support social innovation for sustainability and resilience and to increase research impact? Other recent forms of social innovation include the 'open design' movement which enables public sharing of design information, including free software and open-source hardware. **'**Crowdfunding' of start-ups has also been on the rise, typically via the Internet.

Big data, or large data sets, from different systems should enable more accurate decision-making and social innovation. Challenges such as analysis, capture, curation, search, sharing, storage, transfer, visualization, and information privacy present new areas of research, including the development of decision-making tools based on predictive models. Data required to develop policies, plan actions, provide services and make products which increase the sustainability and resilience of economic, social and environmental systems on global, national, regional and local levels will be sought. There will be a growing need for decision-making tools that can be used by:

- global, national, regional and local governance structures and agencies
- organisations, institutions and business
- community groups
- individuals.

Systems thinking or a systems approach should be used in the development of decision-making tools to identify interdependencies and opportunities. The report on 'Infrastructure Interdependencies Timelines' (Engineering the Future, 2013) has indicated the need for theapplication of systems thinking in planning of national transport, waste, water, energy, ICT and space systems by identifying their physical, digital, geographic and organisational

interdependency. It includes a linear mapping of policies and plans for development of the UK infrastructure systems from 2010 until 2060, which allows the reader to visualise the interdependencies and opportunities and see where and when events resulting from lack of capacity, co-ordination or planning are likely to occur. Regarding planning of the future development of infrastructure systems, the report includes the following recommendations:

1. Policy makers should utilise interdependency analysis and the Infrastructure Timelines to plot current and future policies and align policy development where necessary.
2. Government departments should improve the coordination and communication between and among regulators and asset owners.
3. Further research and implementation of interdependency analysis is required, building on the research currently being undertaken by a number of UK universities and commissioned by government

In conclusion, social innovation will be supported if communities have access to data related to the local, social, economic and environmental context as well as to decision-making tools. Such tools should also be developed for other users in governance, industry and business. Novel models of knowledge sharing between universities and a range of end-users of research outputs should be explored to increase research impact.

Sustainability and resilience of buildings, settlements and natural environment: Research, practice and support for social innovation

Overview of the conference questions and answers

The speakers were invited to provide answers within presentations or during the panel discussion. The delegates (among whom were also PhD students from other departments of the Faculty of Engineering) were invited to send their replies by email.

1. Based on your current research or practice, what potential future research in your area and/or multidisciplinary research should follow?

• We need more studies that follow or comply with NICE guidance on the benefits of interventions on physical health and the environment (including social and community aspects). These are often long-term and should not preclude actions on preventative spend that involve improving the quality of local environments (use them as cases for better evaluation to build the evidence base).

• Consider how to develop the capability of OR deliver useable insight (research) to a community so to improve the way it behaves, and influence the way it decides. Decisions can be informed using basic data, but simple data is not enough to address large complex problems (at scale) which will require the appropriate level of research. Research into core community issues will become even more relevant in the digital age.

• In line with the conference theme, one of the potential future researches should be risks assessment to ascertain the hazard, exposure and vulnerability level of the people, properties and the environment. With adequate classifications of the risks, action plans should be made to prevent new disasters through an integrated implementation approach.

• Low carbon design and evaluation for the entire life cycle of buildings, not just fragmented materials.

2. How the outputs of your research and/or practice could support social innovation, i.e. engagement of community groups or individuals in applying the research or practice outputs to contribute to more sustainable living?

• I'd be interested to hear about more on this, as I represent practitioners who are trying to do more social innovation and engagement. Examples of comments often made are 'we can't involve everyone' and 'what if we raise expectations and people say things we disagree with or can't act on'? Can researchers help us to dispel these myths…?

• The data we have collected provides an insight to what communities see as important in their day to day lives. Area Partnerships are a very powerful tool in considering the needs and investments of an area. Having a common platform will allow the sharing of ideas and encourage collaboration between the parties.

• The outputs of the research or practice could support social innovation by helping in disasters risks reduction (DRR) and the loss of lives and properties, including; the livestock's, fisheries and other farm products. The practice which target sustainable environment will also enhance health status of the community and economic growth.

• My research outputs could indirectly engage the community through a different approach to architectural construction which delivers (hopefully) improved quality buildings, with instructions to occupants how to maintain a healthy building.

3. What dissemination routes and formats would enable easier access to new knowledge not only by businesses and industry, but also by communities and entrepreneurial individuals?

• I think the answer to this is going to depend on who the user groups are. Perhaps it would be useful to bring together findings on what works for different groups? Practitioners often want something that is easy to put into practice, without theoretical frameworks or difficult language.

• Digital is an obvious choice but its limited simply due to being unstructured. Having a tailored push/pull mechanism into the City is by far the most effect way of getting the right information to the right people when they need it.

• The information dissemination routes can be through government, international organisations, municipality, local council, media, various community associations and also through trans boundary or bilateral cooperation.

• Pecha Kucha style events perhaps. Workshops with activities in contrast to research dissemination through presentation. The RDP events such as 'Problem solving' could be useful example.

4. Who might be potential enablers of knowledge dissemination to the population – government and its agencies, local authorities, community groups, media, online knowledge platforms, etc. ?

• There needs to be a collaborative effort. No one agency would have the draw to be able to deliver such knowledge.

• Potential enablers of knowledge dissemination to the population are those considered as non-stakeholders: civil society group, volunteers, public institutions, academia and scientific research institutes, women associations, youths and children should not be ignored they are agent of change in communities, industry, private sectors, business owners associations, even financial institutions, the media and now the almighty social media are becoming more powerful in information dissemination around the world at a glance.

• Community groups, social media and the government.

5. What governance frameworks and partnerships should be developed to support social innovation?

• My sense is that we should be working at the fine-scale (neighbourhoods) – levels at which communities function and not so large that it becomes impossible to make sense of the connections at play. Focus on specific problems/issues and accept that problems and solutions will vary from place to place. It would be good to have some research to show what works in current governance frameworks, and how they might be best developed to foster and enable more social innovation. Social innovation should happen because of, not in spite of, the public sector.

• Area Partnerships; Health Partnerships; Community Area Partnerships

• International collaboration and partnership throughout the world should be developed to support the social innovation. For example, we from the developing countries need transfer of

knowledge, skills acquisition, innovative ideas, and technical know-how for implementation within the global context, especially in new innovation like Sustainability & Resilience of Buildings that is not existing practice in developing countries. Monitoring and evaluation of these transferred knowledge by the international organisations should also be encouraged.

6. What 'big data' do communities and innovators need to enable development of innovative solutions in your area of research or practice?

• I'm a bit suspicious of the idea that 'big data' is the answer to all of our problems. In some cases it may well be, but in others in might not be. Just because data is 'big' it doesn't mean that is free from bias and other sampling issues. So the key thing is to be clear about the problem, and then work out the data needed ('big' or 'small'). Data is not dispassionate: it represents issues framed in particular ways. We should be more candid in our framing of issues alongside our quest for data.

• Value chains are the most important aspect of understanding what big data is needed. Big data is vital component of connecting people with knowledge. You would need to understand the value chains within each of the subsystems or ecosystems. Once you are cognisant of those systems you can then identify the data that contributes to that field. • The Big Data needed by community and innovators in the context of the research is the Disaster Risks assessment data, indicating all its dimensions of vulnerability level, exposure level of the people & properties and the hazards characteristics of the surrounding environment. These can be obtained by the use of Multi criteria spatial assessment where many hazards are identified and the use of GIS and Space obtainable information, also experiences of the communities from previous disasters and through the use of information technology innovations as measurement tools, collection and for analysis of those data as well. • Quality of built environment (energy usage, building types and sizes, occupancy schedules). Opportunities for adaptation rather than demolition of buildings. Available construction and manufacturing opportunities across the UK.

7. What tools should be developed for different users to enable the application of a systems approach in decision-making on governance, planning, infrastructure systems and development of innovative solutions?

• Again, I think this is going to depend on the context (the place and the problem at issue). What works in one place and time, won't necessarily work in another. It would be good to have a resource to gather what worked, giving information on factors that enabled success. Although less popular, it would also be good to have examples of what didn't work in a given situation, and why…

• Understanding data portfolios and their use as well as the classification of data is vital for people so they are able to contextualise.

• Environmental management tools or Approaches of Eco-system based management developed for different users are Protected area management (PAM), Land use planning & zoning (LUPZ), Community based action (CBA), Integrated land management (ILM), Dry lands management system (DLMS), Integrated water resource management (IWRW), Integrated watershed management (IWM) and Integrated Coastal zone management (ICZM).

• Interactive, multi-layered and multi-disciplinary.