# ICOA1091: THE USE OF WEBGIS TO ENHANCE COMMUNITY RESILIENCE TO FLOODING: DISCOVERING THE TANGIBLE AND INTANGIBLE LOCAL FLOOD CULTURE OFTHE CITY OF YORK

# Subtheme 03: Protecting and Interpreting Cultural Heritage in the Age of Digital Empowerment

Session 3: Application of Digital Technology in Disaster Management Practices Location: Silver Oak 2, India Habitat Centre Time: December 14, 2017, 11:30 – 11:45

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**Abstract:** Historic built heritage is the tangible expression of the culture of a place. It represents the identity of a community in relation to its historical inheritance, aesthetic canons and system of beliefs. Natural disasters, such as flooding, constitute a violent interruption to the continuity of these tangible and intangible values. In this context of exceptional cultural emergency, community participation and the understanding of a local risk culture are considered key in the promotion of preventive measures and in reducing disaster vulnerability.

Over the last few decades, the cultural assets of the historic city of York (UK) have been threatened by an increasing frequency of flood episodes due to climate change. In order to mitigate the impact of the flooding and to preserve the vulnerable heritage, it is necessary to enhance the notion of "living with risk" within the community affected. This project explores ways in which digital resources can be used to engage and increase community awareness and to integrate local 'flood culture' – how people understand, respond and adapt to flooding - in long-term planning and mitigation measures.

The study conducted in York's historic centre, aims to enhance community resilience to flood through digital techniques and participatory planning. This research explores the potential of WebGIS as a tool able to record tangible and intangible elements of the York local flood culture in relation to the historic buildings affected by flooding. The data base created by GIS software will inform citizens and conservation practitioners about the vulnerability of historic buildings and it will suggest possible measures to adopt in accordance with principles of sustainability and compatibility with the traditional materials, providing the basis for future best-practice guidelines. A web-based method is proposed that supports social learning and draws on the existing knowledge and capacities of the community.

Key words: digital resources, conservation, dissemination, accessibility

ICOA1091: The use of WebGIS to enhance community resilience to flooding: Discovering the tangible and intangible local flood culture of the city of York

#### Introduction

In 2015, the historic centre of York, UK, experienced the worst flooding for many years, affecting the heart of the Roman, Viking and medieval city. York, like many historic towns, is sited in a strategic position at the confluence of two rivers, the Ouse and the Foss (fig.1).

In response to the particularly damaging effects of this flooding, the University of York and York Civic Trust formed a partnership to improve awareness and anticipation of flood risk for local people in York to protect their heritage. The 'Resilient York' project aims to develop <<table communities where conservation expertise and good practice can be used effectively to help communities in York following future flooding>><sup>1</sup>. The research is developed in the context of this case study and explores how digital resources can be used to engage and increase community awareness and to integrate 'local flood culture' – how people understand, respond and adapt to flooding – in long-term planning and mitigation measures.

Public participation in development and environmental management has become increasingly central to the planning process in the UK over the last 40 years. Disaster Risk Management (DRM), in contrast, has been perceived as an expert domain in which ordinary citizens have little say. Approaches have been characterised by a technocratic and hierarchical response to external hazards<sup>2</sup>. More recently initiatives have begun to focus on the effectiveness of community and locally-led activities introducing the concept of resilience: an intrinsic capacity of a community or system to quickly recover and adapt to external hazards<sup>3</sup>. The role of community planning in resilience to hazards has also been fore grounded in recent studies<sup>4</sup>. The introduction of a notion of 'local culture' in the context of disaster management represents a significant shift in the perception and interpretation of risk that has defined the disaster paradigm over the past three decades. Alongside this, democratisation of heritage practice has also developed significantly with an emerging emphasis on the social value of heritage<sup>5</sup>. As this social value of heritage is increasingly appreciated, it is relevant to consider a local culture of flood preparedness which is sensitive to the risk to heritage assets as well as the risks to life, to property and businesses.

<sup>&</sup>lt;sup>1</sup>(Resilient York 2017)

<sup>&</sup>lt;sup>2</sup>(Kruger *et al* 2015)

<sup>&</sup>lt;sup>3</sup>(Cardona 2003)

<sup>&</sup>lt;sup>4</sup>(Pearce 2003)

<sup>&</sup>lt;sup>5</sup>(Jones and Leech 2015, Jones 2017)



Fig.1–Aerial view of the York historic centre (© localview.york.gov.uk)

The World Disaster Report 2014 has the following definition of culture developed in an area at risk:

<<Culture consists of beliefs, attitudes, values and their associated behaviours, that are shared by a significant number of people in hazard-affected places. Culture in relation to risk refers to the ways that people interpret and live with risk, and how their perceptions, attitudes and behaviour influence their vulnerability to hazards $>>^6$ 

The perceptions and behaviours of a community in response to hazards thus play an active role in the connection between culture and disaster. It is only in recent years, with the Hyogo Framework for Action (HFA) (2005-2015), that the role of culture has been emphasised by the UN for Disaster Risk Reduction, considering social dynamics central for successful disaster preparedness and response. Indeed, in the past decade, action promoted in the HFA agenda was based on participatory democracy, the management of risk and knowledge, and education and preparedness<sup>7</sup>.

Recent research around disaster risk management suggests that community awareness of the risk and local capacity building are key for enhancement of resilience and also central for a more democratic and transparent decision-making process involving a range of different stakeholders. However, in historic cities exposed to natural hazards such initiatives are dependent on an informed analysis of both the tangible and intangible aspects of their cultural assets in context to understand how that resilience may be

<sup>&</sup>lt;sup>6</sup>(International Federation of Red Cross and Red Crescent Societies 2014:14)

<sup>&</sup>lt;sup>7</sup>(Alexander and Davis 2012:2)

developed and retained in a particular context.

The research presented builds upon the theoretical shift in the DRM in which the resilience approach is adopted to mitigate the risk and develop preparedness using digital tools such as Participatory Geographic Information (PGIS) integrating community knowledge into a resilience map.

## Methodology

Preparedness is a key component of the disaster recovery cycle and the quality of the information shared is fundamental in this. Arnstein's model<sup>8</sup> for participative empowerment suggests that information provides an essential component of legitimate citizen participation and consequently of democratic management of the urban and cultural assets.

The methodology proposed in this paper has been designed for such a holistic framework. The physical qualities of historic buildings located in flood prone areas in York are recorded with their intangible aspects in term of human behaviour, economic status and conservation management, using the digital platform of a Participatory Geographic Information System (PGIS). The use of PGIS draws on practice developed for participatory learning<sup>9</sup> and its use in local environmental decision-making<sup>10</sup> consists of gathering data using traditional qualitative methods such as interviews, questionnaires and focus groups and combines them with spatial features in a map<sup>11</sup>. Community mapping has been widely used in order to assess the vulnerability of urban assets using spatial and visual analysis.

However, according to McCall the use of PGIS within the DRM has been limited to understanding the causes of risk and mitigating against its impact. In fact, in his extensive review<sup>12</sup>, he considers only PGIS applications in climate risk and vulnerability identification overlooking the resilient and cultural discourse in terms of physical and behavioural mitigation measures. The use of participatory mapping to investigate the formation of community and built heritage resilience remains an under-explored field.

<sup>&</sup>lt;sup>8</sup>(Arnstein 1969:219)

<sup>&</sup>lt;sup>9</sup>(Rambaldi et al. 2006:106)

<sup>&</sup>lt;sup>10</sup>(e.g. Kingston et al. 2000, Cinderby 2007:165)

<sup>&</sup>lt;sup>11</sup>(Dunn 2007: 616)

<sup>&</sup>lt;sup>12</sup>(McCall 2008)



Fig.2–1933 flood: the community of 1930s York living with and adapting to flooding with raised walk ways. (©cyc.sdp.sirsidynix.net.uk)

## **Research Process**

York sits at the confluence of two major rivers, the River Ouse and the River Foss. Due to its position, York has always been prone to flooding but, with the impacts of global warming and changing land management in its catchment areas, the frequency and severity of flooding is increasing<sup>13</sup>. After the construction of the Foss barrier in 1986/87, the risk of the River Foss flooding was drastically reduced, so that the River Ouse was considered the main risk for the flooding in York. However, during the last flooding in 2015, the flood damage was exacerbated by the failure of the Foss barrier, caused by an exceptional episode of heavy rainfall over the catchment areas for the rivers. This episode has shown that merely relying on structural measures is not sufficient as the community along the River Foss was unaware of the flood risk and unprepared in their response to the threat of flooding.

The 'Resilient York' project also highlighted the unintended consequences of recovery action in the aftermath of flooding. From local accounts it is evident that in some affected areas, for example, internal fittings of historic buildings were unnecessarily removed and destroyed, vulnerable material was inappropriately treated and property owners took ill-advised action to reinstate their buildings. The experience of residents living in other parts of the historic city, who are more accustomed to such episodes and have adapted their buildings accordingly, suggest that preparedness and refurbishment with appropriate materials can mitigate many of the worst impacts for historic properties. Understanding and

<sup>&</sup>lt;sup>13</sup>(Macdonald and Black 2010)

sharing these understandings of risk and preparedness is central to a resilient culture, as studies of householder behaviours indicate<sup>14</sup>.

In his study of 'disaster subculture' Moore suggests that the nature of a disaster culture is constructed through accumulated local knowledge of the elements that have traditionally survived external hazards which are influenced by the frequency and the impact over the time of a specific natural hazard<sup>15</sup>. Examining this hypothesis, the study will analyse the local flood cultures that have developed along the river Ouse and Foss in York, recording the different physical and behavioural aspects which characterise their respective historic areas.



Fig.3–River Foss 2015 flooding (©Catherine Sotheran)

# **Application of PGIS in York**

The PGIS methodology developed for this study explores the resilience of historic buildings and the actions taken by their occupants in the historic centre of York looking at current and past approaches adopted to cope with flooding. In producing this, the ethical issues described by Rambaldi<sup>16</sup> have been considered addressing the Who? And Whose? Questions in terms of participation and empowering issues.

A questionnaire was presented to residents and building managers in selected areas of York which were affected by the 2015 flood. The questionnaire titled 'Mapping the resilience of York's historic buildings after the 2015 flood' is divided into five sections, in which participants are asked to describe the phases Before, During and After the 2015 flood in terms of structural and behavioural mitigation measures. Thus,

<sup>&</sup>lt;sup>14</sup>(Harvatt, Petts, Chilvers 2011)

<sup>&</sup>lt;sup>15</sup>(Wenger and Weller 1973:9)

<sup>&</sup>lt;sup>16</sup>(Rambaldi et al 2006, 108)

it is possible to compare how different building typologies and occupancy can influence the resilience of the building highlighting both the physical and behavioural flood mitigation methods adopted in the buildings.



Fig.4– PGIS analysis of the stakeholders' perception of the flood risk before and after the 2015 flood. It can be observed that along the Foss before the 2015 flood event people did not expect to be flooded (©image of the authors).

The resulted interactive map (fig.5) combines technical source of data with the intangible resilience perception of local stakeholders. The preliminary results show that historic, grade I listed buildings are

now more resilient and better prepared for future flooding due to the awareness and participation of their users who opted for an improvement of the design and behavioural solutions. In contrast, for commercial buildings and lesser-grade listed buildings or unlisted buildings, economic factors and time pressure influenced the conservation approach adopted.

The second stage of the research envisages a dissemination of the outputs through the GIS online software. The online database and map displayed by GIS informs citizens and conservation practitioners of the resilience of historic buildings and it will suggest possible measures to adopt in accordance with principles of sustainability and compatibility with the traditional materials, providing the basis for future best-practice guidelines.



Fig.5– The interactive resilient map of York online. The online database holds responses to the questionnaire highlighting both physical and behavioural measures that people adopted to cope with the flood (©image of the authors).

# Conclusion

The pilot case study of the York historic centre demonstrates how digital technologies, such as GIS software, used to enable participation could offer an opportunity to engage community and specialists in a more democratic and better nuanced decision-making process. Moreover, the spatial analysis of PGIS is an ideal tool to represent both tangible and intangible characteristics of the historic building affected by flooding, recording their architectural elements, materials and conservation interventions but also the stakeholders' behaviour, values and perceptions.

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# ICOA1091: L'UTILISATION DE WEBGIS POUR RENFORCER LA RÉSILIENCE DES COMMUNAUTÉS FACE AUX INONDATIONS: DÉCOUVRIR LA CULTURE TANGIBLE ETINTANGIBLE DES INONDATIONS DE LA VILLE DE YORK

# Sous-thème 03: Protéger et interpréter le patrimoine culturel à l'ère de l'autonomisation numérique

Session 3: Application de la technologie numérique aux pratiques de gestion des catastrophes Lieu: Silver Oak 2, India Habitat Centre Date et heure: 14 Décembre, 2017, 11:30 – 11:45

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Résumé: Le patrimoine bâti historique est l'expression tangible de la culture d'un lieu. Il représente l'identité d'une communauté parrapport à son héritage historique, ses canons esthétiques et son système de croyances. Les catastrophes naturelles, telles que les inondations, constituent une interruption violente de la continuité de ces valeurs tangibles et intangibles. Dans ce contexte d'urgence culturelle exceptionnelle, la participation citoyenne et la compréhension d'une culture locale du risque sont considérées comme essentielles pour la promotion de mesures préventives et la réduction de la vulnérabilité aux catastrophes.

Au cours des dernières décennies, les biens culturels de la ville historique de York (Royaume-Uni) ont été menacés par la fréquence croissante des épisodes d'inondations dus au changement climatique. Afin d'atténuer l'impact des inondations et de préserver le patrimoine vulnérable, il est nécessaire d'améliorer la notion de «vivre avec le risque» au sein de la communauté touchée. Ce projet explore les façons dont les ressources numériques peuvent être utilisées pour sensibiliser la communauté et intégrer la «culture d'inondation» locale - comment les gens comprennent, réagissent et s'adaptent aux inondations - dans la planification à long terme et les mesures d'atténuation.

L'étude menée dans le centre historique de York vise à renforcer la résilience des communautés face aux inondations grâce aux techniques numériques et à la planification participative. Cette recherche explore le potentiel de WebGIS en tant qu'outil capable d'enregistrer les éléments tangibles et intangibles de la « culture d'inondation » locale de York liés aux bâtiments historiques touchés par les inondations. La base de données créée par le logiciel GIS informera les citoyens et les professionnels de la conservation sur la vulnérabilité des bâtiments historiques et suggérera des mesures possibles à adopter conformément aux principes de durabilité et de compatibilité avec les matériaux traditionnels, qui serviront de base aux meilleures pratiques futures. Une méthode disponible sur internet est proposée pour soutenir l'apprentissage social en s'appuyant sur les connaissances et les capacités existantes de la communauté.

Mots-clés: ressources numériques, conservation, diffusion, accessibilité