



# UNIVERSITÀ POLITECNICA DELLE MARCHE

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**Supervisor:** Gabriele Bernardini

Dept. of Civil Engineering, Construction and  
Architecture (DICEA)



**MAIN CORE OF ACTIVITIES:** Urban Built Environment and its performance under disaster risk conditions by:

- Integrated risk assessment and mitigation, under a multi-scenario standpoint, also to develop Disaster Risk Reduction support tools for designers and decision-makers
- Data mining for urban risk assessment, also integrating GIS databases, and other data sources
- Use of ML/AI methods to boost assessment tasks



## Specific sub-items in the main goal:

- Mainly interested in flood risk in urban area, but also potentially considering slow (e.g. increasing temperatures) and sudden (e.g. earthquake, terrorist acts) onset disasters
- Scenario creation and sensitivity analysis
- User-centered/behavioural-based analysis and strategies design process, including both simulation models for evacuation and XR solutions for end-users' training
- Interest in urban use dynamics in relevant contexts (e.g. touristic buildings and sites), over space and time, also in view of multi-risk impacts and effects of risk factors variations (including user exposure-increasing conditions, e.g. seasonal scenarios/massgatherings)
- Additional interest on historic areas due to their complexities in intervention deployment
- Ideally extendable to other hazards as a common framework



Basic projects as research group member and activities responsible at Università Politecnica delle Marche, Ancona – facoltà di Ingegneria, Dipartimento DICEA:

- **“ReACT** - (planning) Resilient urban and metropolitAn built environments through inClusive mulTi-risk behavioural-based models and simulations” BAC Return - [fondazionereturn.it](http://fondazionereturn.it) – PNRR; Periodo: 20.01.2025 – 28.02.2026; PI: prof. E. Quagliarini
- **STRIC+** “Potenziamento centro internazionale per la ricerca sulle Scienze e Tecniche della RICostruzione” technological trasfert support by Lazio, Abruzzo, Umbria e Marche egions; Period: 29/11/2023- ongoing
- **BE S2ECURe** “(make) Built Environment Safer in Slow and Emergency Conditions through behavioUral assessed/designed Resilient solutions - MIUR; Period: 1/3/2020-28/2/2023; PI: prof. E. Quagliarini
- **CLIMRES** - LEADERSHIP FOR CLIMATE RESILIENT BUILDINGS – HORIZON; Period: 01/09/2024 – ongoing





- **Position:** Researcher (RTD-B) at DICEA, UNIVPM
- **Lecturer:** «Building Engineering» since 2018 – UNIVPM; «Sistemi costruttivi, storici e speciali» since 2024
- **Mentorship:** 4 PhD Thesis co-supervisor; 9 BSc and MSc thesis supervisor; 49 BSc and MSc thesis co-supervisor; 1 international MSc thesis co-supervisor
- **Technological transfert:** Co-funder and vice-president of «Lead-Me s.r.l.» - spin off and innovative start-up of UNIVPM, 2019-2022
- **ORCID:** <https://orcid.org/0000-0002-7381-4537> - SCOPUS data: H index: 29 – number of publications: 127 . Last access: 11/02/2026



## - Recent and relevant works:

1. Quagliarini E, Freddo A, Alighieri C, Natalucci M, Bernardini G (2026) A novel dynamic disaster risk assessment of Urban Built Environments: an application to flood and earthquake. *International Journal of Disaster Risk Reduction* 106072. <https://doi.org/10.1016/j.ijdr.2026.106072>
2. De Fino M, Bernardini G, Alighieri C, Tavolare R, Quagliarini E, Fatiguso F (2026) Flood risk management in historic centres: A scalable typological framework integrating GIS, BIM and VR. *International Journal of Disaster Risk Reduction* 135:106031. <https://doi.org/10.1016/j.ijdr.2026.106031>
3. Sparvoli G, Bosi E, Bernardini G, Quagliarini E, Ferreira TM (2026) How much do users matter? An integrated method for building flood vulnerability and exposure assessment in Historic Urban Areas. *Sustainable Cities and Society* 136:107084. <https://doi.org/10.1016/j.scs.2025.107084>
4. Quagliarini E, Bernardini G, Domenella L, Marinelli G (2025) Supporting “Build Back Better” in historical towns: a novel methodology to include users’ exposure and vulnerability in strategic function relocation assessment. *International Journal of Disaster Risk Reduction* 127:105700. <https://doi.org/10.1016/j.ijdr.2025.105700>
5. De Fino M, Cassano F, Bernardini G, Quagliarini E, Fatiguso F (2025) On the user-based assessments of virtual reality for public safety training in urban open spaces depending on immersion levels. *Safety Science* 185:106803. <https://doi.org/10.1016/j.ssci.2025.106803>
6. Bernardini G, Sparvoli G, Cantatore E, Bruno S, Fatiguso F, Isacco I, Salvalai G, Quagliarini E (2025) From single to multi-risk perspective: How heatwaves risk mitigation solutions can reduce terrorist risk in historic outdoor open areas. *Sustainable Cities and Society* 127:106412. <https://doi.org/10.1016/j.scs.2025.106412>
7. Bernardini G, Sparvoli G, Cantatore E, Cadena JDB, Bernabei L, Rosso F, D’Amico A, Russo M, Fatiguso F, Salvalai G, Mochi G, Currà E, Quagliarini E (2025) Evaluating strategies for single to multi-risk mitigation in urban public open spaces: A behavioural simulation-based approach applied to Italian typological historical urban squares. *Cities* 166:106267. <https://doi.org/10.1016/j.cities.2025.106267>
8. Quagliarini E, Bernardini G, D’Orazio M (2023) How Could Increasing Temperature Scenarios Alter the Risk of Terrorist Acts in Different Historical Squares? A Simulation-Based Approach in Typological Italian Squares. *Heritage* 6:5151–5188. <https://doi.org/10.3390/heritage6070274>





## - Recent and relevant works:

9. Quagliarini E, Romano G, Bernardini G (2023) Investigating pedestrian behavioral patterns under different floodwater conditions: A video analysis on real flood evacuations. *Safety Science* 161:106083. <https://doi.org/10.1016/j.ssci.2023.106083>
10. Quagliarini E, Bernardini G, Romano G, D’Orazio M (2022) Simplified flood evacuation simulation in outdoor built environments. Preliminary comparison between setup-based generic software and custom simulator. *Sustainable Cities and Society* 81:103848. <https://doi.org/10.1016/j.scs.2022.103848>
11. Quagliarini E, Bernardini G, Romano G, D’Orazio M (2023) Users’ vulnerability and exposure in Public Open Spaces (squares): A novel way for accounting them in multi-risk scenarios. *Cities* 133:104160. <https://doi.org/10.1016/j.cities.2022.104160>
12. Quagliarini E, Lucesoli M, Bernardini G (2021) How to create seismic risk scenarios in historic built environment using rapid data collection and managing. *Journal of Cultural Heritage* 48:93–105. <https://doi.org/10.1016/j.culher.2020.12.007>
13. Bernardini G, Romano G, Soldini L, Quagliarini E (2021) How urban layout and pedestrian evacuation behaviours can influence flood risk assessment in riverine historic built environments. *Sustainable Cities and Society* 70:102876. <https://doi.org/10.1016/j.scs.2021.102876>
14. Bernardini G, Quagliarini E, D’Orazio M, Brocchini M (2020) Towards the simulation of flood evacuation in urban scenarios: Experiments to estimate human motion speed in floodwaters. *Safety Science* 123:104563. <https://doi.org/10.1016/j.ssci.2019.104563>
15. Zlateski A, Lucesoli M, Bernardini G, Ferreira TM (2020) Integrating human behaviour and building vulnerability for the assessment and mitigation of seismic risk in historic centres: Proposal of a holistic human-centred simulation-based approach. *International Journal of Disaster Risk Reduction* 43:101392. <https://doi.org/10.1016/j.ijdrr.2019.101392>
16. Quagliarini E, Bernardini G, Santarelli S, Lucesoli M (2018) Evacuation paths in historic city centres: A holistic methodology for assessing their seismic risk. *International Journal of Disaster Risk Reduction* 31:698–710. <https://doi.org/10.1016/j.ijdrr.2018.07.010>
17. D’Orazio M, Spalazzi L, Quagliarini E, Bernardini G (2014) Agent-based model for earthquake pedestrians’ evacuation in urban outdoor scenarios: Behavioural patterns definition and evacuation paths choice. *Safety Science* 62:450–465. <https://doi.org/10.1016/j.ssci.2013.09.014>





## Equipment at Building Science and Technology (BS&T) Lab - DICEA ([Building Science and Technology Lab – Dicea](#))

- [Human-building interaction analysis](#)
- [Computer center](#) equipped with fixed workstations, notebooks with high computational power and 7-node clusters.



**Virtual reality and behavioural assessment tools** for visualization, communication, training and design:

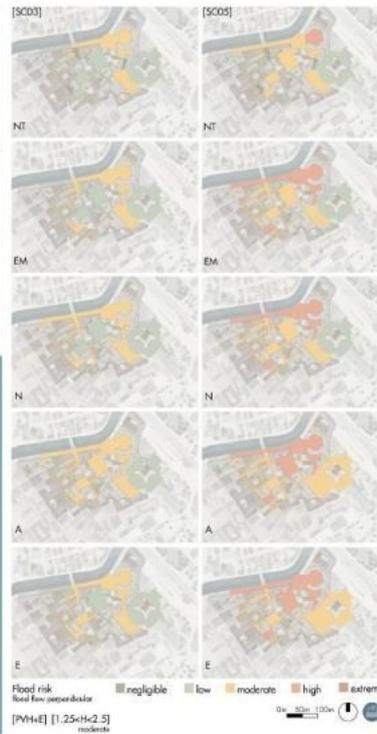
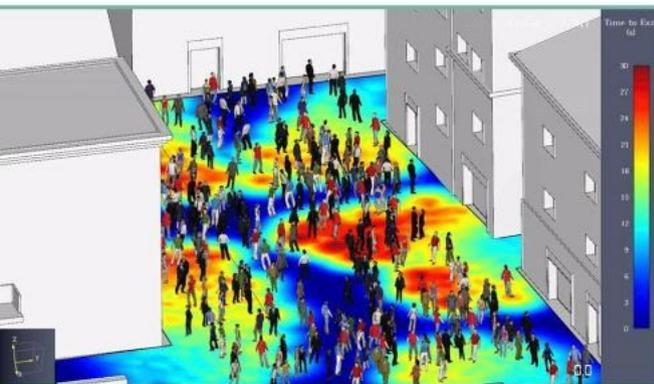
- CAVE
- Head Mounted Display (Meta Quest 3, HTC VIVE 2)
- Eye-tracking glasses (TOBII), physiological activity sensors (Empatica)





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**Simulation and assessment tools** for pedestrian dynamics (proprietary and commercial), GIS-based tools for risk assessment, mitigation and intervention planning/design, ML & LLMs tools (open source/commercial – cloud)





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Staff, equipment and laboratories



## Research group at UNIVPM – DICEA, BS&T

- **Professors:** Prof. Enrico Quagliarini, Prof. Marco D’Orazio, Prof. Elisa Di Giuseppe
- **Researchers:** Dr. Arianna Latini
- **Technical personnel:** Dr. Andrea Gianangeli, Dr. Guido Romano
- **PhD students:** Caterina Alighieri, Leonardo Crescimbeni, Alessia Freddo, Gessica Sparvoli



HR EXCELLENCE IN RESEARCH



Urban databases  
(FAIR principles)



GIS/digital twins



Parameters  
variations & risk-  
increasing conditions

ML/AI methods

## Urban risk assessment under flood scenarios



**Evaluate** risk levels under  
multiple scenarios &  
**provide insights** on  
possible mitigation  
strategies



**Inform/support** decision  
makers and **communicate**  
/ **train communities** on  
risk levels under multi-  
scenario conditions

