XXXIV

SALÓN TECNOLÓGICO DE LA CONSTRUCCIÓN EXCO 2020

INTERNATIONAL ITINERANT EXHIBITION "RESEARCH IN BUILDING ENGINEERING – EXCO'20" - *Valencia SPAIN*

# LA SICUREZZA URBANA. UNA METODOLOGIA RISK BASED A SUPPORTO DEGLI STUMENTI DI PIANIFICAZIONE METROPOLITANA

# URBAN SAFETY. A RISK BASED METHODOLOGY TO SUPPORT METROPOLITAN PLANNING TOOLS

Francesca Coppola[1] Isidoro Fasolino[1] Michele Grimaldi[1] Giacomo Di Ruocco[1]

Department of Civil Engineering / University of Salerno[1]

## 1. Introduzione / Introduction

Ciò che rende la città poco sicura non è soltanto il rischio effettivo di essere vittime di *reati* di tipo *predatorio* ma anche la percezione di insicurezza che si avverte in determinati spazi. Quest'ultima è strettamente correlata al degrado urbano e al disagio sociale che si manifestano sotto forma di *atti vandalici* e *soft crimes*.

What makes the city unsafe is not only the real risk of being the victim of *predatory crime* but also the perception of insecurity that is felt in certain spaces. The latter is closely linked to urban decay and social unease in the form of *vandalism* and *soft crime*.

**Legenda / Legend**
1. Furto / Thefts;
2. Aggressioni, scippi e borseggi / Aggressions, muggings and pickpockets;
3. Spaccio / Drug dealing;
4. Atti vandalici / Vandalism.

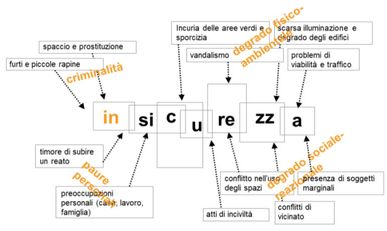
Un cittadino su quattro evita alcune strade, luoghi o persone durante le uscite serali, è forte e diffuso tra la popolazione il timore di subire un furto in abitazione (60,2%), un borseggio, uno scippo, una rapina o un furto d'auto (in media il 40%) (Istat, 2018).
Molti gli esempi virtuosi in ambito internazionale nei quali si è riconosciuta la potenzialità dell'intervento urbanistico nella prevenzione del crimine e nella riduzione del senso di insicurezza (Stati Uniti, Olanda, Inghilterra, Francia) e le esperienze/enti di livello italiano ed europeo che operano nell'ambito della sicurezza urbana (EFUS, FISU, COST Action TU1203, ecc).
Con riferimento al caso italiano, emerge una mancanza di sensibilità per la tematica che, unita all'indisponibilità di dati coerenti ed aggiornati, in merito alla frequenza e alla localizzazione spaziale degli eventi criminosi, rende impossibile analizzare tali aspetti in fase di definizione degli strumenti urbanistici.

One in four citizens avoids certain roads, places or people during evening outings, there is a strong and common fear among the population of being stolen from their homes (60,2%), pickpocketed, mugged, robbed or stolen from their cars (on average 40%) (ISTAT, 2018).
There are many virtuous examples on the international scene in which the potential of urban intervention in the prevention of crime and in the reduction of the sense of insecurity has been recognized (United States, Holland, England, France) and the experiences/entities of Italian and European level that operate in the field of urban safety (EFUS, FISU, COST Action TU1203, etc.).
With reference to the Italian case, there is a lack of sensitivity to the issue that, combined with the unavailability of consistent and updated data on the frequency and spatial location of criminal events, makes it impossible to analyze these aspects when defining urban planning tools.

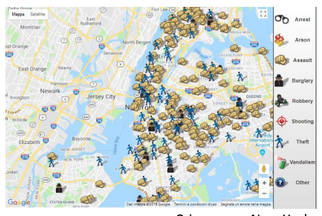
## 2. Obiettivo / Objective

Formulazione di una metodologia che consenta di analizzare l'**organizzazione fisica e funzionale degli spazi** mediante un **indicatore di rischio urbano**, costruito come combinazione di un opportuno set di indicatori "**di sicurezza urbana**", e individuazione di ambiti del tessuto insediativo su cui prevedere **azioni di mitigazione** del fenomeno, da introdurre nel **Piano Urbanistico Comunale**.

Formulation of a **methodology** that allows to analyze the **physical and functional organization of spaces** through an **urban risk indicator**, built as a combination of a suitable set of indicators "**of urban safety**", and identification of settlement areas on which to provide **mitigation actions** of the phenomenon, to be introduced in the **Municipal Urban Plan**.

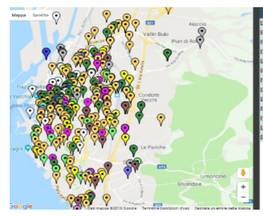



(Associazione Amapola, 2012)

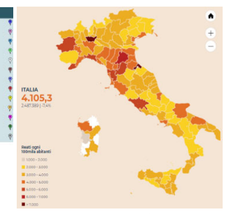


Crime map, New York
https://spotcrime.com/ny/new+york

Crime map, London
https://www.police.uk/city-of-london/cp/crime/W9tRdr/



Crime map, Livorno and province
Il Tirreno

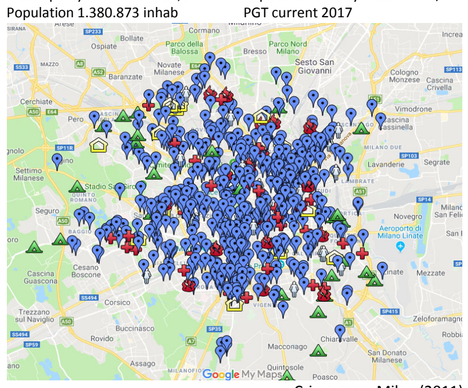


Crime map by province
Il Sole24Ore

## 3. Materiali e metodi / Materials and methods

### Comune di Milano / Municipality of Milan

Municipality extension 181,67 km² Population density 7.601 inhab/km²
Population 1.380.873 inhab PGT current 2017



Crime map, Milan (2011)
Belleri D., Il giro della nera

**Macro Phase 1** — COSTRUZIONE DI UN INDICATORE DI RISCHIO URBANO / CONSTRUCTION OF AN URBAN RISK INDICATOR

$R = H \times V \times E$ (Undro, 1979)

**Rischio Urbano (R):** «Probabilità che un determinato evento criminoso a carattere spaziale, verificandosi in un contesto avente un dato livello di vulnerabilità e causato dal comportamento umano, produca danni a persone o cose».

**Urban Risk (R):** «Likelihood of damage to persons or property caused by a given spatial crime event occurring in a context of a given level of vulnerability and caused by human behavior».

**Indicator of Urban Risk R = H x V x E**
- Hazard indicators
- Vulnerability indicators
- Exposure indicators

**Fattori di rischio / Risk factors**

**Pericolosità (P) / Hazard (H)**
Probabilità che un evento criminoso a carattere spaziale si verifichi in una determinata area, con una certa intensità e in un determinato intervallo di tempo».

«Likelihood that a spatial crime event will occur in a given area, with a certain intensity and in a given time interval».

**Vulnerabilità / Vulnerability (V)**
«Attitudine dello spazio urbano (intesa in termini di assetto fisico e funzionale) a scoraggiare o favorire il verificarsi di un determinato reato a carattere spaziale».

«The attitude of urban space (understood in terms of physical and functional structure) to discourage or favour the occurrence of a specific spatial crime».

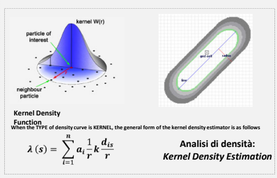
**Esposizione / Exposure (E)**
«Elementi (persone, monumenti o siti di particolare interesse) esposti al rischio derivante dal verificarsi o meno di un determinato evento criminoso in una data area».

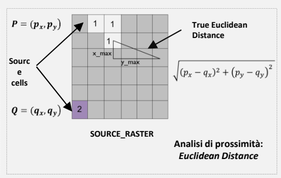
«Elements (persons, monuments or sites of particular interest) exposed to the risk resulting from the occurrence or non-occurrence of a specific criminal event in a given area».

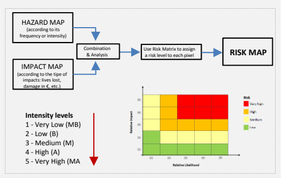
**Macro Phase 2** — COSTRUZIONE DELLA MAPPA DEL RISCHIO URBANO / CONSTRUCTION OF THE URBAN RISK MAP

La trasformazione dell'*indicatore di rischio urbano* in mappa è condotta ricorrendo ad *analisi di densità e di prossimità* implementate in ambiente GIS, attraverso la costruzione di un *Model Builder* ispirato alle funzionalità del software *CrimeStat III*, e applicate al caso studio di Milano.

The transformation of the urban risk indicator into a map is carried out using *density and proximity analyses* implemented in GIS, through the construction of a *Model Builder* inspired by the functions of the *CrimeStat III* software, and applied to the Milan case study.




**Urban Risk map**
- Hazard map
- Vulnerability map
  - Marginality map
  - Functional mix map
  - Proximity map
- Exposure map
  - Resident population map
  - Attractors map
- Impact map
- Urban Risk map

Tutte le mappe sono state riclassificate in 5 livelli di intensità in linea con quanto specificato nel documento della commissione europea *Overview of Disaster Risks that the EU faces* (2013).

All maps have been reclassified into 5 levels of intensity with reference to the European Commission document *Overview of Disaster Risks that the EU faces* (2013).

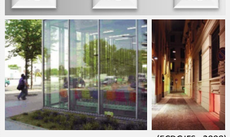
**Macro Phase 3** — CONFRONTO TRA SCENARI / COMPARISON OF SCENARIOS

**Comparison of scenarios**
- Scenario 0
- Scenario 1
  - Identification f critical areas
  - Mitigation actions
- Scenario 2

Tre gli scenari analizzati: ***scenario 0*** (stato di fatto); **scenario 1** (modifica delle condizioni di rischio innescata dall'attuazione delle previsioni degli strumenti urbanistici); **scenario 2** (variazione del rischio urbano generata dall'applicazione delle azioni per la sicurezza).

Three scenarios were analysed: **scenario 0** (the actual state of things); **scenario 1 (**modification of the risk conditions caused by the implementation of the forecasts of the urban planning instruments); **scenario 2** (variation of the urban risk generated by the application of the safety actions).

**Safety actions**
- PS
- PO
- RU





(ECDGJFS, 2008)

**DEFINIZIONI DI AZIONI PER LA SICUREZZA URBANA** / **DEFINITION OF ACTIONS FOR URBAN SAFETY** — **Macro Phase 4**

| STRUCTURAL PLAN | OPERATIONAL PLAN |
|---|---|
| *Functional mix* (residential, commercial, recreational). | *Urban regeneration:* aimed at introducing activities (ground floor residential buildings) and public equipment at strategic points. |
| *Social mix* (diversification of housing offer). | *Road network reorganization:* road design that discourages high speed. Public transport stops located near activities, not in isolated and marginal areas. |
| *Continuity of the urban fabric.* | *Reorganisation of the cycle-pedestrian network:* replacement of underpasses and raised bridges with routes at street level. Routes located near houses and activities. Never pass through the back of them. |
| *Continuity of the road route and the pedestrian cycle network. Mixed-use roads.* | *Reorganization of public spaces and oversized green areas.* Possible fractionation of green areas and concession to residents for management. |
| *Continuity of the public transport system.* | *Localization of commercial activities and public services:* distributed without creating marginal areas. |
| *Infrastructure localization:* attention not to create physical barriers, enclaves and marginal spaces. | *Location of continuous and night-time activities in strategic points.* |
| *Location of public spaces:* (parks, recreation areas, children's playgrounds, etc.) in densely popolated areas. | *Distinction between public, semi-public, semi-private and private spaces.* |
| *Recovery of marginal areas and elimination of potential enclave situations.* | *Public spaces:* multiple entry/exit points, located close to homes and activities. |
| – | *Parking:* small areas with multiple entry/exit points, located near homes or activities. Roadside parking in front of buildings, not on the sides and back. |

| URBAN REGULATION | |
|---|---|
| *Fences:* low and trasparent (about 50%). | *Views private and public buildings:* on roads and public places. |
| *Visual barriers:* walls, unevenness of the ground and low hedges, urban furnishings that do not obstruct the view. | *Access/entrance private and public buildings:* on the road and not on the back. |
| *Urban green:* tall trees in the delimitation of spaces and paths. | *Borders:* retracting housing compared to the roadside max 3 meters. |
| *Transparency:* lifts and parapets (public stair and ramps for the disabled), shelters of bus stops, shop windows (not completely opaque shade). | *Parking spaces:* light-colored finishes for the closed parts. |
| *Lighting:* lighting fixtures, not dazzling, placed in such a way as to guarantee the distinction of faces at 10-15 m of distance, without creating shaded areas. Shop lighting active at night. | *Public transport:* shelters of the stops placed in front of the two lines. |
| *Construction type:* prefer low types (isolated houses, terraced houses) or houses in line. Avoid buildings with long galleries. | *Roads:* materials and elements that discourage high speed. |
| *Ground floor:* adaptable, varying the floor level, both residential (+1.00 m) and commercial (+0.00 m). | *Routes and public/private areas:* diversity of material, finishes, eventual difference in height or symbolic indication. |
| *Exterior elements of buildings:* downpipes incorporated into the wall at 3 m from the ground and located away from balconies and windows. No recesses and protrusions on the ground floors. | *Materials and street furniture:* resistant. Furniture used to outline spaces and paths. |
| *Technical areas buildings and garbage bins:* placed in non-marginal points and where maintenance is easy. | *Finishes:* light colors for enclosed spaces such as underpasses, pedestrian tunnels. |
| *Porticades and retraction facades:* on the ground floor façade flush with the street. | *Pedestrian routes:* minimum width sufficient to guarantee the movement of more people and disabled people in both directions. |
| *Building height:* max 4 floors. | *Signage.* |

La necessità di un'azione sistematica sul territorio ha imposto la definizione di specifiche azioni da introdurre negli *strumenti urbanistici locali* al fine di adeguare, nel tempo, gli spazi urbani a criteri di sicurezza modificandone la vulnerabilità.

The need for a systematic action on the territory has made it necessary to define specific actions to be introduced in *local urban planning tools* in order to adapt, over time, urban spaces to safety criteria, changing the vulnerability conditions.

## 4. Caso studio / Case study

**H**

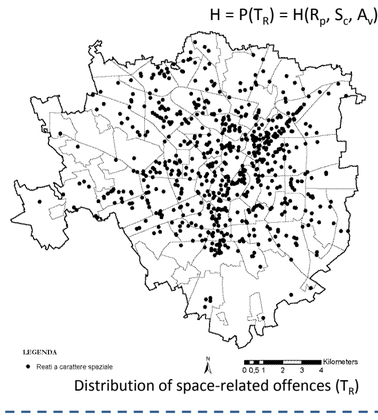
La mappa di pericolosità è stata costruita a partire da dati .xml estratti dalla mappa dei reati di Milano (anno 2011), successivamente *convertiti in* formato .shp. Le informazioni puntuali sono state selezionate, pesate, tradotte in mappa di densità e riclassificate in cinque classi di pericolosità: P1, P2, P3, P4, P5.

The hazard map was built from .xml data extracted by Milan's crime map (year 2011), then converted to .shp format. The precise information was selected, weighed, translated into a density map and reclassified into five hazard classes: H1, H2, H3, H4, H5.

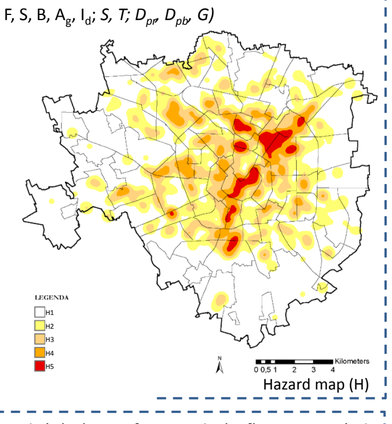
| *Criminal event category* | *Criminal event typology* | *Location and target of the criminal event* |
|---|---|---|
| Predatory crimes ($R_p$) | Robbery (R) | In the street, in store (shops, supermarkets, companies, betting centers, phone centers, etc.), in the subway, in the local, in jewelry stores, in pharmacies, in bars / tobacconists, in banks, in autogrill, in apartments, in hotels, at gas stations and gas stations, in newsstands, other place. |
| | Thefts (F) | Car, motorcycle/motorbike, bicycle, in the street, in the station, in the shop, in the office, in the apartment, in the bank, in the hospital, in the doctor's office, in the hotel, in the museum, in a place of worship, in the building site, in the bar, in another place. |
| | Aggressions (A) | Harassment-rape, stabbing in the street and in the underground, murder in the street, assault on trolleybuses, in restaurants, other place. |
| | Smugglers (S) | In the street. |
| | Pickpocketing (B) | In the street. |
| | Arson ($I_d$) | Car, motorbike, sports centre, newsagent, van, illegal settlement, restaurant, shop, abandoned building, other place. |
| Soft crimes ($S_c$) | Drug dealing ($S_p$) | Public place. |
| | Drug addiction (T) | Public place. |
| Vandalism ($A_v$) | Damage to private property ($D_{pr}$) | Cars. |
| Other | Other | Murders in the apartment, frauds, presence of illegal settlements, illegal occupation of real estate, presence of red light centers, quarrels, fights |

Classification of the types of offences occurred in Milan in 2011

$H = P(T_R) = H(R_p, S_c, A_v) = H(R, F, S, B, A_g, I_d; S, T, D_{pr}, D_{pb}, G)$




Distribution of space-related offences ($T_R$)



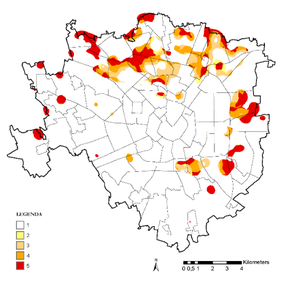

Hazard map (H)

**V**

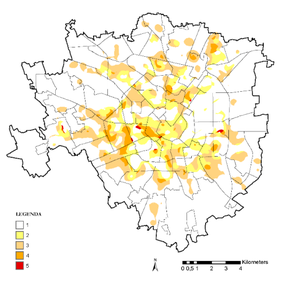
La mappa di vulnerabilità è stata costruita implementando analisi di densità e prossimità su 3 indicatori di base: marginalità (M), mix funzionale (Mf), prossimità di parchi e parcheggi ad aree ed edifici in degrado (P). Ciascuna di tali variabili è, a sua volta, funzione di ulteriori parametri costruiti combinando tra loro, su più livelli, 5 funzioni di base: residenziale (R), commerciale (C), agricola (A), industriale (I) e terziaria (T). La mappa ottenuta è stata interpretata e riclassificata in 5 classi di vulnerabilità: V1, V2, V3, V4, V5.

The vulnerability map was built by implementing density and proximity analyses on 3 basic indicators: marginality (M), functional mix ($M_f$), proximity of parks and car parks to degraded areas and buildings (P). Each of these variables is, in turn, a function of additional parameters built by combining, on several levels, 5 basic functions: residential (R), commercial (C), agricultural (A), industrial (I) and tertiary (T). The resulting map has been interpreted and reclassified into 5 classes of vulnerability: V1, V2, V3, V4, V5.

$V = V(M, M_f, P) = V(R+A, R+I, R+T; R+T+C; A_d+P_i; A_d+P_g)$




Marginality map (M)




Functional mix map ($M_f$)




Proximity map (P)



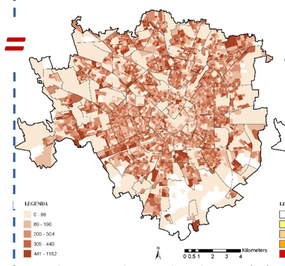

Vulnerability map (V)

**E**

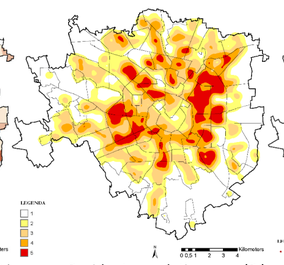
La mappa di esposizione è stata costruita attraverso analisi di densità implementate su 2 indicatori di base: popolazione residente ($P_r$) (dati Istat) e poli attrattori ($P_a$) ottenuti come combinazione di diversi luoghi verso i quali la popolazione tende a convergere.

The exposure map was built through density analyses implemented on 2 basic indicators: resident population ($P_r$) (Istat data) and attracting poles ($P_a$) obtained as a combination of several places towards which the population tends to converge.

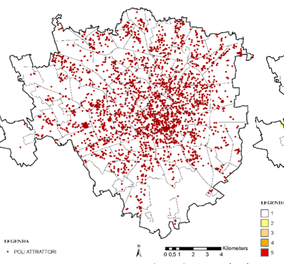
$E = E(P_r, P_a) = E(P_r; L_s, U, O, S_p, S_g, C_{tm}, C_c, S_t, A_i, P_g)$




Resident population distribution ($P_r$)




Resident population map ($P_r$)




Attractors distribution($P_a$)




Attractors map ($P_a$)




Exposure map (E)

**R**

La mappa del rischio urbano è stata costruita attraverso due ulteriori step:
1. Costruzione della mappa del danno (D), ottenuta combinando i fattori vulnerabilità (V) ed esposizione (E).

The urban risk map has been created through two further steps:
1. Construction of the impact map (D), obtained by combining the vulnerability (V) and exposure (E) factors.

**D**

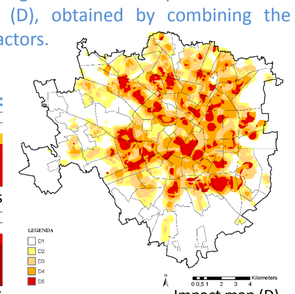
**Matrici del danno / Impact matrixes:**

| *Impact classes* | | Vulnerability classes V1 | V2 | V3 | V4 | V5 |
|---|---|---|---|---|---|---|
| Exposure classes | E1 | 11 | 12 | 13 | 14 | 15 |
| | E2 | 21 | 22 | 23 | 24 | 25 |
| | E3 | 31 | 32 | 33 | 34 | 35 |
| | E4 | 41 | 42 | 43 | 44 | 45 |
| | E5 | 51 | 52 | 53 | 54 | 55 |

Construction of impact classes

| *Impact classes* | | Vulnerability classes V1 | V2 | V3 | V4 | V5 |
|---|---|---|---|---|---|---|
| Exposure classes | E1 | D1 | D2 | D2 | D3 | D4 |
| | E2 | | D2 | | | |
| | E3 | D2 | | D3 | D4 | |
| | E4 | D3 | | D4 | D5 | |
| | E5 | D4 | | | | |

Impact classes




Impact map (D)

2. Combinazione delle variabili danno (D) e pericolosità (P).
La mappa ottenuta è stata riclassificata definendo, attraverso la matrice del rischio, 5 classi di rischio urbano, R1, R2, R3, R4, R5, con intensità crescente da R1 a R5.

2. Combination of impact (D) and hazard (H) variables.
The obtained map has been reclassified by defining, through the risk matrix, 5 classes of urban risk, R1, R2, R3, R4, R5, with increasing intensity from R1 to R5.

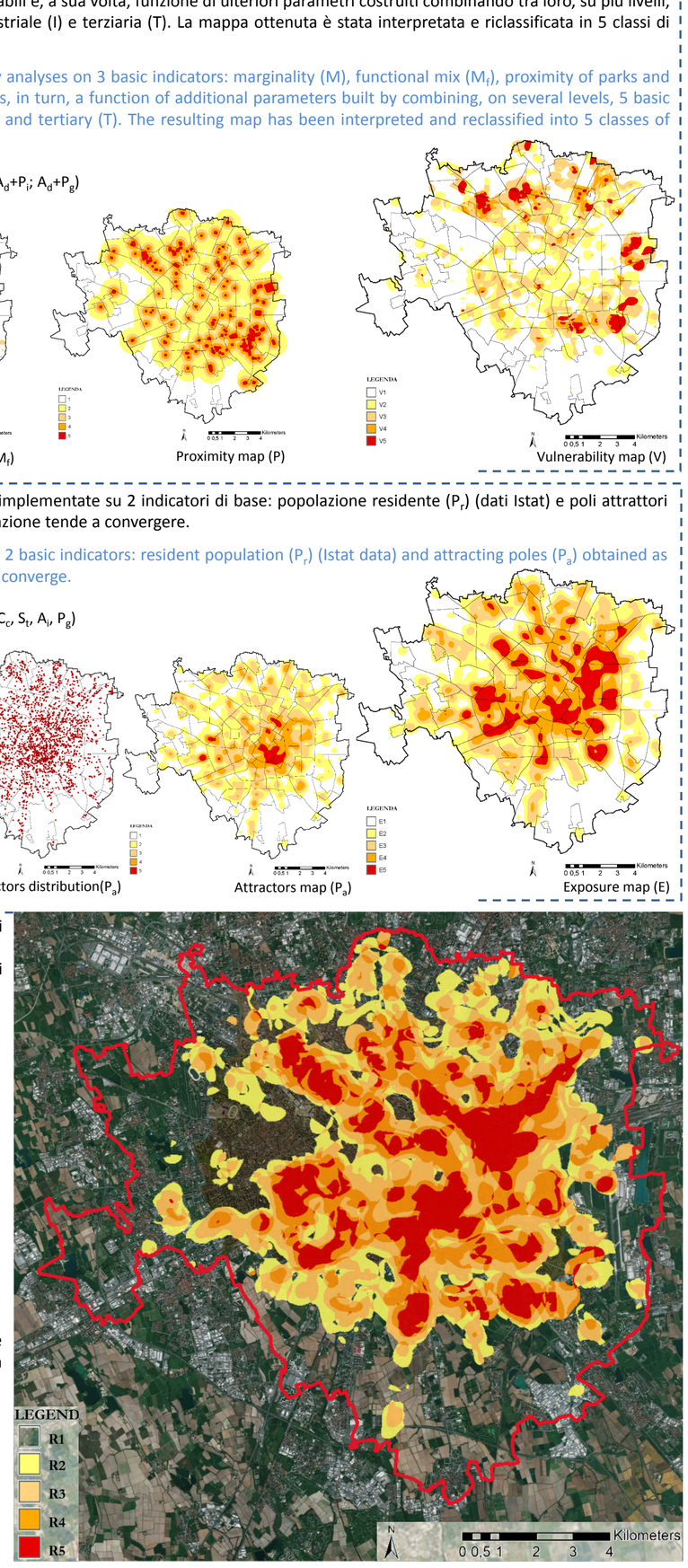
**Matrici del rischio / Risk matrixes:**

| *Risk classes* | | Hazard classes P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|---|
| Damage classes | D1 | R1 | R1 | R2 | R3 | R4 |
| | D2 | R1 | R2 | R3 | R4 | R5 |
| | D3 | R2 | R3 | R3 | R4 | R5 |
| | D4 | R3 | R4 | R4 | R5 | R5 |
| | D5 | R4 | R5 | R5 | R5 | R5 |

Construction of risk classes

| *Risk classes* | | Hazard classes P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|---|
| Damage classes | D1 | R1 | R1 | R2 | R3 | R4 |
| | D2 | R1 | R2 | R3 | R4 | R5 |
| | D3 | R2 | R3 | R3 | R4 | R5 |
| | D4 | R3 | R4 | R4 | R5 | R5 |
| | D5 | R4 | R5 | R5 | R5 | R5 |

Risk classes




**Mappa del Rischio Urbano / Urban Risk map (R)**

## 5. Conclusioni / Conclusions

La traduzione in mappa dell'indicatore di rischio urbano restituisce una fotografia delle condizioni di rischio presenti sul territorio oggetto di studio, evidenziando la presenza e l'estensione superficiale delle zone caratterizzate da criticità, per le quali si rende necessario un intervento. L'inserimento di tale strato informativo tra quelli utilizzati nella definizione degli strumenti urbanistici consentirebbe di effettuare scelte più attente e consapevoli, tenendo conto della sicurezza al pari delle altre esigenze.

The translation of the urban risk indicator in map gives a picture of the risk conditions present in the territory under study, highlighting the presence and superficial extent of critical areas, for which action is necessary. The inclusion of this information layer among those used in the definition of urban planning tools would allow to make more careful and conscious choices, taking into account safety as well as other needs.