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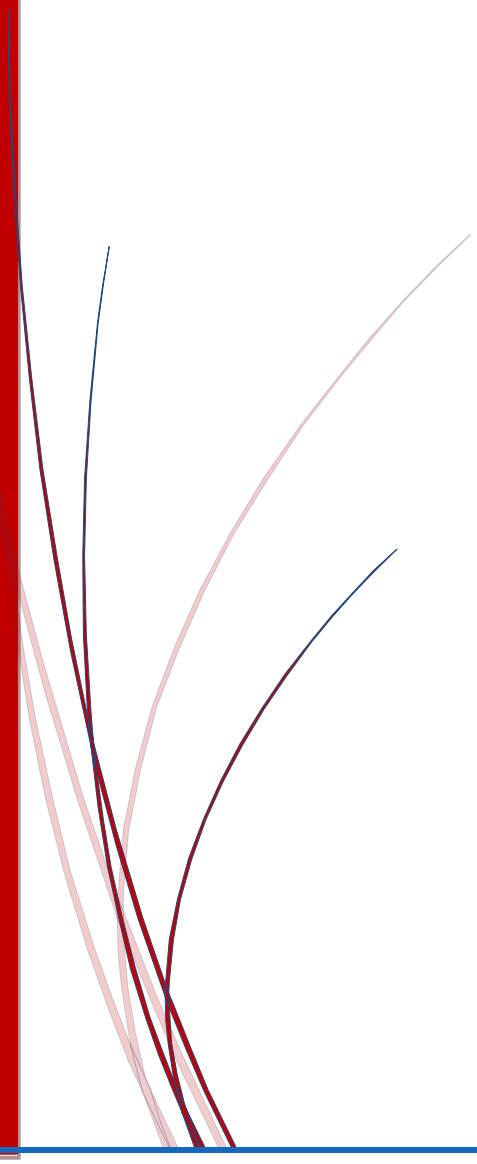
Technical Document Return Project 2025.1



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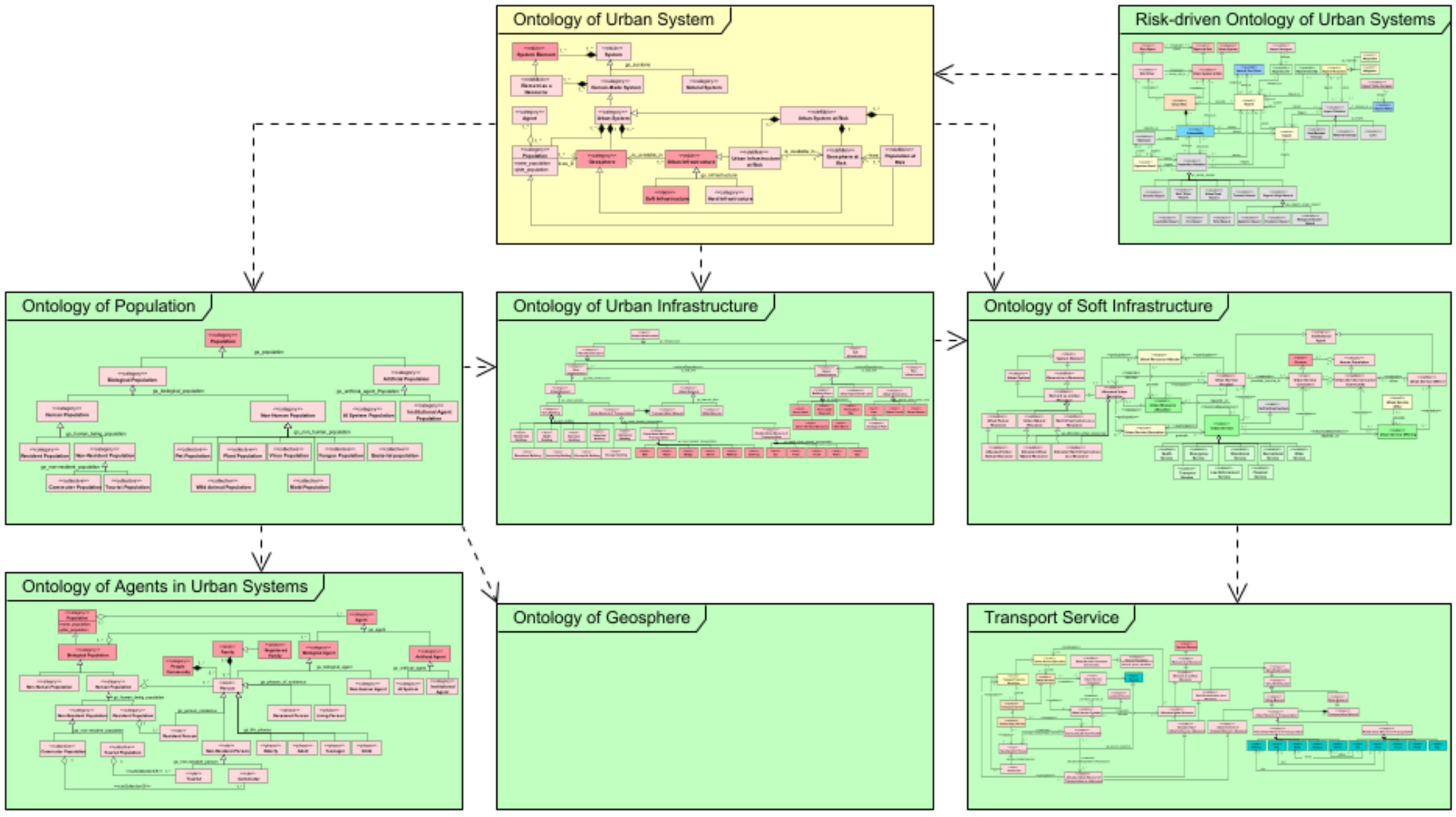
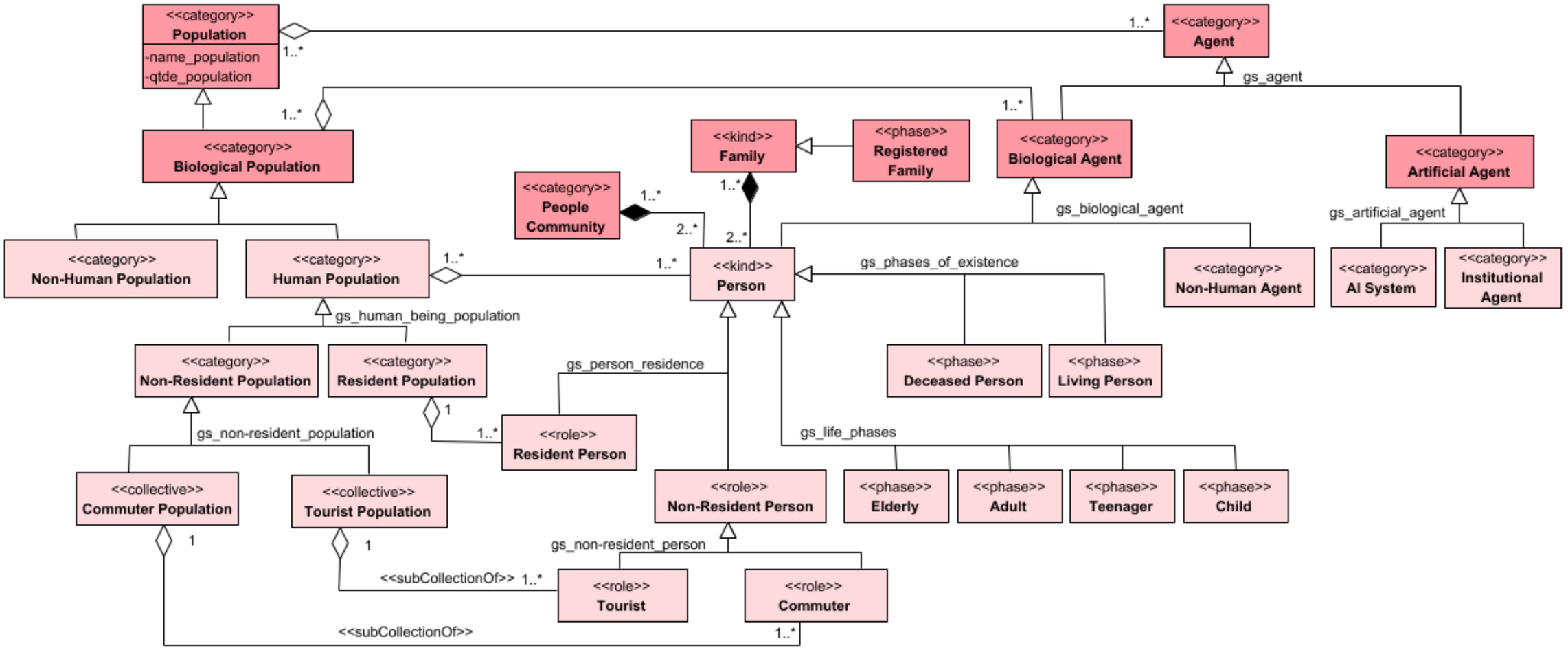
EURAC RESEARCH

Summary

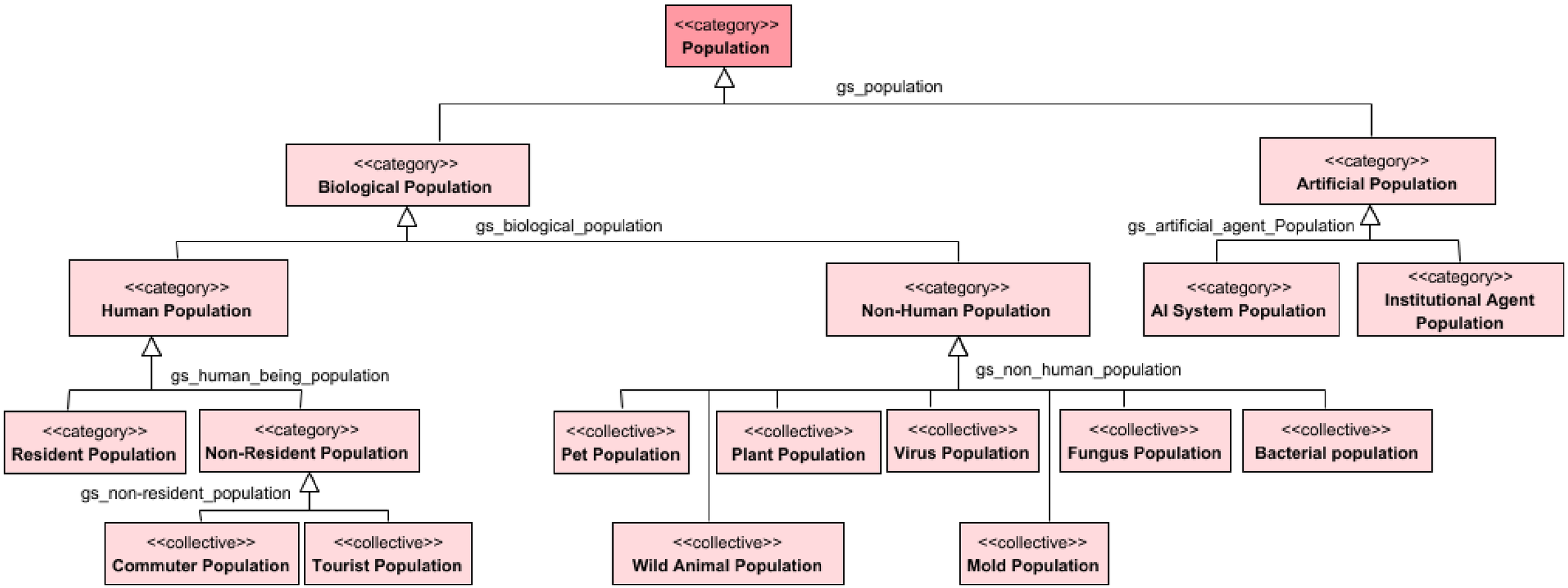
1. Ontologies - Model Preview – Return Project



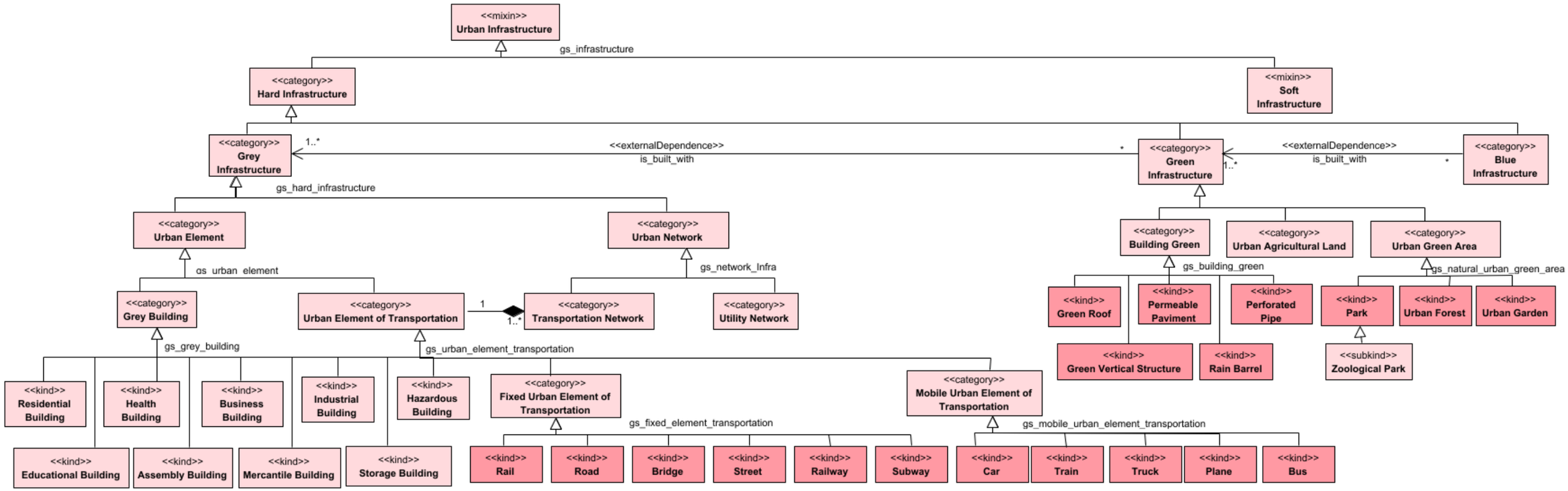
2. Ontology of Agents in Urban Systems



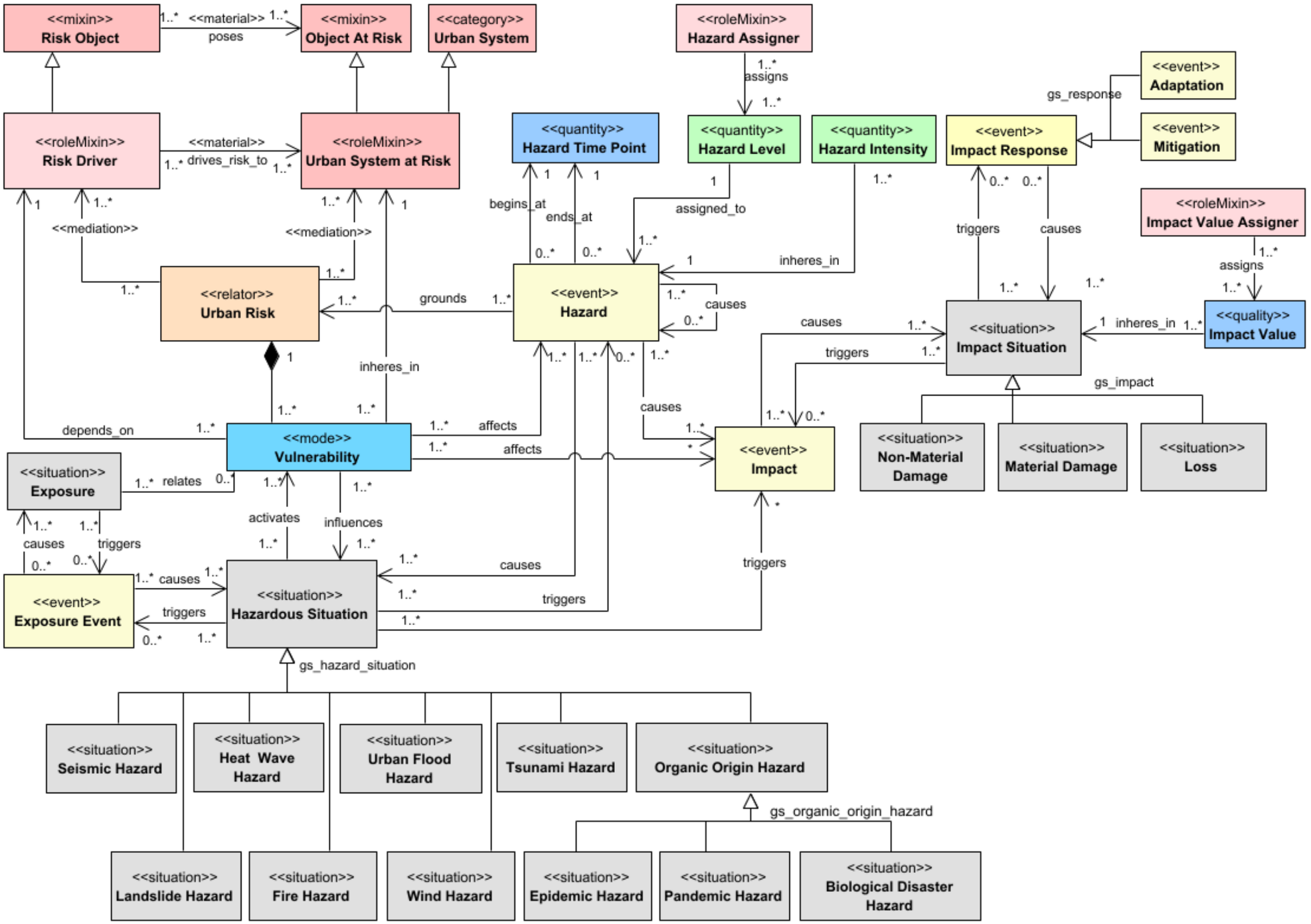
3. Ontology of Population



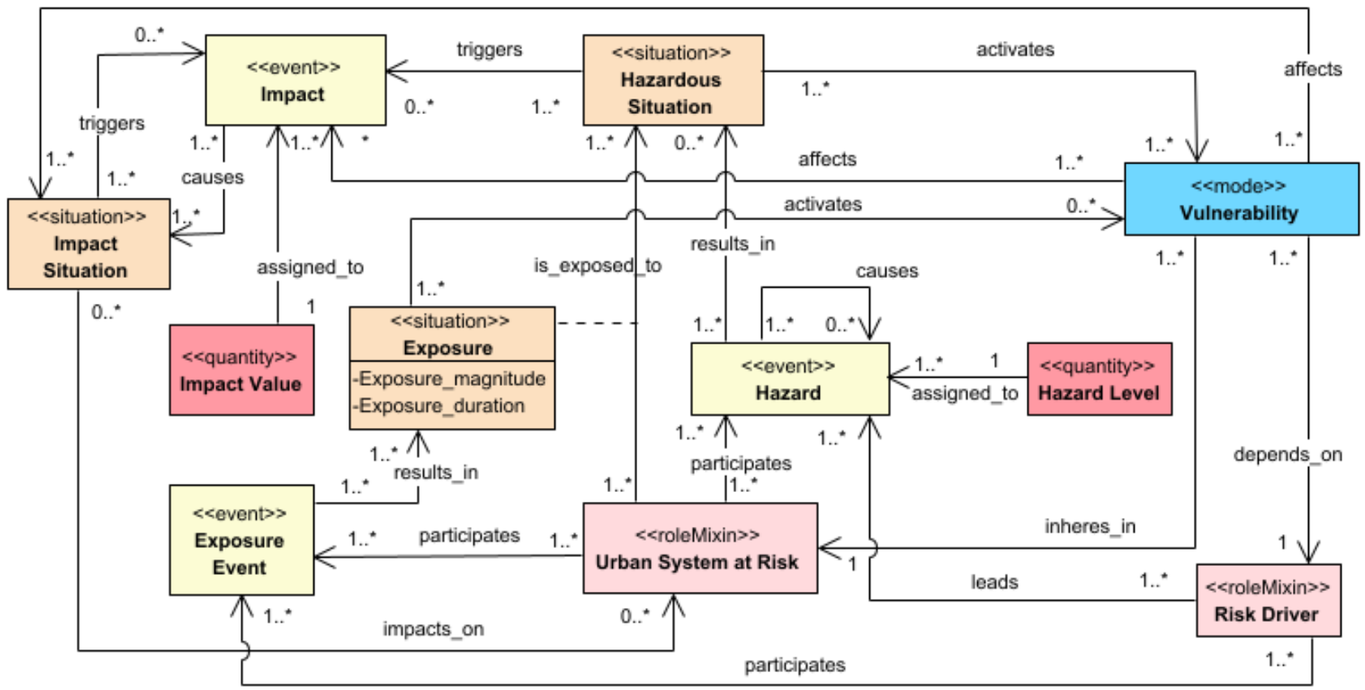
4. Ontology of Urban Infrastructure



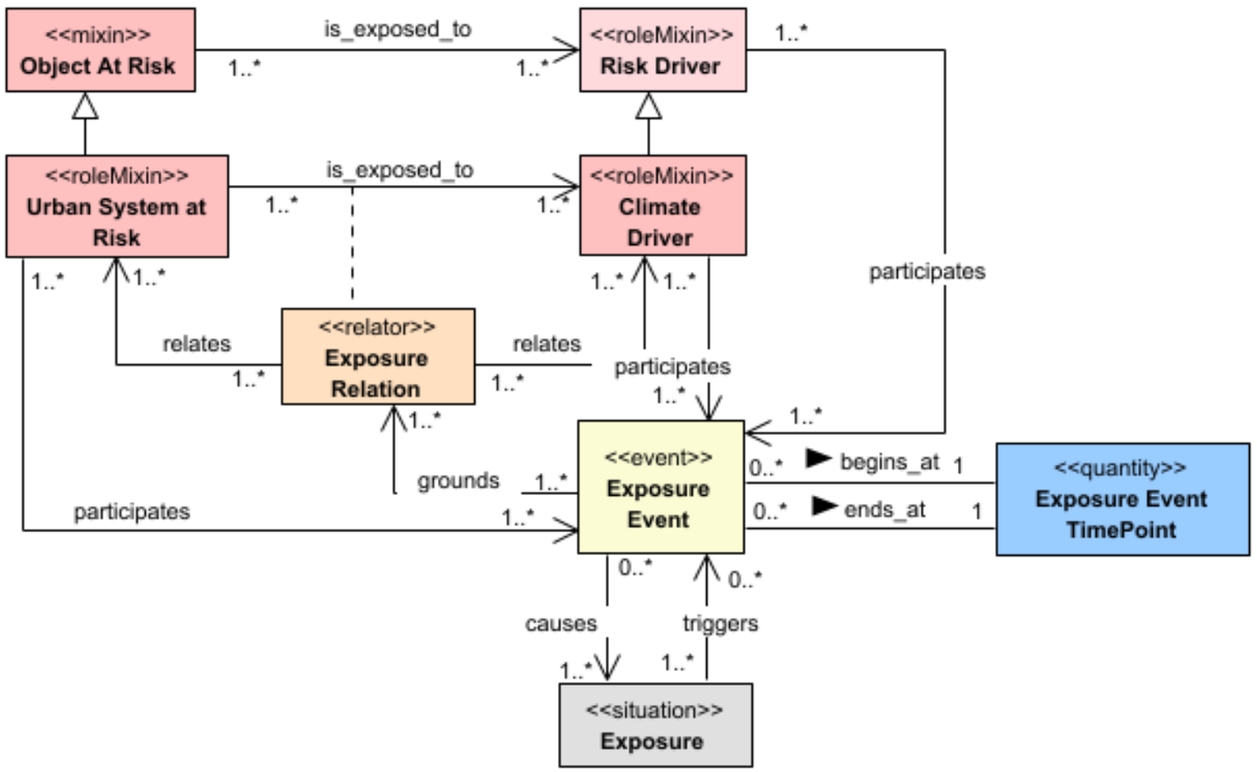
5. Risk-driven Ontology of Urban Systems



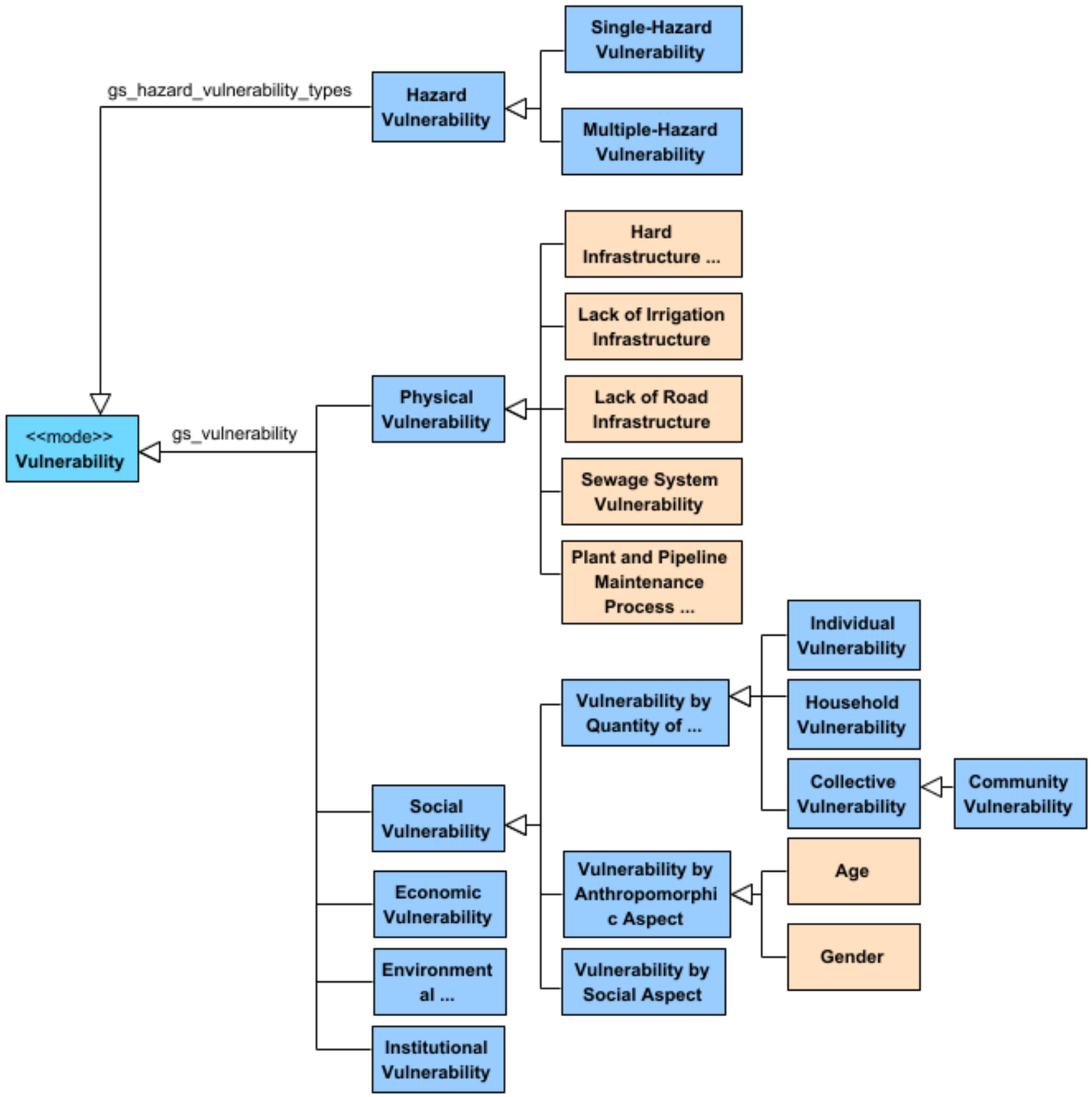
6. Risk-driven Ontology of Urban Systems – Exposure Event



7. Ontology of Exposure

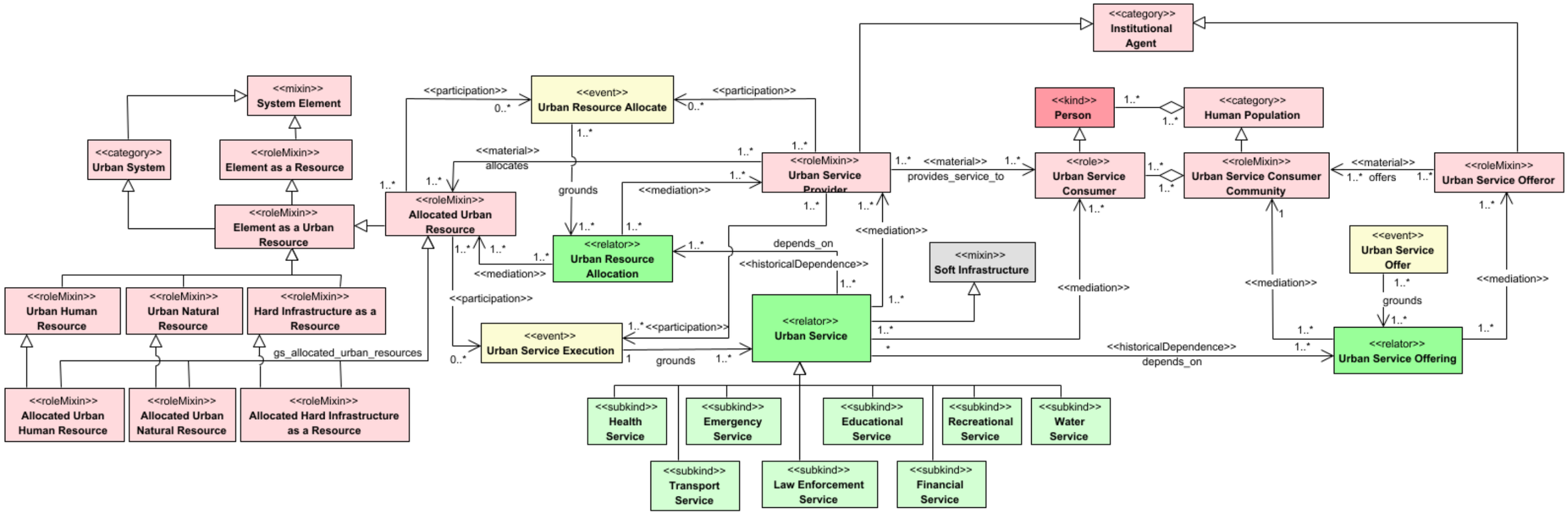


8. Taxonomy of Vulnerabilities

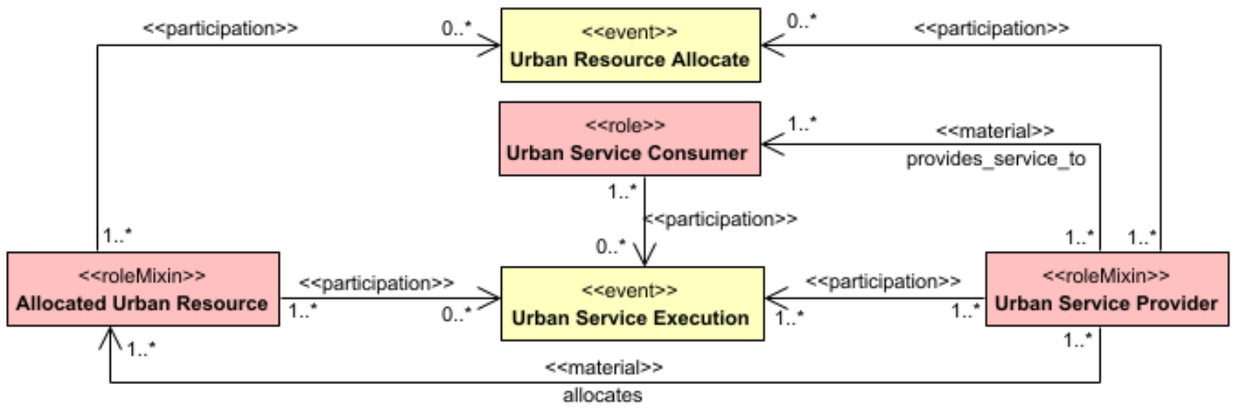


9. Ontology of Soft Infrastructure

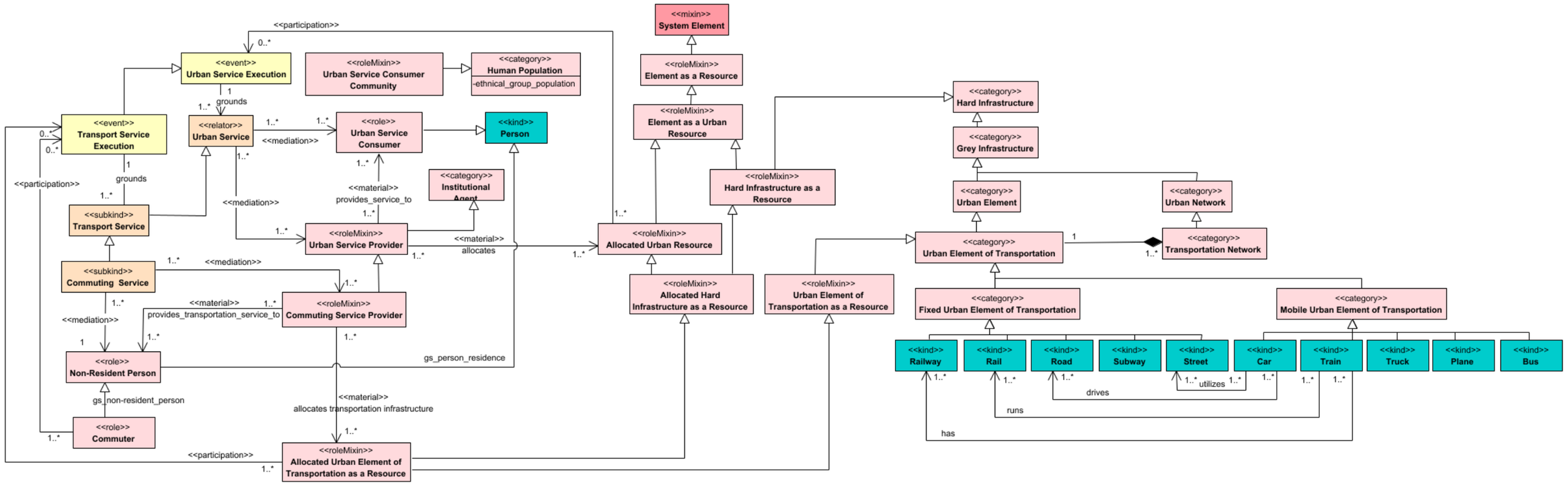
This diagram describes one of the components of Urban Infrastructure called Soft Infrastructure. Soft infrastructures include the set of relevant functions necessary for the ordinary and extraordinary management of the urban system, for instance, health, emergency, law enforcement, mid-term services (e.g., waste management), and long-term services including educational and recreational.



10. Urban Service Execution



11. Transport Service



Glossary

1. Adaptation

[IPCC] Adaptation in in human systems is the process of adjustment to actual or expected risk driver and its effects, in order to moderate harm or exploit beneficial opportunities.

2. Adult

It is a phase or stage of human development that occurs after the stage of adolescence and puberty. There are three distinct stages: early (ages 19 to 45), middle (ages 45 to 60), and late (the later years thereafter).

There is no consensus about the starting age for these three stages of adulthood. The stages used here are extracted at
https://psychologydictionary.org/adulthood/

However, the Italian population statistics by age group are arranged as follows at https://www.statista.com/statistics/789270/population-in-italy-by-age-group/

3. Age

4. Agent

Any agentive *Object*, either physical (e.g. a person, a robot, an oak), or social (e.g. a corporation, an institution, a community).
Defined by: https://w3id.org/italia/onto/l0

5. AI System

'AI system' means a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments.
Source: EU Artificial Intelligence Act. https://artificialintelligenceact.eu/article/3/

6. AI System Population

'AI system' means a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments.

Source: https://artificialintelligenceact.eu/article/3/

7. Allocated Hard Infrastructure as a Resource

It is a hard infrainstructure asset (e.g., bridge, road, street) allocated in a service provided in the context of urban system.

8. Allocated Urban Element of Transportation as a Resource

9. Allocated Urban Human Resource

It is a person or a set of people allocated in a service provided in the context of urban system.

10. Allocated Urban Natural Resource

It is a natural asset (e.g., river, sea, lake, soil, sky) allocated in a service provided in the context of urban system.

11. Allocated Urban Resource

Allocated resources as a Service (RaaS).

12. Artificial Agent

Artificial agent is a broad concept that encompasses both technological agents (AI systems, for example, robots, etc.) and agents socially built to act in social reality (e.g., companies, public entities with legal personality, etc.).

13. Artificial Population

Artificial Population is all populations that do not encompass natural beings (humans or not) and are designed by human beings. For instance, autonomous systems, institutional agents, intelligent artificial agents, etc.

14. Assembly Building

These buildings may include any building or part of a building where a group of people gathers for recreation, amusement, social, religious, or such types of purposes such as theaters, assembly halls, exhibition halls, restaurants, museums, club rooms, auditoria, etc.

15. Biological Agent

A biological agent is a broad category that encompasses all biological agents present or potentially present in an urban system. These agents can have both a component role in the urban system and a risk driver role, actively participating in risk events initiated by hazardous situations.

16. Bacterial population

It is the collective of bacteria of a specified gender and species. A bacterial colony may expand in a geometric or exponential fashion.

17. Biological Disaster Hazard

18. Biological Population

Biological Population is a group of biological organisms living in the same place at the same time.

19. Blue Infrastructure

Blue Infrastructure integrates blue areas, such as lakes, aquifers, wetlands, floodplains, canals, and coastal areas, to the urban context.

20. Bridge

21. Building Green

Building Green or Green Construction encompasses a set of practices and principles that aim to make the design and utilization of the built environment as environmentally friendly as possible. These practices minimize the negative impact on the natural environment.

22. Bus

23. Business Building

It is any building type or part of a building that is used for business transactions, keeping records of accounts, town halls, city halls, courthouses, etc.

24. Car

25. Child

It is a human being between the stages of birth and puberty, or between the developmental period of infancy and puberty. It may also refer to an unborn human being.

For the UNICEF Convention, a child means every human being below the age of eighteen years unless under the law applicable to the child, the majority is attained earlier.

In the context of urban systems, the Child is a phase that a human being goes through. The following subphases are covered: Early childhood (birth to age 5), middle childhood (ages 6 to 12).

26. Climate Driver

27. Collective Vulnerability

28. Community Vulnerability

29. Commuter

A commuter is someone who travels a significant distance each day between home and place of work or study.

30. Commuter Population

It is a collective of people who regularly travel some distance to work or study.

31. Commuting Service

Commuting is periodically recurring travel between a place of residence and place of work or study, where the traveler, referred to as a commuter, leaves the boundary of their home community.

32. Commuting Service Provider

33. Deceased Person

It is the phase in which a person is no longer alive. A person cannot be alive and not alive at the same time. Therefore, it is a disjointed phase from the Alive phase.

34. Economic Vulnerability

35. Educational Building

These buildings include any building used for school, college, or daycare purposes involving assembly for instruction, education, or recreation.

36. Educational Service

It is a service relation between the consumer of educational services and the agent who provides it. For instance, the public educational service provided by a public entity to people in a city.

37. Elderly

"Elderly" is a concept that cannot be absolutely defined, as it has different meanings in different societies and historical periods. The United Nations refers to those aged 60 and over as "older persons", while ISTAT and the Ministry of Health speak of people aged 65 and over.

In 2018, during the National Congress of the Italian Society of Gerontology and Geriatrics (SIGG - Congresso Nazionale della Società Italiana di Gerontologia e Geriatria), an adjustment to 75 years was proposed. Given the increase in average life expectancy at birth (85 for women, 82 for men in Italy), SIGG argues for a distinction among people over 65 between those in the so-called third age (characterized by good health, social integration and access to resources) and those in the fourth age (characterized by dependence on others and physical decline).

In this ontology, the elderly are all people over the age of 65.

38. Element as a Resource

It is everything that is used to satisfy the human needs.

39. Element as a Urban Resource

It is every element that is used to satisfy the human needs in the context of urban systems.

40. Emergency Service

It is a service relation between the consumer of emergency services and the agent who provides it. For instance, the public emergency service provided by a public entity to people in a city.

41. Environmental Vulnerability

42. Epidemic Hazard

43. Exposure

[IPCC] "Exposure is defined as the presence of people; livelihoods; species or ecosystems; environmental functions, services and resources; infrastructure; or economic, social or cultural assets in places and settings that could be adversely affected."
Source: https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Annex-II.pdf

Exposure is a necessary but not sufficient determinant of risk. It is possible to be exposed but not vulnerable. However, to be vulnerable to an extreme event, one must also be exposed.

Source: O.D., M.K. van Aalst, J. Birkmann, M. Fordham, G. McGregor, R. Perez, R.S. Pulwarty, E.L.F. Schipper, and B.T. Sinh, 2012: Determinants of risk: exposure and vulnerability. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation[Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 65-108.

44. Exposure Event

Exposure event is the action of dispose people; livelihoods; species or ecosystems; environmental functions, services and resources; infrastructure; or economic, social or cultural assets in places and settings that could be adversely affected by hazards.

45. Exposure Event TimePoint

46. Exposure Relation

47. Family

1. A human community generally formed by people tied together by a relationship of coexistence, of kinship, of affinity, which constitutes the fundamental element of every society, since it is aimed, in its processes and relations, at the perpetuation of the species through reproduction.

2. A family is the basic unit in society traditionally consisting of two parents rearing their children (“Family.” Merriam-Webster.com Dictionary, Merriam-Webster, https://www.merriam-webster.com/dictionary/family.

3. A group of two or more persons related by birth, blood, marriage, *de facto* union, or adoption who live together.

4. All the descendants of a common ancestor. (Oxford Language)

48. Financial Service

It is a service relation between the consumer of the financial system and the agent who provides it. For instance, the financial system (e.g., banks) provided by a public entity to people in a city.

49. Fire Hazard

50. Fixed Urban Element of Transportation

The physical support of transport modes, where routes (e.g. rail tracks, canals, or highways) and terminals (e.g. ports or airports).

51. Fungus Population

It is a collective of Fungus, which is any of about 144.000 known species of organisms of the kingdom Fungi, including yeasts, mildews, molds, and mushrooms.

52. Gender

53. Geosphere

The geosphere is the collection of physical and geological elements that contribute to shaping the Earth's surface. In the urban environment, the geosphere provides the foundation upon which population and infrastructure develop so that the elements of the geosphere affect them, but the population and infrastructure can also modify the geosphere. For example, urban development and even risk mitigation often involve excavations that interact with and often modify the underlying geology. Therefore, urban development requires an understanding of the local geology, such as soil stability, groundwater conditions, and subsurface characteristics. The geosphere includes the following elements: subsurface, soil, topography, resources, and hydrology.

54. Geosphere at Risk

55. Green Infrastructure

It is a fusion of natural resources and man-made structures (grey infrastructure) designed to work with the nature to provide social, environmental, and economic benefits to urban populations, such as air filtration, temperature regulation, noise reduction, flood control, and recreational areas.

56. Green Roof

57. Green Vertical Structure

58. Grey Building

A Grey Building is one built with a traditional structure with walls and a roof standing more or less permanently in one place. For example a house or factory. *Buildings* serve several societal needs – primarily as shelter, living space, privacy & security, to store materials, workspace, etc. In this model, grey building are classified by its functionality/occupancy (the use of a structure: for housing, for educational, etc.) based on Table 6 of GEM Building Taxonomy combined with the building taxonomy proposed in NBC 2005.

In additional, Grey Building is classified by its structure based on GEM Building Taxonomy, following 13 attributes have been included in the GEM Building Taxonomy Version 2.0 (v2.0): 1. direction 2. material of the lateral load-resisting system 3. lateral load-resisting system 4. height 5. date of construction or retrofit 6. occupancy 7. building position within a block 8. shape of the building plan 9. structural irregularity 10. exterior walls 11. roof 12. floor 13. foundation system.

Source:

https://cloud-storage.globalquakemodel.org/public/wix-new-website/pdf-collections-wix/publications/GEM%20Building%20Taxonomy%20Version%202.0.pdf

https://dailycivil.com/types-of-buildings/

59. Grey Infrastructure

It is a category of all tangible/physical elements that are (mostly) of atrophic origin (that is, artificial), in other words, engineered assets that provide one or multiple services required by society. This is in turn preliminary subdivided into Urban Elements (e.g., buildings, bridges, rails, roads, streets, and public spaces) and Urban Networks (a composition of these urban elements).

60. Hard Infrastructure

It is the built environment, the physical connections between places that move people, materials, information, and energy. These "fixed" things include roads, railroads, pipes, buildings, cables, and the networks composed of these constructions. Moreover, encompasses the green infrastructure, which is a category of ecological-oriented designed structures, i.e., a combination of grey and green infrastructures; and the Blue Infrastructure defined as the blue areas, a mix of natural resources (rivers, sea, beaches, etc) and human-designed elements.

61. Hard Infrastructure as a Resource

It is the tangible infrastructure, i.e. the physical infrastructure of roads, bridges, tunnels, railways, ports, etc., that are managed as assets in the context of an urban system.

62. Hard Infrastructure Vulnerability

63. Hazard

It is a quality carried by a hazardous situation. Hazard is a condition or set of circumstances that has the potential to cause or contribute to injury or death" (Sanders and McCormick, 1993, p. 675).

64. Hazard Assigner

An agentive object (Person or Artificial Agent) who assigns a hazard value to a situation.

65. Hazardous Building

These types of buildings include any building which is used for storage, handling, manufacturing, or processing of highly combustible explosive materials or products that are liable to burn extremely rapidly, which may produce poisonous fumes.

66. Hazard Intensity

67. Hazard Level

68. Hazard Vulnerability

69. Hazardous Situation

Hazardous situations are circumstances in which people, infrastructures, urban spaces or the environment is/are exposed to one or more harms.

Hazard is a **situation** that contains "a source of energy or physiological factors and behaviors that, if uncontrolled, will lead to harmful/harmful events/occurrences" (Shinar, Gurion, and Flascher, 1991, p. 1095, apud. Grimaldi and Simonds, 1984, p. 236).

Hazard is a condition or set of circumstances that has the potential to cause or contribute to injury or death" (Sanders and McCormick, 1993, p. 675).

70. Health Building

These buildings include any building or part which is used for medical treatment etc. Such as Hospitals, nursing homes, orphanages, sanatoria, jails, prisons, mental hospitals, etc.

71. Hazard Level

72. Hazard Time Point

73. Hazardous Situation

Hazardous situations are circumstances in which people, infrastructures, urban spaces or the environment is/are exposed to one or more harms.

Hazard is a **situation** that contains "a source of energy or physiological factors and behaviors that, if uncontrolled, will lead to harmful/harmful events/occurrences" (Shinar, Gurion, and Flascher, 1991, p. 1095, apud. Grimaldi and Simonds, 1984, p. 236).

Hazard is a condition or set of circumstances that has the potential to cause or contribute to injury or death" (Sanders and McCormick, 1993, p. 675).

74. Health Service

It is a service relation between the consumer of health services and the agent who provides it. For instance, the public health service provided by a public entity to people in a city.

75. Heat Wave Hazard

76. Household Vulnerability

77. Human-Made System

A system designed by human beings.

78. Human Population

It is a subtype of the *Biological Population* collective, covering the subtypes of resident, non-resident populations in a given space and at the same time.

79. Individual Vulnerability

80. Institutional Agent

A juridical person is a legal person who is not a natural person but an organization recognized by law as a fictitious person such as a corporation, government agency, non-governmental organization, or international organization (such as the European Union).

Juristic Person. An entity, such as a corporation, that is recognized as having legal personality, i.e. it is capable of enjoying and being subject to legal rights and duties. It is contrasted with a human being, who is referred to as a natural person.
Source: https://www.oxfordreference.com/display/10.1093/oi/authority.20110803100027393

81. Institutional Vulnerability

82. Impact

Impacts are events that result in situations of impacts on urban systems. It is a type of one or more resulting events from realized risks. In the context of climate change, the consequences of realized risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather/climate events), exposure, and vulnerability.

83. Impact Analysis

84. Impact Response

Impact response in an urban context involves a two-pronged approach: mitigation of the impacts on urban systems and adaptation of urban systems to non-controlled situations.

85. Impact Situation

Impacts generally refer to effects on lives, livelihoods, health and well-being, ecosystems and species, economic, social, and cultural assets, services (including ecosystem services), and infrastructure. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial. In the model, only the type of adverse impact.

Impacts are also defined as the quantification of the overall potential damage and losses that a reference event may generate in the same area and in a set timeframe.

Effects on natural and human systems. In this report, the term 'impacts' is used to refer to the effects on natural and human systems of physical events, of disasters, and of climate change.

Source: https://archive.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf

86. Impact Value

It is the value given to the impact caused by the risk event that has occurred or is estimated. The level of impact is directly proportional to the damage and losses that have occurred or could occur as a result of the event.

87. Impact Value Assigner

An agentive object (Person or Artificial Agent) who assigns a impact value to a situation of risk event impact.

88. Industrial Building

These types of building are mainly used for manufacturing purposes. Here products or materials of all kinds and properties are fabricated, assembled, or processed, for example, gas plants, refineries, mills, dairies, etc.

89. Institutional Agent

A juridical person is a legal person who is not a natural person but an organization recognized by law as a fictitious person such as a corporation, government agency, non-governmental organization, or international organization (such as the European Union).

Juristic Person. An entity, such as a corporation, that is recognized as having legal personality, i.e. it is capable of enjoying and being subject to legal rights and duties. It is contrasted with a human being, who is referred to as a natural person.
Source: https://www.oxfordreference.com/display/10.1093/oi/authority.20110803100027393

90. Institutional Agent Population

It is a collection of fictitious persons that exist in the legal system, which are entities such as corporations, firms (business entities), and some government agencies. They are treated in law as if they were persons, i.e. they can do the things that a human person can normally do in law - such as make contracts, sue and be sued, own property, and so on. There are no natural persons (human beings) in this category.

91. Lack of Irrigation Infrastructure

92. Lack of Road Infrastructure

93. Landslide Hazard

94. Law Enforcement Service

It is a service relation between the consumer of law enforcement services and the agent who provides it. For instance, the legal system (courts, mediation courts, policy, etc) provided by a public entity to people in a city.

95. Living Person

It is a phase or stage of being alive, as opposed to being dead, during which your organs work and carry out their functions.

96. Loss

Loss (resulting from being deprived of something) is a measure (quantified or not) of the damage or destruction caused by a disaster. This includes the loss of human life in dangerous events.

97. Material Damage

Material damage, also known as property damage, is damage to a person's assets or urban system`s assets, i.e. the loss of goods or things that have economic value. Material damages include losses actually suffered (emergent damages), as well as amounts that the person has failed to receive (lost profits).

98. Mercantile Building

These shall include buildings used for soap, markets, stores, wholesale or retail.

99. Mitigation

Mitigation is defined as the implementation of actions or activities that are designed to limit the adverse impacts caused by hazardous events and urban risks that have already occurred.

100. Mobile Urban Element of Transportation

Mobile element of transportation or modes represent the conveyances, mostly taking the form of vehicles used to support the mobility of passengers or freight. Some modes are designed to carry only passengers or freight, while others can carry both.

See https://transportgeography.org/contents/chapter1/what-is-transport-geography/core-components-transportation/

101. Mold Population

It is the collective of mold, a subtype of fungus that grown indoor.

102. Multiple-Hazard Vulnerability

103. Natural System

It is a set of elements that arise naturally, without human construction.

104. Non-Human Agent

It is every non-human being with agentive capacity to influence an urban system. This category is classified as Pet, Plant, Wild Animal, Fungus, MGE, Virus, Mold, and Bacteria.

1) Pet is any domesticated or tamed animal that is kept as a companion and cared for affectionately.

2) Wild animal in a urban system is any non-domesticated animal that has adapted its lifestyle to living in the cities or in suburban neighborhoods.

3) A plant is a living and natural organism of the kind exemplified by trees, shrubs, herbs, grasses, ferns, and mosses, typically growing in a permanent site, absorbing water and inorganic substances through its roots, and synthesizing nutrients in its leaves by photosynthesis using the green pigment chlorophyll.

4) Mobile genetic element (MGE), also known as transposable element (TE), is a type of moving genetic material that can either move around within a genome or jump across different genomes.

5) Viruses may have arisen from mobile genetic elements that gained the ability to move between cells. They may be descendants of previously free-living organisms that adapted a parasitic replication strategy. Viruses can leave the cell and move to other cells and organisms; mobile genetic elements generally just move around the genome within a cell.

6) Fungus is any member of a kingdom of organisms called Fungi that lack chlorophyll, leaves, true stems, and roots, reproduce by spores, and live as saprotrophs or parasites. The group includes moulds, mildews, rusts, yeasts, and mushrooms.

7) A mold is a microscopic fungus that grows and lives on plant or animal matter or on non-organic objects. Most molds are made up of filaments and reproduce through the production of spores. Spores spread by air, water, or insects. There are many thousands of species of fungi. Mold is the colloquial term used for indoor fungi. Fungal spores occur naturally outdoors easily be transferred inside well they can sit on surfaces. Mold organisms are extremely resilient and have evolved to adapt to survive in sub-optimal conditions. Types of indoor mold differ according to geographical location.

105. Non-Human Population

Non-Human Being Population is all populations that do not encompass human beings but it is natural. It is subcategorized as: 2.1) Pet Population, 2.2) Wild Animal Population, 2.3) Plant Population, 2.4) Mobile Genetic Element Population (MGE), 2.5) Fungus Population, 2.6) Protist Population, and 2.7) Bacteria Population.

There is a subtype of MGE, which is the Virus Population. Also, there is a subtype of Protist Population, which is Mold Population.

106. Non-Material Damage

Decreased integrity, size, efficiency (function), or conditions that are not considered beneficial by a community as a result of an adverse event. Depending on the application, damage can be measured in different ways, using metrics appropriate for each type of risk analysis. In particular, non-physical damage affects the social life of an urban system. This type of damage is understood as a measure of social disruption, in terms of deterioration of social relations and functions, that a natural or anthropogenic event causes to a community in the short to medium term (i.e. homelessness) or psychological symptoms in a part of the population, such as anxiety, panic syndrome, correlated with the possibility of new occurrence of the risk events.

107. Non-Resident Person

It is a role played by persons who are not registered in the Register of Residents in a given municipality at a given time. It can be a tourist or a person who temporarily lives in a certain place without having the rights and duties of residents.

108. Non-Resident Population

It is the collective of individuals who are not registered with the Registry of the Resident Population in a given municipality in a given time.
It can be a tourist or a person who is temporally living in a particular place without the duties and rights of the residents.

109. Object At Risk

An object at risk is any agentive or non-agentive object that is exposed to a hazardous situation or is vulnerable to certain hazardous situations.

110. Organic Origin Hazard

111. Pandemic Hazard

112. Park

113. People Community

A group of people with diverse characteristics who are linked by social ties, share common perspectives and engage in joint action in geographical locations or settings. Community can be defined by a sense of identification with and emotional connection to others through common symbol systems, values, and norms; shared interests; and commitments to meeting mutual needs.

Source:https://www.evms.edu/education/resources/community-engaged_learning/glossary_of_terms/

114. Perforated Pipe

115. Permeable Pavement

116. Person

It is every human being with the capacity to influence and act on an urban system.

117. Pet Population

It is a collection of any domesticated or tamed animal that is kept as a companion and cared for affectionately.

118. Physical Vulnerability

119. Plane

120. Plant and Pipeline Maintenance Process Vulnerability

121. Plant Population

It is the collection of plants per unit area of land. Plant populations are characterized by their size (or density) and their structure (the number of individuals of different ages and sizes).

122. Population

It is a collection of *Agents (*biological or artificial) of the same taxonomic class, counted or sampled at a given location or area, given a time interval.

123. Population at Risk

It is a collection of *Agents (*biological or artificial) of the same taxonomic class, counted or sampled at a given location or area, given a time interval that is at risk.

124. Rail

125. Railway

126. Rain Barrel

127. Recreational Service

It is a service relation between the consumer of recreational services and the agent who provides it. For instance, the public recreational service provided by a public entity to people in a city.

128. Registered Family

It is a group of people tied together by relationships of marriage, kinship, affinity, adoption, protection or affection.

Constraint: The members must live and be habitually resident in the same municipality (Article 4 of Italian Presidential Decree 30/05/1989, n. 223)

129. Resident Person

It is a person who is enlisted with the Resident Population Registry in a particular local authority area in a given time. The classification of a Resident Person as a <<role>> derives from residency being an incidental characteristic of a human being.

130. Resident Population

It refers to the collective of people enlisted with the Resident Population Registry in a particular local authority area in a given time. The classification of a Resident Person as a <<role>> derives from residency being an incidental characteristic of a human being.

131. Residential Building

A building should be considered a residential building when more than half of the floor area is employed for dwelling purposes. Other buildings should be considered non-residential.
A residential building is one that is designed and accordingly built for inhabitants to measure in and call House. Inhabitants can either be a family, single, a couple, roommates or may be in a group. A residential building has basically:

- - A sleeping room(bedroom)/space,
- - A living room/space,
- - Conveniences (as in toilet and bath),
- - Cooking room/area (kitchen).
-

All of those functions can either be in shared rooms or spaces or have exclusive rooms per function. These types of buildings include one or two private dwellings, apartment houses (flats), bungalows, duplexes, storey houses, terrace buildings, apartment buildings, condominium buildings, hotels, dormitories, semi-detached buildings, etc.
Source: https://dailycivil.com/types-of-buildings/

132. Risk Driver

1. [IPCC] Any natural or human-induced factor that directly or indirectly causes a change in a system (adapted from MA, 2005).

2. It encompasses both natural and human-induced factors, processes, or conditions that result in a direct or indirect alteration of a system.

Available at: https://civil-protection-knowledge-network.europa.eu/eu-overview-risks

133. Risk Object

The Risk Object is considered, under certain contingent circumstances and in some causal way, to pose a threat to the valued object at risk.
Source: Åsa Boholm & Hervé Corvellec, 2011. "A relational theory of risk," Journal of Risk Research, Taylor & Francis Journals, vol. 14(2), pages 175-190, February.

In risk-oriented urban systems, a risk object is specialized as a Risk Driver.

134. Road

135. Seismic Hazard

136. Sewage System Vulnerability

137. Single-Hazard Vulnerability

138. Social Vulnerability

139. Soft Infrastructure

Soft infrastructure refers to the intangible things needed to maintain or improve the utilities and services such as financial, health, cultural, and social in an urban system. The **population** uses the infrastructure of an urban system through services offered by public or private agents.

140. Storage Building

These buildings are generally used for the storage or sheltering of goods, wares, or merchandise like warehouses, cold storages, garages, stables, transit sheds, etc.

141. System

A set of things working together as parts of a mechanism or an interconnecting network; a complex whole.

In Return Project, in the ontological model, a system is categorized as 1) made by humans (artificial systems) and 2) a natural system, which is a set of elements that arise naturally, without human construction. Both types of systems are coupled, that is, human systems interact with natural systems and vice versa in multi-levels and aspects.

There are several kinds of human-made systems (e.g., urban systems, economic systems, judicial systems) and natural systems. An urban system is a human-made system placed in a specific space and exists at a specific

time. It is composed of essential parts, which are Resource and Population. A Resource is an essential part of one or more urban systems, for instance, a river can be a resource for different countries, and different cities. The resource is subcategorized as Urban Infrastructure and Agent as a Resource.

142. System Element

According to standard ISO/IEC 15288:2015, a *system element* is a discrete part of a system. A system element can be hardware, software, data, humans, processes, procedures (e.g., operator instructions), facilities, materials, and naturally occurring entities (e.g., water, organisms, minerals), or any combination.

143. Street

144. Subway

145. Teenager

It is the last phase of the childhood that a human being goes through (13 to 18 years).

146. Tourist

It is a role played by a person who is traveling or visiting a place for pleasure or interest.

147. Tourist Population

It is a collective of people who is traveling or visiting a place for pleasure or interesting.

148. Train

149. Transport Service

It is a service relation between the consumer of transport services and the agent who provides it. For instance, the public transport service provided by a public entity to people in a city.

150. Transportation Network

Transportation Network is a conglomerate of heterogeneous urban elements, such as roads, streets, paths, railways, bridges, etc., used for the mobility or transportation of goods and people.

151. Truck

152. Tsunami Hazard

153. Urban Agricultural Land

It refers to the land within the urban development boundary designated for small-scale farming activities and growing crops for personal use or sale in surrounding markets. This encompasses vertical production, warehouse farms, community gardens, rooftop farms, hydroponics, aeroponic, and aquaponic facilities, as well as other innovative techniques.

154. Urban Element

It is a category of constructed items encompassing buildings, bridges, roads, footpaths, streets, rails, and other related infrastructures.

155. Urban Element of Transportation

Consists of urban elements that are used for transportation of people and goods, including fixed infrastructure (e.g. bridges, roads, highways) and mobile element of transportation (e.g., cars, trains, plains, etc).

156. Urban Flood Hazard

157. Urban Forest

158. Urban Garden

159. Urban Green Area

Urban green space refers to open areas reserved for parks and natural environments - encompassing plant life. The landscape of urban open spaces typically ranges from playing fields and highly maintained environments to more natural landscapes. It links ecological processes and functions and encompasses forests, roadside trees, park trees, garden trees, and nature conservation areas.
In the context of urban land-use growth and its impact on the environment, green spaces offer ecosystem services to promote human health. Green spaces such as parks, public gardens, and roadside trees are vital components of urban planning.

Available at: https://doi.org/10.3390/land10020105

160. Urban Human Resource

Urban human resources is the set of people who make up the workforce of an urban system.

161. Urban Infrastructure

Urban infrastructure is a mix of structures built horizontally or vertically by humans, which provide a variety of utilities and services such as housing, transportation, and leisure. The design of these structures serves to ensure accessibility and convenience to meet the needs of the urban dwellers.

162. Urban Infrastructure at Risk

Urban infrastructure is a mix of structures built horizontally or vertically by humans at risk.

163. Urban Natural Resource

Urban natural resource is a set of any biological, mineral, or aesthetic asset afforded by nature without human intervention that can be used for some form of benefit, whether material (economic) or immaterial. What is considered a “resource” (or, for that matter, “natural”) has varied over time and from one society to another. Examples of assets that can be considered natural resources include forests, surface water and groundwater, and the fertile lands or the soil and minerals within them (rather than the crops that grow on them), as well as energy resources (such as petroleum, natural gas, and heated water [that is, geothermal energy]) contained within layers of rock.

Source: https://www.britannica.com/science/natural-resource

164. Urban Network

It is an ordered composition of heterogeneous urban structures, arranged according to their application in an urban system, e.g., a transportation network.

165. Urban Resource Allocate

It is an event that allocates resources (human, natural or hard infrastructure resources) to provide a service in the context of an urban system. In this event participates an agent playing the role of Urban Service Provider as well as the resource to be allocated. This event creates the historical foundational of a relationship called Urban Resource Allocation between the allocated urban resource and the Urban Service Provider.

166. Urban Resource Allocation

It is the (reified) relationship between the Allocated Urban Resource and Urban Service Provider grounded by the Urban Resource Allocate event.

167. Urban Risk

It is a relational structure that links Risk Drivers and Urban Systems at Risk.

In the case of urban systems, risks are assessed based on two different types of phenomena: 1) natural phenomena; and 2) man-made phenomena. Natural phenomena are events that do not have a human cause; examples include earthquakes, tsunamis, and solar storms. Conversely, human phenomena are events caused by human action. For example, pollution, urbanization, extensive monoculture, and deforestation.
[IPCC] Risk is defined by IPCC v.6 as the potential for adverse consequences for human or ecological systems, recognizing the diversity of values and objectives associated with such systems.

In the context of climate change, risks can arise from potential impacts of climate change as well as human responses to climate change. Relevant adverse consequences include those on lives, livelihoods, health and well-being, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species.

In the context of climate change impacts, risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards. Hazards, exposure and vulnerability may each be subject to uncertainty in terms of magnitude and likelihood of occurrence, and each may change over time and space due to socio-economic changes and human decision-making (see also risk management, adaptation and mitigation).

In the context of climate change responses, risks result from the potential for such responses not achieving the intended objective(s), or from potential trade-offs with, or negative side-effects on, other societal objectives, such as the Sustainable Development Goals (SDGs) (see also risk trade-off). Risks can arise, for example, from uncertainty in implementation, effectiveness or outcomes of climate policy, climate-related investments, technology development or adoption, and system transitions.

Source: https://www.ipcc.ch/site/assets/uploads/2021/02/Risk-guidance-FINAL_15Feb2021.pdf

168. Urban Service

It represents all services provided by a municipality, either directly or by contract, to any of its current residents. For example: sanitation, water, fire protection, parks, open space, recreation, and streets, roads, and mass transit. The Return Project views urban services as a relationship between the service consumer and the service provider in urban systems. This relation is usually formalized in a document (Normative Description) called Service Contract

169. Urban Service Consumer

In general, a service consumer can be anything from a system, to an application, to an artificial agent, to a person. A service consumer is a user of products and services provided by a service provider, which can be either

a company or a person. In the domain represented by urban systems, we restrict the definition of service consumer to people and service provider to companies (Juridical Person). Between a service consumer and a service provider, a contract is signed and establishes a bind (a service contract) based on legal rules for the consumption of services.

170. Urban Service Consumer Community

It is a group of people connected by their shared interest in a service provided in a urban system.

171. Urban Service Execution

It is an event that executes a service in the context of urban system (health, transport, education). In this event participates one or more allocated urban resources and an agent (Juridical Person), playing the role of Urban Service Provider. This event creates the historical foundational of a relationship called Urban Service between the allocated urban resource and the Urban Service Provider.

172. Urban Service Offering

It represents the relation between Urban Service Consumer Community and Urban Service Offeror. This relation is usually presented through oral or written publicity that binds the Service Offeror.

173. Urban Service Offeror

It is a role plays by a Juridical Person in a relationship with the Urban Service Consumer Community. In this relation, Juridical Person offers a set of urban services for a group of people in an urban system.

174. Urban Service Provider

It is a role play by a Juridical Person who is active in service relationships with Urban Resources or Urban Service Consumer/Community. In this role, a Service Provider has the scope to offer, provide, and run urban services such as health, transportation, etc.

175. Urban System

An Urban System is a human-made system placed in a specific space and time. It is composed of essential parts, which are *Infrastructure, Geosphere*, and *Population*. Population is a collective of agents who live or use the urban space and the tangible Infrastructure (hard infrastructure) through services (soft infrastructure). In turn, the Urban Space (Geosphere) is the territory, the place where the population (resident or non-resident) lives or uses the soil as well as where the infrastructure is located.

176. Urban System at Risk

An urban system is a set of interconnected parts (population, urban space, and infrastructure). An urban system at risk has one or more parts vulnerable or exposed to certain risk drivers in certain situations.

177. Utility Network

It is a system of engineered hydrologic and hydraulic components that provide water supply for an urban system.

178. Virus Population

It is a collective of a kind of virus. It is possible that viruses originated from mobile genetic elements that acquired intercellular migration capabilities. They could be descendants of formerly free-living organisms that adopted a parasite replication strategy.

179. Vulnerability

The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Vulnerability expresses the relationship between the intensity of an adverse event, the features of the elements at risk (assets, community, system, environment) that affect their behavior, and the measure of the damage resulting from the event (response). Uncertainty in assessing vulnerability is due to insufficient knowledge of the features affecting the response and the possible effects on the elements exposed to an event.

Vulnerability is defined in different ways depending on the types of risk being assessed. In seismic risks, vulnerability is the probability that an element at risk, belonging to a specific behavioral class (vulnerability class), experiences or exceeds a damage threshold (according to a predetermined scale of damage) upon the occurrence of an event of an assigned intensity. In flood risks, vulnerability expresses the expected damage to the elements at risk, the extent of damage ranging from 0 (no damage) to 1 (total destruction).

180. Vulnerability by Anthropomorphic Aspect

181. Vulnerability by Quantity of People

182. Vulnerability by Social Aspect

183. Water Service

It is a service relation between the consumer of water services and the agent who provides it. For instance, the public water service provided by a public entity to people in a city.

184. Wild Animal Population

Urban wildlife animal populations consist of species that utilize human-dominated ecosystems.

185. Zoological Park