# CONSIDERATIONS REGARDING THE IMPLEMENTATION OF THE TECHNICAL SPECIFICATIONS IN THE URBAN INFORMATION SYSTEM

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***Abstract:*** *In this article are highlighted some specific aspects of the features recorded in an urban information system from the perspective of the current technical specifications. There are mentioned some attributes and classifications that are recommended to be implemented also in Romania for completeness and accuracy cadastral data and to ensure data transfer much easier due to standardization.*

## 1. Introduction

In the INSPIRE and OGC (OpenGIS Consortium) specifications were found standardized elements regarding geospatial data modeling. These specifications are published on the website , first as draft versions and then in adopted final form. INSPIRE is calling for the establishment of a Community Geoportal by Member States to provide access to their infrastructure through a Geoportal or any other access points.
INSPIRE is based on the spatial information infrastructures that are created and maintained by the member states. To support the establishment of a European infrastructure, the main components are: metadata, interoperability of spatial data sets (according to Annexes I, II , III of the Directive) and spatial data services, network services, data exchange services and procedures for monitoring and reporting.
With the occurrence of the INSPIRE Directive the large companies that are producing software started to develop appropriate IT solutions to support the implementation. The ESRI has developed ArcGIS ArcGIS for INSPIRE which brings in full compliance with INSPIRE and related requirements. ArcGIS for INSPIRE is an extension of ArcGIS software, including data models and data management allowing INSPIRE metadata and web services in the ArcGIS Desktop. ArcGIS Server includes viewing and downloading INSPIRE services. This software solution is useful for: creating and maintaining metadata, interoperability of spatial data sets and services - ArcGIS for INSPIRE provides geodatabase templates in support of spatial data creation INSPIRE compliant. They should allow the extraction, transformation and loading of geospatial information from existing databases in INSPIRE, without the need for auxiliary service transformation and the creation of new data. ArcGIS Desktop is an extension to create and maintain spatial data and metadata.
Given these issues, the question of the creation of standardized data according to INSPIRE and its achievement of the Urban Information System, data that would help a lot as basic data. The issues addressed still want to justify the relevance of this viewpoint.

## 2. NACLR (National Agency for Cadastre and Land Registraton) Solution

In this context, the solution adopted by the National Agency for Cadastre and Land Registration for the distribution and sharing of spatial data sets and web services is the Romanian INSPIRE geoportal highlighted in Figure 1.

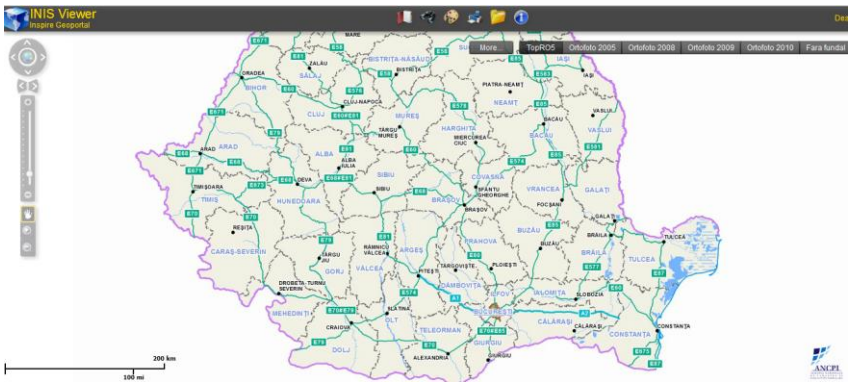


Figure 1 – INIS Geoportal

Application aim is to facilitate the discovery and sharing of geospatial data resources for a diverse community of users, providing the means to search and discovery of spatial data sets and web services in the meaning of INSPIRE Directive.
The ISO 19100 series of standards was adopted as the technical base for INSPIRE by the European standardization organization Comité Européen Normalisation - CEN TC/211.
In the implementation are included 34 themes. The themes are subdivided into three groups and included into the INSPIRE directive in three appendices. Member States must to make the metadata available for the themes in Appendices I and II in 2010, and for the themes in Appendix III in 2013. The content of the three Appendices are highlighted in Figure 2.

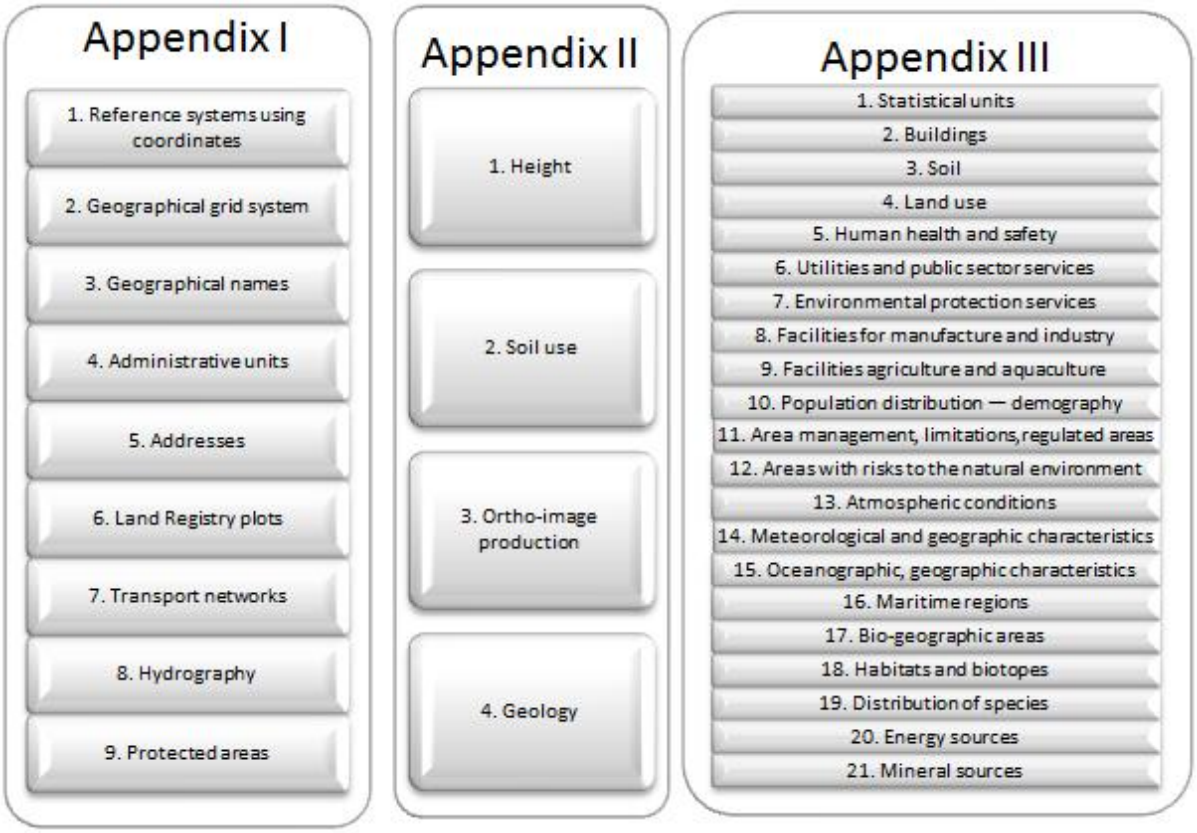


Figure 2 – The three main INSPIRE Annexes [5]

Romanian INSPIRE Geo-portal was developed on ESRI Geoportal Server Extension Technology. It is constantly updated with quality geographic information and help improve decision-making and operations at all national levels, dealing with activities which have a direct or indirect impact on the environment.

In this context, the INSPIRE Directive has an big impact on the Urban Information System, issues that will be addressed below. Starting from the idea that this information system can integrate INSPIRE data, it may be the basis for decisions for supporting of the local sustainable development, including the issuance of building permits.

## 3. Incident Specifications – INSPIRE Data Specification on Buildings

Interoperability in INSPIRE means the possibility to combine spatial data and services from different EU sources in a consistent way without involving specific efforts further. It is important to note that "interoperability" is understood as providing access to spatial data through network services, typically the Internet. Interoperability can be achieved by either changing (harmonizing) and storing existing data sets or transforming them through publishing services INSPIRE infrastructure. The idea for users is to make less effort to understanding and data integration and the development of applications based on data according to INSPIRE.

To facilitate the implementation of INSPIRE , it is important that all stakeholders are able to participate in the specification and development of Geo-portals. For this reason, the Commission has implemented a consultation process with stakeholders (interested parties).

hese beneficiaries are organized as interesting common spatial data (SDIC) and legally mandated Organizations (LMO) and participates actively in the geoportal.

Given all these considerations it can be started from the premise that it would be desirable for the organization of the urban cadastral data to be harmonized with those specifications.

Thus, the "Data Specification on Buildings - Draft Technical Guidelines" describes the characteristic elements for describing spatial construction theme. There are currently several sets of data that describe characteristics related to construction. These data sets are mainly produced by organizations Member States mandated usually by national cadastral agencies .

There are special data about buildings having different levels of detail both in terms of geometry, and semantics. Representations can be used for construction points, surfaces and solids. Building the 2D surface representations are most common, while the 3D levels are generally made using the standard OGC CityGML detail.

Regarding the types of construction, under the municipal fund information should be taken into account under the INSPIRE specifications, namely: arch, bunker, canopy, castle, cave building, chapel, church, dam, greenhouse, lighthouse, mosque, shed, silo, stadium, storage tank, synagogue, temple, tower, windmill, wind turbine) and other auxiliary categories, too.

In terms of the categories of construction (after use) are those illustrated in Figure 3.

Another main constructions attributes are:

- The state of construction - declined, demolished, functional, projected, ruin, under construction.
- Contruction height - estimated, measured.
- Reference plane - above ground envelope, bottom of construction, entrance point, general eave, general ground, general roof, general roof edge, highest eave, highest ground point, highest point, highest roof edge, lowest eave, lowest floor above ground, lowest ground point, lowest roof edge, top of construction.
- Footprint - above ground envelope, combined, entrance point, envelope, footprint, lower floor above ground, point inside building, point inside cadastral parcel, roof edge. (figure 4)


*Figure 3 – Categories of Buildings*

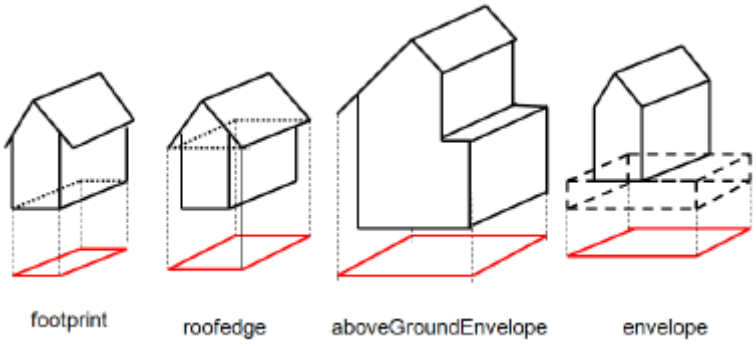


Figure 4 – Examples of Horizontal Geometry Reference (from [5])

In terms of spatial data consistency, can be defined certain rules, but that can be waived for specific cases. For example, buildings with sewage farming should default 'agricultural' and those which have industrial or manufacturing facility should have the value "industrial" attribute to the use attribute. There may be exceptions and, therefore, no absolute standard of consistency can be imposed.

## 4. Incident Specifications – CityGML

CityGML data model is composed by different classes that belong to the most important types of objects in the 3D virtual models city. CityGML data model is decomposed in terms of theme in a core module and thematic extension modules. The basic module includes basic concepts and components of the CityGML data model. Based on the core module, each extension covers a specific thematic virtual 3D city models.
CityGML introduces the following eleven thematic extension modules: Appearance, Building, CityFurniture, CityObjectGroup, Generics, Land, Relief, Transportation, Vegetation, Water-Body and TexturedSurface.
A fundamental aspect in shaping a city is to integrate 3D objects in the field.

To solve this problem is used the notion of TerrainIntersectionCurve (ICT). These curves indicate the exact position and ICTs can be applied to constructions.
CityGML has been designed as a universal model topography, which defines the types of objects and attributes that are useful for a wide range of applications. CityGML provides two different concepts to support data exchange:

- generic objects and attributes
- extensions in application domain.

The concept of generic objects (GenericCityObject) and attributes (CityObjectGenericAttribute) allow extending CityGML applications at runtime, meaning any CityObject may have added additional attributes whose names, data types and values can be supplied by an application that is already running, without intervention for changing in the CityGML XML schema.The buildings represent INSPIRE is based on 4 levels of detail defined in CityGML.

## 5. Comparison of data models: INSPIRE - CityGML - Urban Information System (Romania)

In the City GML approach, there are a number of attributes shown in Table 1.

Table 1 - CityGML attributes (adapted from OGC specifications) to highlight additional elements needed for urban information system in Romania

| No. | CityGML Attributes | Romanian Urban Information System Attributes |
|---|---|---|
| | *Core attributes (inherited)* | |
| 1. | name | |
| 2. | creationDate | |
| 3. | terminationDate | |
| 4. | ExternalReference | |
| 5. | Association to Address | Required |
| | *Building attributes* | |
| 6. | geometry | |
| 7. | class | |
| 8. | function | Required |
| 9. | usage | Required |
| 10. | yearOfConstruction | Required |
| 11. | yearOfDemolition | |
| 12. | storeysAboveGround | Required |
| 13. | storeyHeightsAboveGround | |
| 14. | storeysBelowGround | Required |
| 15. | storeyHeightsBelowGround | |
| 16. | aggregation into Parts | |

In INSPIRE approach there are basic attributes and additional attributes, according to Table 2.

In Table 3 we emphasized the attributes needed for urban information system in Romania.

Table 2 - Attributes INSPIRE (adapted from INSPIRE specifications) to highlight additional elements needed for urban information system in Romania

| No. | INSPIRE Attribute | Romanian Urban Information System Attributes |
|---|---|---|
| | *From BuildingBase::AbstractConstruction* | |
| 1. | inspireId | |
| 2. | name | |
| 3. | beginLifespanVersion | |
| 4. | endLifespanVersion | |
| 5. | externalReference | |
| 6. | dateOfConstruction | |
| 7. | dateOfDemolition | |
| 8. | dateOfRenovation | |
| 9. | heightAboveGround | |
| 10. | elevation | |
| 11. | conditionOfConstruction | Required |
| | *From BuildingBase::AbstractBuilding* | |
| 12. | buildingNature | Required |
| 13. | currentUse | Required |
| 14. | numberOfDwellings | |
| 15. | numberOfBuildingUnits | |
| 16. | numberOfFloorsAboveGround | Required |
| 17. | aggregation into Parts | |
| | *From buildings2D::AbstractBuilding* | |
| 18. | geometry2D | Required |
| | *From extended2D::AbstractBuilding* | |
| 19. | association to Address | Required |
| 20. | association to Cadastral Parcel | Required |
| 21. | address | Required |
| 22. | document | |
| 23. | numberOfFloorsBelowground | Required |
| 24. | heightBelowGround | |
| 25. | materialOfRoof | Required |
| 26. | materialOfStructure | Required |
| 27. | materialOfFacade | |
| 28. | officialArea | Required |
| 29. | officialValue | |
| 30. | roofType | |
| 31. | energyPerformance | |
| 32. | heatingSystem | |
| 33. | heatingSource | Required |
| 34. | floorDescription | |
| 35. | floorDistribution | |
| 36. | connectionToWater | Required |
| 37. | connectionToSewage | Required |
| 38. | connectionToGas | Required |
| 39. | connectionToElectricity | Required |
| 40. | connectionToWater | Required |

Table 3 - Attributes needed for urban information system in Romania

| No. | Construction Attributes | Possible Attributes Values |
|---|---|---|
| 1 | Building Number | C1, C2, C3, … |
| 2 | Destination | CL, CIE, CAS, CA |
| 3 | Use | |
| 4 | Number of Storeys | |
| 5 | Număr of Basements | |
| 6 | Resistance structure | A,B, C, M |
| 7 | Foundation | B, P, R, L, A |
| 8 | Walls | CP, D, L, P, PM, ZP, A |
| 9 | Roof (material) | Circulated Patio, Uncirculated Patio, AZ, B, OL, S, SD, T, TB, A |
| 10 | Heating | L, G, t, P, E |
| 11 | Technical Urban Features | A, C, t, E, T |
| 12 | Construction Condition | F, B, S, R, I, X |
| 13 | Property Type | N, L, S, A, F, J |
| 14 | Administration Mode | A, C, F, P, R, M, S, T, L |
| 15 | Capacity Type | One room apartment-01, ..., Student House-10, ..., Pharmacy, 16, ..., Hospital-19, ..., Museum / Exhibition-27, ..., Higher Education, 33, ..., Hotel-45. .., Gym-51, ..., Railway Station-59, ..., Abbey-65, ... local Administration-68, ..., Historical Monuments-86 (Annex 4) |
| 16 | Number of Families | |
| 17 | Number of Persons | |
| 18 | Building Ground Area | |
| 19 | Unfolded Built Area | |

Between INSPIRE and CityGML approaches exists multiple equivalent like in the Figure 5.

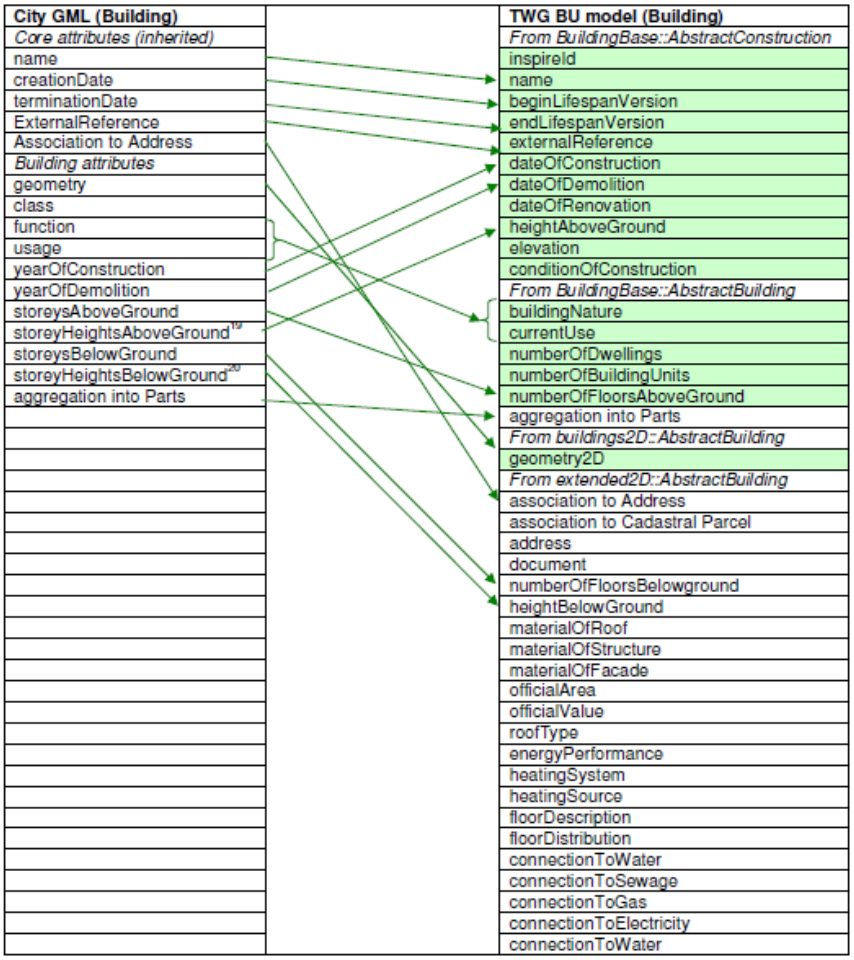

Figure 5 – Equivalent Targets between INSPIRE and CityGML

## 6. Study Applicability in the Urban Planning Rules

"Sustainability can be measured on different scales and is influenced by political decisions and aims. … The European Commission monitors the sustainable development of the member states by using the following indicators: socio-economic development, sustainable consumption and production, social inclusion, demographic changes, public health, climate change and energy, sustainable transport, natural resources, global partnership, good governance." [2]

Developing of new areas of building should consider building codes regulations in force in the country. In these rules should be made mandatory and planning issues (adapted from [2]):

- a healthy system of life and workplace;
- safety;
- housing needs of the population;
- social and cultural needs ;
- maintaining and developing existing economical sectors, central supply zones;
- interest in culture, architecture and heritage protection;
- worship needs;
- environmental needs , impact over the animals, plants , soil, water, air, conservation of objectives and scope of protection of Natura 2000 sites, effects on man and on his state of health, prevention and appropriate treatment of waste emissions, use renewable energy and energy efficiency economy, maintaining air quality, etc. .
- preserving, maintaining and creating jobs;
- postal and telecommunications services;
- supply, particularly energy and water supplies;
- protection of natural resources ;
- basic needs and mobility needs of the population;
- the interests of defense and civil defense ;
- problems of flood protection , etc. .

Important issues to be taken into account by local authorities for issuance of the building - using GIS functionalities of the urban information system established under INSPIRE - are shown in Table 4. This table shows the spatial relationships must be analyzed between people, environment and the new building to be approved.

Table 4 – Spatial Criteria for Analyzing Relationships between People-Environment-New Building (adapted from [2])

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Analysis on access to | Road infrastructure | Waste water disposal | Rain water disposal | Energy | Drinking water | Water needed for fire fighting | |
| Analysis on distance to | Railway | Forest and health | Water body | Industrial mass production of livestock | Other emitting livestock | Emitting industry | |
| Position in/on | Protected sites | Flood endangered area | Land protection dyke | Airport noise protection areas | Contamined sites influence areas | Weapons contamined areas | Areas where the soil tends to settlements |
| Proximity analysis to | Natural monument | Cultural monument | Open wire transmission line | Dumpsite | | | |

Design and construction of a building should be made after a rigorous workflow for obtaining the authorization of construction. Once the planning is completed, the new house can be designed according to previously defined planning framework . Before building new homes the local authorities must approve planning. To standardize this process would be desirable to complete a form containing more questions about the new house, landscaping mode, availability of infrastructure and the local situation. If the distance or proximity of an object (another building, electric poles, etc..) are not complied with, they must play a role in the approval / rejection of authorization. Knowledge of these elements can be adapted to perform a careful analysis of the causes and effects of space between human actions and the environment. Sustainable development indicators are those of Figure 6 (adapted from Heiland, 2003).

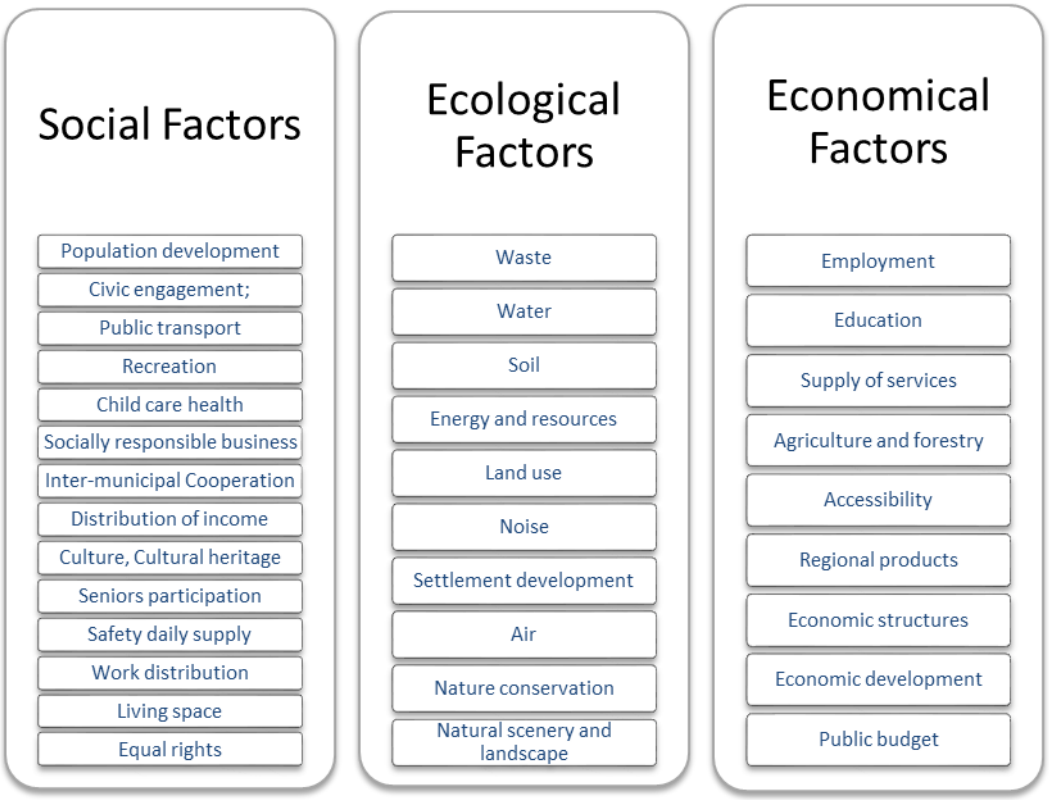


Figure 6 – Sustainable indicators (adapted from [1])

## 7. Conclusions

In Romania it is absolutely necessary a harmonization of urban information system attributes with the existing standards, such as those of INSPIRE and with the CityGML, being desirable a 3D migration. The first application of implementation of new standardized attributes in this system are consisted from complex environmental studies and building authorization in relation to the actual parameters of sustainable development.
Also one can see an evolution of the SDI cadastre. Riecken, 2012 [4] said that Cadastre Development is to a SDI, like in Figure 8, "In the last decades the cadastre was increasingly used for other necessary mapping and (planning) uses - it became a so called multi purpose cadastre as a geo-basis LIS and nowadays as a part of the NSDI."

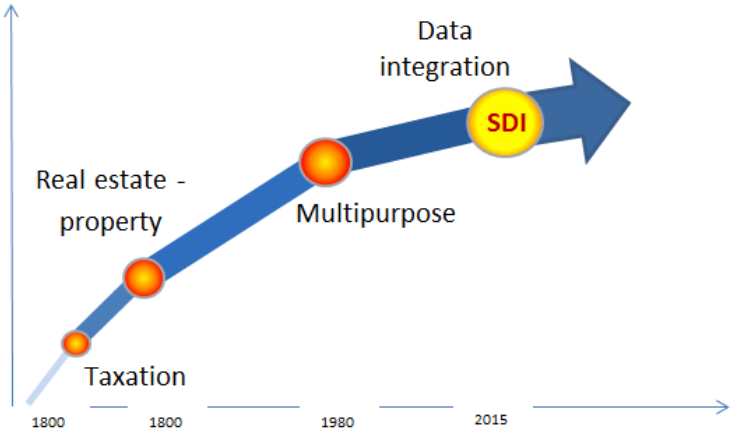


Figure 7 – Evolution of Cadastre to a NSDI

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