Universe Scientific Publishing

ORIGINAL ARTICLE

Heritage-related Indicators for Urban Sustainable Development: A Systematic Review

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Abstract: In recent years, interest in urban sustainability has grown, leading it to attain a central importance in the international contemporary debate on the future development of cities. Heritage, which has long been absent from the mainstream sustainable development debate, is nowadays recognized to have great potential in contributing to social, economic and environmental sustainability goals. Nevertheless, heritage as a key problem area of urban sustainable development is often limited to theoretical discourse. For this reason, several authors have stressed the urgency to develop a set of indicators to assess the role that heritage could play in urban sustainable development. On this basis, the present papers aims to fill this gap by providing a critical literature review of actual urban sustainability assessment methodologies, in order to contribute to the creation of a state-of-the-art framework of heritage-related indictors.

Keywords: Sustainable development; urban heritage; assessment; sustainable indicators; urban sustainabilit

1. Introduction

In recent years, interest in urban sustainability has grown, leading it to attain a central importance in the international contemporary debate in response to global climate change and rapid urbanization. Cities are currently the protagonists of an unprecedented crisis[15,17] involving the environment, the economy and society. They suffer from substantial transformations and pressures, which make the adoption of sustainable policies and tools a matter of urgency, recognized as "the issue of twenty-first century"[16]. Particularly, significant attention is dedicated to the process of measuring sustainable development progress[7], whereby the use of indicators has become common practice[14].

The emergence of these phenomena constitutes a great challenge for historic cities in which sustainability ambitions must operate in accordance with the aims of urban heritage preservation[3,5,6]. Nowadays, heritage is considered to play a pivotal role in the creation of sustainable cities[27], as emphasized by the current global agenda on sustainable development[25].

However, as revealed by a number of authors[4,13,14,18,20], heritage is often the weakest component in current studies on urban sustainability and there is a lack of systematic assessment methodologies for its adequate consideration.

2. Heritage in urban sustainable development

Sustainable development is a complex concept that dates back to over thirty years ago. There is no shared definition of sustainable development and the notion is rather ambiguous and vague. The well-known 1987 Bruntland Report definition, which defines sustainable development as development that is able to "meet the needs of the present without compromising the ability of future generations to meet their own needs", reveals this indeterminateness.

doi: 10.18686/utc.v4i1.32

Despite this, sustainable development is viewed as "the most important guiding principle"[1] and "the issue"[28] of the twenty-first century. This is particularly evident for cities[2], due to rapid urbanization, increasing pollution, and intensity of climate change and resource consumption. In recognizing the environmental, economic and social challenges that cities currently face, sustainable development approaches are multiplying[15].

Sustainable development is an evolving concept: while originally based mainly on its environmental dimension, it has evolved over time into a more holistic concept, thanks to the contribution of international debates and meetings. In this framework, heritage, which has long been absent from the mainstream sustainable development debate, is nowadays recognized to have great potential in contributing to social, economic and environmental sustainability goals[11,26]. In particular, heritage plays a "critical role as a non-renewable resource that is a vital part of cities, integral to their identity and underpinning their dynamism as hubs of economic development"[27]. According to the European Commission (2015), heritage conservation within urban contexts has "improved quality of life and reduced carbon emissions". Its economic and social benefits have also been underlined by Bandarin and Van Oers (2012), and Tweed and Sutherland (2007), with attention especially for its intangible aspects and community involvement.

Also the new urban agenda recognizes heritage as an important factor for urban sustainable development[13,18], most notably in sub goal 11.4, which is aimed to "strengthen efforts to protect and safeguard the world's cultural and natural heritage"[25].

Therefore, the role of heritage in sustainable development is becoming unquestionable. Nevertheless, there is practically no general consensus in terms of how to best approach and deal with it[1], and current studies on urban sustainability dedicate only little attention to heritage[3,13,20]. Furthermore, as Nocca (2017) claims, heritage is often excluded from cities' sustainable development programs and only a few researches about indicators are able to support the claim that a relationship between heritage and sustainable development exists.

3. Indicators for urban sustainable development

In recent years, various tools and methodologies have been developed, both at a strategic and operative level, for the assessment of sustainable urban development, thereby reporting by means of indicators[7,12]. The popularity of these tools relies on their capacity to compare urban management performance and competitiveness in the framework of sustainability aims[12]. Sustainability assessments allow for setting targets and supporting decision-making strategies, and function as guides for investments, as measures for the results of actions and as a means by which to monitor them through time[10]. They usually have a multi-target utility, thereby becoming fundamental in operating balances for planners, administrations, politicians and decision-makers. The assessment process can be considered to be a real knowledge process, rather than only a judgment tool[7].

Current studies demonstrate the existence of over a hundred possible assessment tools, which are extremely diverse in characteristics, aims, typologies, contexts and scale[8]. According to De Chastenet *et al*. (2016), "rating systems are often the best way to assess the objectivity of sustainable scopes of urban projects and policies […] In the future, evaluation must become an instrument of policy and of sustainable development for the city of tomorrow".

From the heritage perspective, the number of heritage-related indicators to date is small [13] and the scientific literature is limited[3]. Moreover, according to Sowinska-Swierkosz (2017), there is a lack of comprehensive studies summarizing recent developments, and heritage as a key problem area of urban sustainable development is limited to theoretical discourse[14]. For these reasons, a set of indicators by which to assess the role that heritage could play in sustainable development is urgently needed[18].

On this basis, the present paper aims to address the two following questions:

Q1) Which heritage-related indicators exist for the assessment of urban sustainable development?

Q2) Which aspects of heritage are taken into consideration in urban sustainable development assessment tools?

By reviewing and comparing existing indicators in international scientific publications, this article provides a state-of-the-art framework of heritage-related sustainability indicators.

4. Methodology

As previously noted, the published literature reviews focusing on heritage-related indicators for sustainable development are few and often centered on specific sustainability dimensions[22]. For this reason, a systematic literature review was undertaken, with the purpose of consolidating published research on the topic and contributing to the creation of a state-of-the-art framework of heritage-related sustainability indicators.

From this perspective, this research adopted a three-step methodology:

1) First, a worldwide selection of sustainability assessment tools was made. Using computer-based engines and the Scopus database, a total of 30 tools/documents presenting multi-criteria techniques were selected. The selection process rejected all tools in which heritage-related sustainability indicators were found to be absent. The selected tools/documents are related to six different categories: scientific literature, reports, certification systems, local urban tools, European projects and international organizations' initiatives (Table 1).

2) Subsequently, the heritage-related indicators were quantified (Table 1), deeply analyzed and classified according to their type and the aspects of heritage's they take into consideration (Table 2).

3) Finally, according to the analysis results, a state-of-the-art framework of heritage-related sustainability indicators was proposed (Table 2).

5. Results and discussion

The selected tools and documents are extremely varied in nature. To ensure a holistic approach, attention was dedicated not only to scientific articles, but also to other types of documents and tools presenting heritage-related indicators within urban sustainability assessment tools.

Scientific literature-review publications formed the basis of this theoretical work. In particular, seven articles were selected and analyzed (Table 1). Nevertheless, no article adopted the advocated holistic approach. For example, Cassatella and Peano (2011), and Sowińska-Świerkosz (2017) provide a complete analysis of indicators, but primarily relate them to landscape, while Guzman *et al*. (2017) focus only on urban reports from international agencies. In contrast, Nocca (2017) analyses 40 case studies of culture-led regeneration projects, mainly focusing on the tourism sector and climate change. Both Tanguy *et al*. (2014) and Salat (2011) propose two frameworks of indicators: in the first case, the research is based on 25 scholarly papers focusing on indicators by which to bridge heritage conservation and urban sustainability, while in the second, the framework refers to all sustainable development dimensions, whereby heritage plays only a limited role.

Departing from these considerations, the present study also takes into account reports, the major certification systems and protocols, local urban assessment tools, European projects and UN initiatives, in order to obtain the most complete possible of heritage-related sustainability indicators (Table 1). More to the point, all of these documents and tools constitute the main references on an international level and have been increasingly used by local administrations and planners to achieve sustainability goals. Hence, the choice was motivated by the aim to analyze precisely those documents that are most well-known, diffused and utilized in urban sustainability assessments. Furthermore, they all present a check-list of criteria and the relevant indicators, and are classified according to thematic sessions or categories.

Category	Title	Year	Number of heritage-related indicators
Certification tools	Dossier de Labellisation EcoQuartier	2015	4
	HQE – Aménagement	2016	4
	BREEAM Communities	2012	5
	LEED for Neighborhood Development	2009	2
	CASBEE for Urban Devlopment	2007	4

	Protocollo ITACA scala urbana	2016	4
	GBC Historic Building	2013	10
Urban local tools	Matrice della Qualità Urbana di AUDIS	2013	4
	BES – benessere equo e sostenibile (ISTAT)	2015	4
	ARPE Midi-Pyrénées	1999	1
	Grille RST.01 / 02	2006	1
	Guide de la qualité environnementale de la Ville de Grenoble	2006	1
	Référentiel un aménagement durable pour Paris	2010	7
European projects	ADEQUA	2006	3
	TISSUE	2004	1
	RESPECT - Réseau d'Evaluation et de suivi des politiques environnementales des collectivités territoriales	2001	2
	HQE2R / INDI	2010	1
	Reference Framework for Sustainable Cities	2008	1
	CityKeys	2015	3
International organisms initiatives	UN-Sustainable Development Goals	2015	1
	UN - Monitoring human settlements with urban indicators	1995	3
Reports	V. Augiseau, D. Belziti, Recensement et analyse d'indicateurs pour l'évaluation des EcoQuartiers, CSTB	2011	7
	IFEN - Institut Français de l'Environnement	1997	1
Scientific literature	Tanguay *et al*., A comprehensive strategy to identify indicators of sustainable heritage conservation, Les cahiers du CRTP.	2014	20
	Tanguay *et al*., Measuring the sustainability of cities: An analysis of the use of local indicators, Ecological Indicators, 10(2), pp. 407–418.	2010	1
	Salat, Cities and forms on sustainable urbanism, Paris: Hermann.	2011	1
	Cassatella, Peano, Landscape indicators: Assessing and monitoring landscape quality, Dordrecht: Springer.	2011	8
	Guzman *et al*., Measuring links between cultural heritage management and sustainable development: an overview of global monitoring tools, Cities, 60, pp. 192-201	2017	12
	Sowińska-Świerkosz, Review of cultural heritage indicators related to landscape: Types, categorisation schemes and their usefulness in quality assessment, Ecological Indicators, 81, pp. 526-542	2017	12
	Nocca, The Role of Cultural Heritage in Sustainable Development: Multidimensional Indicators as	2017	14

Decision-Making Tool, Sustainability, 9 (10), 1882.	
TOTAL	142

Table 1. List of selected tools/documents.

A total of 142 heritage-related indicators were found in the 30 documents and tools that were analyzed, as set out in the table below (Table 2). The first overview highlights that indicators are currently relatively few in numbers, most notably regarding the assessment tools. Despite the fact that the number of culture-related indicators in these tools is higher, the criteria are still far from offering a holistic measurement of the advantages of heritage consideration on an environmental, economic and social sustainability level.

Title	Heritage-related indicators
Dossier de Labellisation EcoQuartier	1) Comment le patrimoine et la mémoire du site sont-ils valorisés dans l' EcoQuartier (restauration, réhabilitation, mise en valeur...) ? 2) En quoi votre EcoQuartier contribue-t-il à l'identité et la culture locale ? 3) % de la surface de plancher réhabilitée ou reconvertie par rapport aux surfaces existantes 4) Valorisation du patrimoine existant
HQE – Aménagement	1) Respect du patrimoine existant 2) Intégration de la mémoire 3) Eléments du paysage identifiés mis en valeur 4) Intégration de la mémoire, sentiment d'appartenance
BREEAM Communities	1) A review of the area surrounding the proposed development is undertaken to establish the key aspects of the local character 2) The designer/developer has demonstrated that the key elements identified in the review and consultation will be implemented in the design of the site 3) Members of the local community and appropriate stakeholders have been identified for consultation 4) An assessment of any existing buildings and infrastructure (including their materials) is carried out to determine what can be refurbished, re-used, recycled or maintained 5) The developer commits to recycling building and/or infrastructure materials and (where possible) using the materials on the development site
LEED for Neighborhood Development	1) Includes a historic building(s), and rehabilitates if necessary 2) Reuses and restores at least 20% of the existing building stock
CASBEE for Urban Devlopment	1) Conservation and use of historical, cultural and natural assets 2) Formation of urban context and scenery 3) Harmony with the surroundings 4) Conservation of the built environment
Protocollo ITACA scala urbana	1) Rapporto con il contesto: Considerazione degli aspetti strutturanti e caratterizzanti del contesto nelle scelte localizzative e di morfologia dell'impianto insediativo 2) Rafforzamento del ruolo urbano: Raggiungimento dell'"effetto urbano" degli interventi di rigenerazione di insediamenti consolidati e di aree periferiche 3) Qualificazione del gruppo di progettazione 4) Prossimità a strutture per il tempo libero (culturali)
GBC Historic Building	1) Indagini conoscitive preliminari (Carta di identità dell'edificio storico) 2) Indagini conoscitive avanzate: indagini energetiche 3) Indagini conoscitive avanzate: indagini diagnostiche su materiali e forme di degrado

	4) Indagini conoscitive avanzate: indagini diagnostiche sulle strutture e monitoraggio strutturale 5) Compatibilità della destinazione d'uso e benefici insediativi 6) Compatibilità strutturale rispetto alla struttura esistente 7) Cantiere di restauro sostenibile 8) Specialista in beni architettonici e del paesaggio 9) Riutilizzo degli edifici 10) Riutilizzo dei materiali
Matrice della Qualità Urbana di AUDIS	1) Riconoscibilità formale (sostanziale) delle scelte progettuali che definiscono continuità e/o discontinuità rispetto all'evoluzione storica della città e rispetto a tutti gli "insiemi di senso" culturali, estetici e memoriali che sono racchiusi nella parola "contesto" 2) Numero e qualità degli elementi trasformati o conservati e loro giustificazione 3) Percezione complessiva del paesaggio 4) Accessibilità e fruizione visiva del paesaggio
BES – benessere equo e sostenibile (ISTAT)	1) Numero di beni archeologici, architettonici e museali per 100 km2. 2) Pagamenti di competenza per la gestione di musei, biblioteche e pinacoteche in euro pro capite. 3) Superficie in m2 delle aree di Verde storico e Parchi urbani di notevole interesse pubblico per 100 m2 di superficie urbanizzata (centri e nuclei abitati) nei Comuni capoluogo di provincia. 4) Percentuale di edifici in ottimo o buono stato di conservazione sul totale degli edifici abitati costruiti prima del 1919.
ARPE Midi-Pyrénées	1) Nombre de monuments inscrits ou classés.
Grille RST.01 / 02	1) Identité culturelle - Le projet se préoccupe-t-il du vécu des habitants ? Le projet valorise-t-il le paysage et le patrimoine culturel ?
Guide de la qualité environnementale de la Ville de Grenoble	1) Repérer les édifices classés et l'architecture mineure susceptibles de constituer des points d'appui à la conception des plans de référence
Référentiel un aménagement durable pour Paris	1) Préserver et améliorer la qualité paysagère du patrimoine bâti : coût d'achat par EDF de l'électricité produite par les panneaux photovoltaïques 2) Mettre en valeur le patrimoine architectural : S^2 SHON réhabilitée / S^2 SHON total 3) Faire évoluer durablement le patrimoine bâti : % de constructions neuves ou réhabilitées réalisées suivant une démarche environnementale 4) Adapter le bâti au réchauffement climatique : Type et qualité de l'isolation et de la végétalisation 5) Prévoir des équipements et services culturels de proximité 6) Développer et encourager la création culturelle : Nombre d'œuvre d'arts créées 7) Réaliser un diagnostic détaillé
ADEQUA	1) Patrimoine culturel, religieux, architectural, vernaculaire ou historique : nombre de monuments inscrits et classés, respect du patrimoine existant, intégration de la mémoire, amélioration de l'intégration au site 2) Prise en compte du patrimoine existant dans le projet du point de vue urbanistique et architectural 3) Patrimoine naturel : protection des espèces menacées et non menacées présentes sur le site, respect des zones protégés et des zones d'habitat des espèces, protection

	des cheminements des espèces, conservation et valorisation du paysage nature, proportion d'espace vert naturel et plantés, liaisons vertes, biodiversité des plantes et des espèces, adaptation des essence de plantes avec le climat local
TISSUE	1) Maintenance of cultural heritage of built environment
RESPECT - Réseau d'Evaluation et de suivi des politiques environnementales des collectivités territoriales	1) Esthétique urbaine 2) Protection du patrimoine bâti
HQE2R / INDI	1) Préservation et valorisation du patrimoine :Mesures de préservation et/ou de valorisation du patrimoine bâti/culturel/naturel
Reference Framework for Sustainable Cities	1) Pourcentage du budget municipal alloué aux infrastructures culturelles et sportives
CityKeys	1) Connection to the existing cultural heritage 2) Design for a sense of place 3) Preservation of cultural heritage
UN-Sustainable Development Goals	1) Strengthen efforts to protect and safeguard the world's cultural and natural heritage: Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage (cultural, natural, mixed and World Heritage Centre designation), level of government (national, regional and local/municipal), type of expenditure (operating expenditure/investment) and type of private funding (donations in kind, private non-profit sector and sponsorship).
UN - Monitoring human settlements with urban indicators	1) Number of buildings in city on heritage or monuments lists 2) Expenditure in rehabilitation and upgrading of buildings in city on heritage or monuments lists 3) Incentives to private owners for rehabilitation and upgrading of buildings in urban areas part of cultural heritage
V. Augiseau, D. Belziti, Recensement et analyse d'indicateurs pour l'évaluation des EcoQuartiers, CSTB	1) S^2 SHON réhabilitée / S^2 SHON total 2) Harmonie avec les alentours 3) Analyses détaillées. 4) valeur patrimoniale des arbres plantés/valeur patrimoniale des arbres supprimés 5) conception paysagère en consultation avec les autorités locales/experts. 6) Nombre des œuvres d'arts créées 7) Nombre de manifestations.
IFEN - Institut Français de l'Environnement	1) Protection du territoire
Tanguay *et al.*, A comprehensive strategy to identify indicators of sustainable heritage conservation, Les cahiers du CRTP.	1) Attachement to place 2) Traditional value or perceived 3) Artisctic, aesthetical and harmonious value or perceived 4) Building fabrics, insulation and ability to adapt 5) Viability of recycling existing materials 6) Authenticity 7) Integrity 8) Spatial compatibility 9) Environmental and ecological awareness

	10) Promotion of actions for further knowledge of historical-cultural heritage 11) Improvement of living conditions and quality of life 12) Benefit of reuse versus redevelopment 13) Locals and visitors interests and involvement to conservation 14) Business and functional use 15) Investments and tourists drawing 16) Increase urban density 17) Public perceived consideration of their opinion 18) Adequate protection and management system 19) Compliance with regulations and building codes 20) Stakeholders inclusiveness and partnership
Tanguay *et al*., Measuring the sustainability of cities: An analysis of the use of local indicators, Ecological Indicators, 10(2), pp. 407–418.	1) Cultural events : Annual number of cultural events.
Salat, Cities and forms on sustainable urbanism, Paris: Hermann.	1) Intensity of cultural activity: Activities per year/population.
Cassatella, Peano, Landscape indicators: Assessing and monitoring landscape quality, Dordrecht: Springer.	1) Exceptionality of the historical-cultural characteristics of the landscape 2) Fragility of the historical-cultural characteristics of the landscape 3) Significance of the historical-cultural characteristics of the landscape 4) Preservation of the assets 5) Preservation of relation systems between assets 6) Promotion of actions for further knowledge of historical-cultural heritage 7) Economic enhancement of historical-cultural heritage. 8) Use of historical-cultural heritage, networking
Guzman *et al*., Measuring links between cultural heritage management and sustainable development: an overview of global monitoring tools, Cities, 60, pp. 192-201	1) No. of World Heritage sites 2) Other heritage/historical sites 3) Number of museums 4) % of the protected areas of the total municipal area 5) Protected urban areas (km2) 6) Public open space 7) Public indoor recreation space per capita [m2] 8) Public outdoor recreation space per capita [m2] 9) % of jobs in the cultural sector 10) Level of citizen satisfaction in general and with regard to specific features in the municipality 11) Citizen access to nearby public open areas and other basic services 12) Number of times that the limit values for selected air pollutants are exceeded
Sowińska-Świerkosz, Review of cultural heritage indicators related to landscape: Types, categorisation schemes and their usefulness in quality assessment, Ecological Indicators, 81, pp. 526-542	1) Architectonic quality- Conservation of facades 2) Ecological quality- Enhancement of urban green, Existence of old habitat trees and fruit trees 3) Economic relevance-Investments required for restoration of cultural property, Community arts funding 4) Perception dimension-Area/percentage of spiritual/religious landscapes/sites 5) Quality of political actions- Effectiveness of landscape management, Plan that does

	not spoil natural and historical environment 6) Social support-Percentage of people participating in traditional/cultural activities 7) Spatial quality-Monuments and historical buildings 8) Visual quality-Number and visibility of disturbing elements and objects, Visibility of cultural landscape elements
Nocca, The Role of Cultural Heritage in Sustainable Development: Multidimensional Indicators as Decision-Making Tool, Sustainability, 9 (10), 1882.	1) N. (or percentage) of well-preserved buildings 2) N. (or percentage) of buildings in poor condition 3) N. (or percentage) of historic building with minor problems 4) N. (or percentage) of buildings in 5) N. (or percentage) of improper housing 6) Percentage of used/partially used historic building 7) Percentage of vacant historic building 8) N. of historic properties/districts designated to be of cultural heritage value or interest 9) N. of restoration and adaptation works undertaken on historic buildings/sites 10) Percentage of re-functionalized historic buildings 11) Area of facades of historic buildings rehabilitated (sqm) 12) Percentage of citizens satisfied with historic buildings 13) Percentage (or number) of visitors available to make a contribution to heritage restoration 14) Willingness to pay for a contribution to heritage restoration

Table 2. List of selected heritage-related indicators.

As set out above, the present study addresses heritage indicators in order to understand their typology and content. The selected indicators are categorized according to both type and calculation methodology. Particularly regarding their type, the indicators can be divided into qualitative and quantitative, in almost equal parts. Following Sowińska-Świerkosz (2017), three groups of indicators were identified: state indicators, constituting the majority; action indicators, referring to protection, enhancement and various other actions; and pressure indicators, mostly related to landscape-impact assessments.

Moreover, the analysis reveals a lack of consensus regarding the nature of heritage-related sustainability indicators. Indeed, as demonstrated by Tanguy et al. (2014), only a few indicators appear in a number of documents or tools. Among the latter, the most popular indicators were the number of historical sites or listed monuments, the maintenance or restoration of historic buildings, the number of cultural activities, the visual quality of heritage sites and the protection of heritage (Table 2). It is however important to underline that the variety of the indicators reflects that of the chosen documents and assessment tools, which are used for different purposes and at different scales.

HERITAGE-RELATED DIMENSIONS	NUMBER OF INDICATORS
1. Characterization	44
2. Conservation	30
3. Enhancement	15
4. Landscape impact	12
5. Identity/memory	14

6. Culture	17
7. Stakeholders' involvement	10

Table 3. State-of-the-art framework of heritage-related sustainability indicators.

Despite their differences, the indicators also share certain common characteristics. Consequently, as shown in Table 3, seven categories of heritage-related sustainability indicators have been defined and proposed. These categories, which reflect the most frequently assessed heritage components, can be viewed as a state-of-the-art framework.

As is clearly apparent in the graphic below, the indicators are in most cases related to heritage characterization and conservation, while only a few indicators concern landscape impacts and stakeholders' involvement.

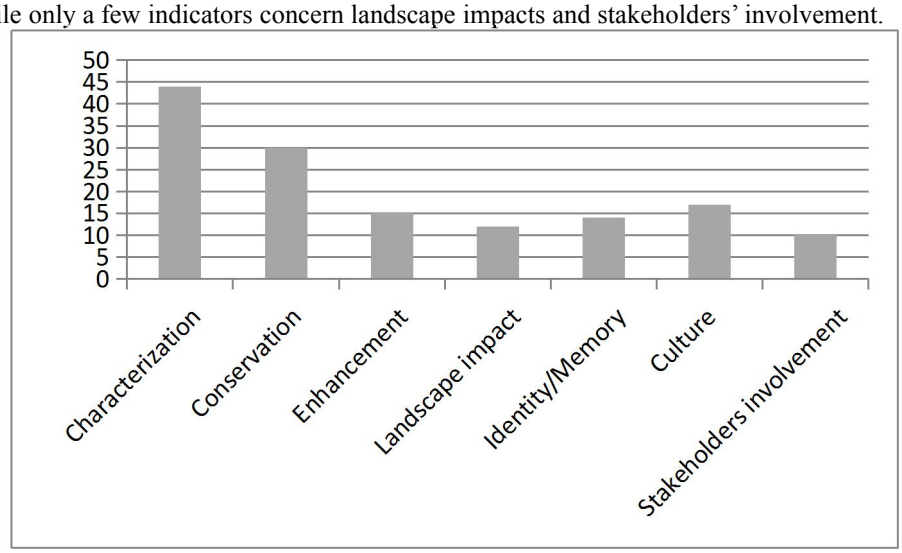

Figure 1. Percentage of indicators referring to given heritage categories.

6. Conclusion

The literature review reveals a need to develop assessment and measuring methodologies to reconnect and overcome the gap between cultural heritage management and sustainable development[5,6,14,18]. Departing from this assumption, this article aims to provide a state-of-the-art framework of heritage-related sustainability indicators.

Although culture-related indicators are gaining ground within urban sustainability assessment tools and methodologies[14], the present paper demonstrates that, in practice, there is still a limited number of indicators and that heritage is not yet considered in all its complexity and potential. The proposed state-of-the-art framework represents a step forward in the assessment of heritage within the overall goals of urban sustainable development. In fact, as Guzman *et al*. (2017) claim, "the identification of common indicators between urban development and heritage management could help forecasting challenges, setting priorities and providing baseline knowledge to foster more and better sustainable practices in urban development."

Further steps in this research field are required, concerning the study and analysis of other typologies of tools and documents, in order to allow for a major and detailed consideration of heritage aspects within sustainable development. The operated selection of indicators is based on a non-exhaustive list of tools and documents.

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