Review of the Basic Theory and Evaluation Methods of Sustainable Urban Renewal

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Abstract. With the integration of the sustainable development concept and urban renewal practices, sustainable urban renewal has emerged as a new research area. At the same time, in the context of the emergence of urban problems with the increasing complexity, sustainable urban renewal has gradually become a new type of governance that takes social, economic and environmental sustainability into account. Based on the analysis of relevant terms of urban renewal and reviewing the relevant theories of sustainable urban renewal, this paper systematically sorts out the research progress of sustainable urban renewal evaluation methods, which provides theoretical guidance and technical support for sustainable urban renewal decision-making.

1. Introduction
Urban renewal is usually aimed at improving the quality of environment while improving the value of land, solving urban decay and enhancing the inclusiveness of the city to vulnerable groups[1]. Western urban renewal has gradually shifted from removing dilapidated buildings to multi-dimensional community rejuvenation, and at the same time, the core concept of sustainability emphasizing the harmony balance of nature, economy and society has also gradually integrated into modern urban renewal of western countries [2]. By reviewing researches of urban renewal, it is obvious that sustainable urban renewal has gradually become a newly emerging research field, and its research content involves sustainability in housing or heritage, etc., interests of relevant people and their participation methods, evaluation of sustainable urban renewal, etc. Based on this, this paper systematically sorts out researches on sustainable urban renewal, and summarizes the basic theory and evaluation methods of sustainable urban renewal, in order to provide sustainable urban renewal practices with valuable experience and theoretical reference.

2. Theory of sustainable urban renewal
2.1. Discrimination of related terms
There are various terms related to urban renewal, such as urban renewal, urban reconstruction, urban revitalization, urban redevelopment, urban regeneration, urban renaissance, etc. These terms appear frequently and are related to each other. In existing researches, especially the research on the urban renewal process in western countries, different terms are used in combination with their phase characteristics. For example, British has experienced the “urban reconstruction(1950s)-urban revitalization(1960s)-urban renewal(1970s)-urban redevelopment(1980s)-urban regeneration(1990s)-
urban renaissance (2000s)” process [3]. With the transformation of the definition of urban renewal, most researchers choose the term according to focus of their research. In the context of pursuing sustainable urban development, current researches use the definition of urban regeneration frequently, which is considered to be overall concept and initiatives of comprehensive implementation of economic, social, physical and environmental aspects of the city [4]. In order to fully understand the relevant research progress, this paper defines the research object as the generalized urban renewal, that is, comprehensive expression covering terms such as urban renewal, urban reconstruction, urban revitalization, urban redevelopment, urban regeneration, urban renaissance, etc., and it no longer distinguishes the differences between these terms.

2.2. Relevant theory of sustainable urban renewal

2.2.1. Sustainable development theory. The idea of “Sustainable Development” can be traced back to the 1970s. In the Human Environment Conference held in Stockholm of Sweden in 1972, “development” was regarded as the process of harmonious and coordinated development of both human and nature in Declaration of the United Nations Conference on the Human Environment. In 1987, chaired by Brundtland, the chairperson of World Commission on Environment and Development, clearly stated the concept of sustainable development, that is the ability to demand meeting needs of the present without compromising satisfaction of future generations. Since the 1990s, the concept of sustainable development has really begun to be integrated into urban construction, which has affected the way of urban development to a certain extent [5], emphasizing the coordination of various elements at ecological, economic and social levels and its role in promoting urban development [6]. Meanwhile, the concept of green renewal is introduced into urban renewal [7].

2.2.2. Smart growth theory. In the face of various problems caused by the spread of farmland, the deterioration of environment, and the severe division of social classes, Maryland of the United States first proposed the concept of “Smart Growth” in 1997. In 2000, American Planning Association teamed up “Smart Growth America” with 60 public groups. Smart growth focuses on a broad range of issues concerning the quality of life, primarily control urban sprawl through planning and building compact communities, leveraging the effectiveness of existing infrastructure, and providing more diverse modes of transportation and housing options, etc. Smart Growth Theory embodies the compact urban spatial development concept and enabling the city develop more sustainable and connotative through new designing and planning methods, such as the delineating urban growth boundary [8]. Currently, Smart Growth in the United States is a way to build economically prosperous, socially equitable and environmentally sustainable towns and communities.

2.2.3. New urbanism theory. The idea of “New Urbanism” originated in the 1980s, and it was also born in the face of many problems brought by the spread of city. New urbanism emphasizes the influence of urban form, pays attention to the significance of urban development, and advocates learning from the experience of small town planning of the United States before World War II to create a compact community with living atmosphere to avoid the spreading way. New urbanism attaches importance to regional planning, emphasizing the treatment and resolution of problems from the overall level of the region. New urbanism pays more attention on people-centeredness, focusing on the livability of built-up environment, emphasizing the feeling and experience of residents. In addition, it also advocates respect for history and nature, emphasizing that urban planning, design and construction should maintain the harmony of nature, humanity and historical environment. New urbanism promotes urban sustainable development by building high-density, high-quality urban spatial structures such as Traditional Neighborhood Development (TND) and Transit-oriented Development (TOD). On the other hand, it makes reasonable guidelines of developing intensity and design to promote self-renewal and sustainable development of community.
2.2.4. Organic renewal theory. Since the 1990s, the theory of organic renewal has developed in China. It was originally proposed by Wu Liangyong who has done the long-term research on the planning and construction of the old area in Beijing and other cities. Wu concluded in the book, “Organic Renewal” means adopting appropriate scale, properly handling the relationship between the present and the future according to the content and requirements of the transformation, continuously improving the quality of planning and design, and making each piece of development reach a relatively complete level [9]. It can promote the overall environment of the old city while achieving the purpose of organic renewal. The core idea of organic renewal is to follow the law of urban development, adapt to the city's mechanism, and to explore the city's renewal and development on the basis of sustainable development. On the one hand, organic renewal theory provides new urban design concepts for adapting to urban renewal. On the other hand, it also attempts to implement sustainable strategies into urban renewal practices. However, related research based on organic renewal theory is less than what other theories have produced.

2.3. Definition of sustainable urban renewal
Since the end of the last century, relevant researches on urban renewal and sustainability have been carried out. Scholars have tried to give a definition of Sustainable Urban Renewal (SUR) from different perspectives. For example, Lombardi et al. proposed economic-social-ecologic-dimension and double-nested sustainable development connotation, and pointed out that in the urban renewal planning, the principle of sustainable or unsustainable development should be clarified through the concept of sustainable development[10]; Erbey and Erbas believe that it is a way of improving the quality of life to meet the people's sustainable development needs by promoting society, economic and environmental level and so on[11]. Although there is no unified definition of sustainable urban renewal, scholars have basically reached a consensus that sustainable urban renewal is not only focused on material renewal, but also on the comprehensive sustainable renewal of economic, social and environmental dimensions. This paper defines sustainable urban renewal as: with the premise of adhering to environmental sustainability, maintaining economic sustainability as a driving force, and achieving social sustainability as a guarantee, through integrating sustainable development with urban renewal concepts, on the basis of the participation and decision-making of the bottom-up multi-stakeholders, through measures such as building restoration and land redevelopment, it is a kind of construction activity committed to the improvement of the city's appearance and connotation in an efficient, long-term, high-quality and continuous manner, and keeps pace with the pace of adjustment, innovation technology, models and methods.

3. Sustainability evaluation and decision support for urban renewal

3.1. The Significance of Sustainable Urban Renewal Decision
For a long time, urban renewal has become an important part of urban research because of its commitment to urban decay [12-14], urban economic improvement [15], and urban reputation improvement [16]. In the process of implementation, urban renewal often ignores its fundamental goals, and even brings about problems such as increasing social exclusion, weakening social identity, and excessive pursuit of profits. Sustainable urban renewal is a new governance model that takes into account social, economic and environmental sustainability. Only by jumping out of the old urban development path and adopting comprehensive methods and measures can we achieve sustainable urban renewal. Decision support is especially important for achieving sustainable urban renewal, given the need to coordinate solutions to a variety of issues, stakeholders and solutions. Therefore, urban renewal at this stage urgently requires effective implementation under the support of scientific decision-making methods. At present, some scholars have conducted research on urban renewal decision support methods. For example, Yi et al. proposed to assess people's attitudes, experiences and their understanding of urban renewal projects, which is an urgent need for sustainable development[17]; Simon et al. found that in the construction of smart cities, decision support can effectively help stakeholders to visualize the selection and arrangement of urban renewal projects[18]; Wang et al. introduced expert systems as tools
in urban renewal decisions, providing similar cases and recommendations for target cases[19]; Zhou et al. discuss different roles played by various interests relevant people in urban renewal decision-making and so on[20]. However, there is few researches on decision support methods under the new model of sustainable urban renewal.

3.2. Sustainable urban renewal evaluation and decision support
Sustainability assessment is a quantitative or qualitative decision support tool that measures status, provides early warnings, displays the results of a particular behaviour or process, and helps policy makers determine what actions to take or which path to choose[21]. Sustainability assessment indicators not only provide decision makers with an effective information tool to understand the sustainability process, but also help decision makers prioritize sustainability issues[22]. Under the guidance of the principles of sustainability evaluation, urban sustainability assessment methods and tools have also been developed and widely used[23].

In the emerging field of sustainable urban renewal, the evaluation of sustainable urban renewal has also received wider attention as a support tool for decision-making. Among them, urban renewal sustainability evaluation has become the most important decision support method. For example, Ho et al. evaluated the applicability of different urban renewal strategies to different buildings by establishing a structured building assessment program[24]. And they found that physical conditions and management factors used in decision-making to distinguish between well-performing buildings and dilapidated buildings play almost the same role.

3.3. Urban renewal sustainability evaluation method

3.3.1. Renewal evaluation angle. Sustainable urban renewal assessments can help stakeholders improve their strategies or decision-making strategies for achieving sustainable urban renewal, often in terms of social, economic and environmental aspects[25]. Hemphill et al. designed a method to measure the relative importance of key attributes of sustainable urban renewal to integrate economic, environmental, and social sustainability, and found that even though people have recognized the need for a comprehensive and integrated approach to assess economic, environmental and social issues, but there are relatively few evaluative reviews of urban policies in three areas[26]. Tom evaluated sustainability from these three aspects and analyzed six aspects including housing and construction environment, economy and employment, local community status, resource utilization, local service capacity and facility support level[27]. Schädler et al. comprehensively evaluated the redevelopment of large-scale contaminated brownfields from the aspects of sustainable land management, natural landscape protection, energy conservation and emission reduction management, high-quality living environment, and strengthening the local economy which could help to identify useful land use patterns in a sustainable and economic sense[28]. Winston found that both environmental and social aspects are often overlooked in renewal projects, leading to unsustainable urban renewal[29].

Some scholars only evaluate the social and economic sustainability of urban renewal. For example, Andreas and Cecilia studied the impact of urban brownfield development in the poorest areas of England by assessing the impact of policies on housing market change, housing density, population growth and economic poverty[30]. Hemphill et al. used the baseline indicator method to improve monitoring the progress of sustainable renewal by designing a comprehensive system of redevelopment indicators and point scoring methods, which can evaluate the effectiveness of government renewal initiatives by combining qualitative and quantitative methods[31]. There are also a few scholars involved in the evaluation of the impact of urban renewal areas or programmes on the environment. For example, Collier discusses how sustainability changes in renewal projects affect local weather and air quality, and suggests that weather impact should be considered when assessing the sustainability of future urban development[32].
3.3.2. Renewal evaluation metric. Renewal evaluation based on indicators is the most common method currently. Hemphill et al. constructed five indicators including economy and work, resource utilization, construction and land use, transportation and mobility, and community welfare as evaluation criteria of effectiveness of sustainable urban renewal for and analyzed the benefits of sustainability indicators [33]. Subsequently, scholars tried to reconstruct or improve the index system combining qualitative and quantitative from different levels and angles. For example, in the overall level of the city, Giudice et al. screened out the obvious indicators like tourism hotels, cultural and sports entertainment, arts and crafts, public administration, etc., in order to support the decision-making of urban abandonment area renewal scope[34]; Lu Bin and Wang Chun constructed the social assessment system for the sustainable renewal performance of the historical districts in China from five aspects including the degree of participation of the main body, the recognition of the local image and the orientation of the urban design, the satisfaction degree of the implementation effect, and the social awareness and influence of the post-implementation area[35]; Nessa used key features such as geographic location, architectural design, and usage status to assess sustainable housing renewal in the city[36].

At the project level, Pediaditi et al. assessed the construction of relevant indicator systems from project conception, design and planning, construction and remediation to the ability of operating and reclaiming the sustainability of the entire project life cycle[37]. Williams and Dair suggested a framework for assessing sustainable redevelopment of brownfields through a study of five brownfield redevelopment projects[38]. And the performance of the indicator system was judged and its potential practical uses were analyzed. In short, there is currently no unified index system for sustainable renewal evaluation[39]. Besides, the indicator system constructed in existing researches have the characteristics of obvious evaluation object and strong limitation of application scope.

3.3.3. Renewal evaluation method. Most scholars use the method of index system construction to evaluate sustainable urban renewal. For example, Lee and Chan summarized the principles of urban sustainable development, proposed economic, social and environmental sustainability impact factors in urban renewal, and used the analytic hierarchy process to evaluate urban renewal projects[40]. Ai Dong et al. concluded the method of evaluating the sustainable renewal of industrial waste land by using target-driven types and process-driven models[41]. The target-driven model can be divided into single-item and comprehensive-target-index evaluation method according to the difference of objectives, while process-driven model is divided into SEA-driven and project-based EIA-driven models related to land planning. Dennis and Shankar design sustainable cities based on project management such as project organization, team structure, team member attributes, stakeholder management, communication and information technology tools[42].

Some scholars predict the future and propose corresponding solutions from the perspective of planning, and evaluate existing and potential sustainable renewal based on future scenarios. For example, Rogers et al. conducted simulation tests on case areas, and analyzed based on results of different scenarios in the future, and then gave the solution[43]. Raziyeh et al. evaluated the water supply and demand balance strategy through four future scenarios, and provided sustainable solutions for how to cope with the future[44]. Sakieh et al. pointed out that the sustainability analysis of urban integrated system requires an integrated modeling approach to analyze the relationship between land parameters and landscape patterns[45]. And they emphasized that application dynamics and scenario-based approaches to survey urban environments can be applied to understand the interaction between urban suitability and landscape patterns. Boyko et al. combined sustainability indicators with four future scenarios to comprehensively measure the effectiveness of sustainability assessment indicators, and determined the relative sensitivity or vulnerability of the indicator to different future scenarios[46].

3.4. Difficulties in decision making based on renewal evaluation
In addition to the various issues in urban renewal, the complexity of stakeholders also increases the difficulty and uncertainty of urban renewal decisions. And traditional methods based on updated evaluations are difficult to provide more effective decision support for sustainable urban renewal.
Williams and Dair proposed the identification of stakeholders in land reuse as an important part of the framework[38]. Second, different renewal projects have different characteristics and involve different stakeholder components. Thus, project sustainability decisions involve different standards[47]. Another difficulty faced by decision makers is the lack of a universal solution. The relatively fixed indicator system in the renewal evaluation is difficult to meet the decision-making needs of sustainable urban renewal. Third, the traditional urban renewal decision-making method based on evaluation usually ignores the individual's subjective knowledge of project development. In addition to the above difficulties, although the indicator system can be designed related to public participation, the decision based on the renewal evaluation is actually difficult to truly reflect the public participation in the decision-making process[48].

4. Conclusion
As the concept of sustainability continues to be integrated into urban renewal practices, the field of sustainable urban renewal research has emerged. Foreign scholars have already paid more attention to sustainable urban renewal, while domestic research is fresh. Domestic and foreign scholars have carried out research on the decision support methods of traditional urban renewal, but research on decision support methods under the new model of sustainable urban renewal is rare. Based on the research progress of sustainable urban renewal, this paper attempts to give a definition of sustainable urban renewal and its decision-making.

As the most common decision support method, sustainable urban renewal evaluation is usually carried out in three aspects: social, economic and environmental. The overall evaluation of the sub-city and the evaluation of the renewal project are respectively built into the indicator system. The construction of the indicator system and the simulation of the future scenario are the main way. Considering the limitations of decision support methods based on update evaluation, some scholars began to explore innovative ways to solve some of the difficulties.

References
[1] Adams D and Hastings E M 2001 Urban renewal in Hong Kong: transition from development corporation to renewal authority Land Use Policy 18 245-58
[2] Tallon A 2013 Urban Regeneration in the UK(Routledge)
[3] Roberts P 2000 The evolution, definition and purpose of urban regeneration Urban regeneration 9-36
[4] Helen Z W, Geoffrey S Q and Hao W 2014 A review of recent studies on sustainable urban renewal Habitat International 41 272-9
[5] Couch C, Sykes O and Borstinghaus W 2011 Thirty years of urban regeneration in Britain, Germany and France: the importance of context and path dependency Progress in Planning 75 1-52
[6] Gregorio V and Seixas J 2017 Energy savings potential in urban rehabilitation: a spatial-based methodology applied to historic centres Energy and Buildings 152 11-23
[7] Sousa C D 2008 Brownfields Redevelopment and the Quest for Sustainability (International Journal of Climate Change Strategies & Managemen)
[8] Roger R G 1999 Towards an urban renaissance(Urban Task Force)
[9] WU Liangyong 1994 Old city in Beijing and Juer Hutong(China Architecture & Building Press)
[10] Lombardi D R, Porter L, Barber A, et al. 2011 Conceptualising sustainability in UK urban regeneration: a discursive formation Urban Studies 48 273-96
[11] Erbey D and Erbas A E 2017 The challenges on spatial continuity of urban regeneration projects: the case of fener balat historical district in Istanbul International Journal of Sustainable Development and Planning 12 498-507
[12] Edwin C and Grace L K L 2008 Critical factors for improving social sustainability of urban renewal projects Social Indicators Research 85 243-56
[13] Larsen H G and Lund Hansen A 2008 Gentle gentrification? Urban renewal policies and socio-cultural transformations in Copenhagen Urban Studies
[14] Ding Yi, Wang Hongmei and Chen Xuexiong 2017 Distribution scheme of urban renewal and reconstruction modes based on system dynamics: a case of Guangzhou city Areal Research and Development 36 64-9
[15] Musterd S and Ostendorf W 2008 Integrated urban renewal in the Netherlands: a critical appraisal Urban Research & Practice 1 78-92
[16] Kleinhans R 2004 Social implications of housing diversification in urban renewal: a review of recent literature Journal of Housing & the Built Environment 19 367-90
[17] Yi Z, Liu G, Lang W, et al. 2017 Strategic approaches to sustainable urban renewal in developing countries: a case study of Shenzhen, China Sustainability 9 1460
[18] Simon H, Reyhaneh R and Ali P 2013 ‘Smart’ sustainable urban regeneration: institutions, quality and financial innovation Cities 48 66-75
[19] Wang Tingkwei and Deng Jingjing 2016 A conceptual framework study of urban regeneration scheme decision-making expert system Urban Development Studies 23 47-53
[20] Zhou T, Zhou Y and Liu G 2017 Key variables for decision-making on urban renewal in China: a case study of Chongqing Sustainability 9 370
[21] Noor N M, Zainors A M and Abdullah A 2015 Sustainable Urban Regeneration: GIS and Hedonic Pricing Method in determining the value of green space in housing area Procedia Social and Behavioral Sciences 170 669-79
[22] Colantonio A 2007 Measuring social sustainability, best practice from urban renewal in the EU(Oxford Institute for Sustainable Development)
[23] Aladag H and Isik Z 2016 Sustainable key performance indicators for urban regeneration projects Sigma Journal of Engineering & Natural Sciences 34 1
[24] Ho D C W, Yau Y, Sun W P, et al 2012 Achieving sustainable urban renewal in Hong Kong: strategy for dilapidation assessment of high rises Journal of Urban Planning & Development 138 153-65
[25] Helen Z W, Geoffrey S Q and Hao W 2014 A review of recent studies on sustainable urban renewal Habitat International 41 272-9
[26] Hemphill L, Megeal S and Berry J 2002 An aggregated weighting system for evaluating sustainable urban regeneration Journal of Property Research 19 353-73
[27] Tom K 2012 End in sight? On the (un)sustainability of property development in the Budapest region International Journal of Strategic Property Management 16 37-55
[28] Schadler S, Morio M, Bartke S, et al. 2011 Designing sustainable and economically attractive brownfield revitalization options using an integrated assessment model Journal of Environmental Management 92 827-37
[29] Winston N 2009 Urban regeneration for sustainable development: the role of sustainable housing European Planning Studies 17 1781-96
[30] Andreas S B, Cecilia W 2012 Brownfield residential development: what happens to the most deprived neighbourhoods in England Urban Studies 49 2989-3008
[31] Hemphill L, Megeal S and Berry J 2004 An indicator-based approach to measuring sustainable urban regeneration performance: part 2, empirical evaluation and case-study analysis Urban Studies 41 757-72
[32] Collier C G 2011 The role of micro-climates in urban regeneration planning Municipal Engineer 164 73-82
[33] Hemphill L, Berry J and Mcgeal S 2004 An indicator-based approach to measuring sustainable urban regeneration performance: part 1, conceptual foundations and methodological framework Urban Studies 41 725-55
[34] Giudice V D, Paola P D and Torrieri F 2014 An integrated choice model for the evaluation of urban sustainable renewal scenarios Advanced Materials Research 1030-1032 2399-406
[35] Lu Bin and Wang Chun 2013 Social assessment on performance of urban design in sustainable urban regeneration of historic district: practicing open-style urban design in Nanluoguxiang area of Beijing City Planning Review 37 31-8

[36] Nessa W 2010 Regeneration for sustainable communities? Barriers to implementing sustainable housing in urban areas Sustainable Development 18 319-30

[37] Pediaditi K, Wehrmeyer W and Chenoweth J 2006 Sustainability evaluation for brownfield redevelopment Engineering Sustainability 159 3-10

[38] Williams K and Dair C 2007 A framework for assessing the sustainability of brownfield developments Journal of Environmental Planning and Management 50 23-40

[39] Pediaditi K, Wehrmeyer W and Burningham K 2006 Evaluating brownfield redevelopment projects: a review of existing sustainability indicator tools and their adoption by the UK development industry WIT Transactions on Ecology and the Environment 94 51-60

[40] Lee G K L and Chan E H W 2008 Factors affecting urban renewal in high-density city: case study of Hong Kong Journal of Urban Planning and Development 134 140-8

[41] Ai Dong, Luan Shengji and Hao Jingmin 2008 A review of sustainability assessment for derelict land redevelopment Ecolohg and Environment 17 2464-72

[42] Dennis M H F and Shankar S 2004 An effective project management-based application model for sustainable urban renewal in Hong Kong Project Management Journal 14-34

[43] Rogers C D, Lombardi D R, Leach J M, et al. 2012 The urban futures methodology applied to urban regeneration Engineering Sustainability 165 5-20

[44] Raziyeh F, David B, Dexter H V L, et al. 2012 Scenario-based sustainable water management and urban regeneration Engineering Sustainability 165 89-98

[45] Sakieh Y, Amiri B J, Danekar A, et al. 2015 Scenario-based evaluation of urban development sustainability: an integrative modeling approach to compromise between urbanization suitability index and landscape pattern Environment Development & Sustainability 17 1343-65

[46] Boyko C T, Gaterell M R, Barber A R G, et al. 2012 Benchmarking sustainability in cities: the role of indicators and future scenarios Global Environmental Change 22 245-54

[47] Jeung J Y, Yeon G J and Seungil L 2011 Evaluating integrated land use and transport strategies in the urban regeneration projects toward sustainable urban structure: case studies of Hafen City in Germany and Shinagawa Station in Tokyo International Journal of Urban Sciences 15 187-99

[48] Wallbaum H, Krank S and Teloh R 2011 Prioritizing sustainability criteria in urban planning processes: methodology application Journal of Urban Planning & Development 137 20-8