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# Repurposing the Built Environment: Emerging Challenges and Key Entry Points for Future Research

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**Abstract:** The built environment faces challenges in all three dimensions of sustainable development—economic, social, and environmental. The increasing loss of functionality is a cross-sectional issue affecting buildings and settlements and their layering of social, spatial, and cultural processes. Based on a critical review, this paper aims to bridge the gap between international charters and ongoing research for built environments losing their original uses. Three emerging challenges to sustainability in repurposing are outlined from the debate, checking their incidence on research: (a) values preservation, (b) resources optimization, (c) systems effectiveness promotion. Experiences of conversion and regeneration in Japan, the Netherlands, Australia, Hong Kong City, and the USA are taken into account with the aim of comparing approaches, methods, and results. The discussion highlights three key entry points for future research on built environments: (1) communities involvement: new alliances between stakeholders, (2) the potential of technologies: combining resources' protection and affordability, and (3) renewed productivity to preserve values and uses.

**Keywords:** built environment; repurposing; values; resources; effectiveness

## 1. Introduction

Long relegated to the margins of the debate on heritage conservation, built environment repurposing is today a topic at the forefront for sustainability [1,2]. Rapid and uncontrolled urbanizations, social and spatial fragmentations, and drastic quality deterioration are some of the processes triggering built spaces vulnerabilities with the loss of functionality and abandonment [3].

Assuming built environments as key testimonies of the cultural, economic, and social layering of settlements [4], the commitment to repurposing is taking on a priority role within theoretical debates [5]. In addition to the focus on memories and values preservation, scholars at present are increasingly involved with a sustainable reuse of built spaces that have outlived the function for which they were designed [6]. In a scenario marked by the environmental crisis, with emerging societal and economic challenges [7], theoretical debates and research focus on tailored approaches and measures aimed at finding out compatible functions and dynamic uses [8]. Social inclusion and waste containment become central drivers of approaches to sustainability [9].

Based on the assumption that architectural regeneration can support the shift from a linear make–use–dispose perspective to the closure of loops, a conceptual framework on built environment repurposing is outlined by the LRRM Lab of the University of Naples, DiARC, within the funded research project—Prin (2010–2012) *Historic urban landscapes between conservation and transformation* (Italian Miur 2010PEA4H8\_002). According to the achieved results, the aim of this paper is to identify new areas of investigation.

Countless examples of disused, decaying, and abandoned built environments have been stimulating, during the last 25 years, the exploration of theories and approaches aimed at giving

new life to spatial and social contexts [10]. The legal guarantees, benefits, and the fruition duration were assumed as investigation fields [11,12]. In cases of decaying and abandoned systems, a special declination of adaptability was explored through a transitory repurposing [13], with an occasional use foreseen, waiting for final conversion. Dynamic fruition or dynamic transformation were tested, focusing on the technical and constructive characters [14,15]. Conceiving the built as a privileged arena where to experience transitions towards sustainability, the paper deals with the following main research questions: (1) Which are the main challenges faced within the international debate and shared by research? (2) What are the approaches and methods? (3) Are there cultural and procedural gaps between debate and research? (4) What are the future key entry points for design?

Supported by a critical review, the paper moves from the hypothesis that an increase in built environment repurposing awareness has been achieved internationally since the Nara Document on Authenticity in 1994 [16]. The UNESCO Historic Urban Landscape document in 2011 [17] paves the way towards the circular economy paradigms [18,19]. A content analysis of official documents and research reports drove the interpretation of the heritage-led and people-centered repurposing processes [20]. The qualitative approach supported the definition of a complex framework. Three cutting-edge challenges emerged from the observation: (a) Value preservation; (b) resource optimization; and (c) systems effectiveness promotion. Adopting an empirical perspective, the paper is articulated as follows: First, a concise background is given on terminology and issues, with the methodology description (Section 2); then, the critical reviews of international policies are presented (Section 3), relating them to recent research on built environment repurposing matured in different cultural contexts—Japan, the Netherlands, Australia, Hong Kong City, and the USA (Section 4); finally, key entry points for future research are suggested (Section 5).

## 2. Issues and Methods

The term regeneration has been used as an umbrella concept with a special focus on protection, preservation, and repurposing as opportunities of—cultural, natural, and built—legacies for future generations. Conceiving regeneration as the process aimed at improving settlements' qualities, creating the conditions for a sustainable and inclusive growth, the need to recover underused or abandoned spaces has been informing several experiences and strategies in Europe since the 1990s [21]. Within regenerative practices, design for repurposing has been defined as the process for buildings and urban settlements that have lost their original purposes while retaining their material and constructive features [22]. It concerns the loss of functionality of individual buildings or built systems, and their layout reorganization [23] that extends their life cycle and can modify configurations without altering the original conceptions [24].

Within a dialectical process aimed at matching conservation and transformation instances, the LRRM Lab (University of Naples, Federico II) has long been working on design constraints for regeneration—cultural and perceptive, morphological and dimensional, material and constructive—able to drive processes [25], linking quality expectations and compatibility [26]. The concept of built environment adaptability was explored, crossing the issues of conservation with users' requirements, through the observation of meanings, purposes, and opportunities. Compatibility to repurposing is a research field where the LRRM lab has been working for long, outlining the differences between adaptation within use, providing for functions' conservation with the addition of auxiliary uses, and adaptation across uses with a mix of different services [27].

Focusing on the cultural changes in the debate, this paper aims to bridge the gap between international charters and ongoing research for built environments losing their original uses, addressing a theoretical problem that can affect future design in several practical ways [28]. The method is based on a content analysis. Two sources of texts were selected: International documents officially approved by organizations responsible for protecting the built environment (Section 3) and research papers (Section 4). The method has been identified as the most suitable due to the richness of an open debate supported by ongoing research projects. In Section 3, fifteen documents—agreements,

recommendations, and guidelines focusing on built environment repurposing—were selected among those produced during the last 25 years by ICOMOS, UNESCO, and the European Ministers. Following a diachronic perspective, the documents were grouped according to the aims, commitments, and strategies they outline. Extending beyond the concept of memory protection, the international organizations for built environment link the issues of built environment repurposing with: (a) Values preservation, exploiting the inherited material and immaterial resources; (b) resources optimization, promoting economic and environmental benefits—as an efficient and lessened use of primary resources combined with improved waste collection; (c) systems effectiveness promotion, resource recycling, and energy recovery [29]. In Section 4, researchers from five geographical contexts were selected for their commitment in the definition of adaptability thresholds, promoting temporary, transitory, or dynamic solutions aimed at values preservation, resources optimization, and systems effectiveness promotion [30]. For each country, the paper describes design policies; for each researcher, it puts in place a deductive analysis through paper peer review, supported by electronic databases and Google search engines, with the aim of compiling comparable tables that report methodologies and tools, case studies, and findings. The analysis highlights an evolution in the approaches, progressively satisfying changing needs, through a dynamic use of disused, decaying, and abandoned spaces [18,19].

Crossing data, the content analysis—of Sections 3 and 4—returns a complex framework for built environment repurposing, marked by three cutting-edge challenges: (a) Values preservation, (b) resources optimization, and (c) systems effectiveness promotion. Reading through the data and interpreting them paved the way to key entry points for future research.

### 3. The International Conceptual Framework

Recurring to a theoretical simplification, 15 international documents dealing with built environment repurposing were analyzed and grouped into three categories according to the aims, commitments, and strategies they outline.

(a) Documents linking the issues of built environment repurposing with values preservation. Since 1994 with the Nara Document on Authenticity [16], the international debate has dealt with the idea that physical, cultural, economic, and social values protection is essential to promote human development. The diversity of cultures is an irreplaceable source of richness. The Nara Document links diversity protection to human development (art. 5). Uses and functions are suggested as authenticity factors which can orientate conservation, in addition to forms and design, materials and substance, traditions and techniques, location and setting, and spirit and feeling (art. 13). Two main issues, arising within this document, are at the basis of the later international debate: Life cycle lengthening and the stakeholders' involvement. Within the Nara Document, these themes refer to the idea that heritage belongs to the cultural community, and their management is entrusted to it (art. 8). Ten years later, the Vienna Memorandum [31] returned to these issues, focusing on the impact of contemporary development on the overall urban landscape of heritage significance (art. 11). Arguing that historic urban landscape has shaped modern society, the document suggested that it is composed of character-defining elements that include land uses and spatial organization (art. 7 and 8) and that it acquires its exceptional and universal significance from a gradual evolutionary. These continuous changes in the inherited historic urban landscape require visions and forward-looking actions on the part of decision-makers, and a dialogue with the other actors and stakeholders involved (art. 13). The document outlines procedural approaches for managing dynamic changes and developments, anticipating issues related to conversion codes and regulations in adaptation (art. 27). A central concern of physical and functional interventions is to enhance the quality of life and production efficiency by improving living, working, and recreational conditions and adapting uses, not only through the improvement of technical standards but also through a conversion and contemporary development based upon a proper inventory and assessment of its values (art. 17). In 2007, the Leipzig Charter on Sustainable European Cities contributed to the international debate on architectural and urban life cycle lengthening, emphasizing how European heritage includes not only historic buildings but also public

spaces [32,33]. The Charter underlined the concept of *baukultur* as the sum of all the cultural, economic, technological, social, and ecological aspects influencing the quality and process of cities' planning and construction. Making greater use of integrated urban development policy approaches is an aim that can be achieved through the involvement of both the economic stakeholders and general public (I. Recommendation). Three strategies for action take into account the possibility of repurposing the built environment: Creating and ensuring high-quality public spaces; modernizing infrastructure networks; and promoting proactive innovation and educational policies. The 2008 Quebec declaration on the spirit of place preservation contributed to the international debate with a theoretical reflection on the built environments' identity and relationship between tangible (sites, buildings, landscapes, routes, objects) and intangible elements (memories, narratives, written documents, festivals, commemorations, rituals, traditional knowledge, values, textures, colors, odors, etc.), which all significantly contribute to making place [34]. Since the spirit of place is a continuously reconstructed process, the document focused on the needs for change and continuity, expressed by various social actors, architects, and managers as well as users (art. 1), assuming that their requirements can vary in time and from one culture to another, according to memory practices (art. 3). Recognizing that the spirit of place is transmitted essentially by people, the declaration focused on the benefits of conservation through communication and the participation (art. 8). The New Zealand Charter [35] underlined that conservation maintains and reveals the authenticity and integrity of a place (art. 5); interventions should be the minimum necessary to ensure the retention of tangible and intangible values and the continuation of uses integral to those values (art. 6). The conservation of a place of cultural heritage value is usually facilitated by the place serving a useful purpose (art. 8). The document stressed the links between the cultural heritage value, uses, and productivity (art. 9–12). Alterations and additions may be acceptable where they are necessary for a compatible use of the place. Proposals for the adaptation of a place may arise from maintaining its past functions, or from a proposed change in uses (art. 21).

(b) Documents linking the issues of built environment repurposing with resources optimization. These documents deal with the idea that life cycle lengthening and stakeholders' involvement can support built environment repurposing, balancing urban growth and sustainable development. In 2010, the Urban Development Ministers processed the Toledo declaration, taking into account the urban dimension of the emerging crises and challenges faced by cities [36]. The repurposing of abandoned, derelict or unused areas was proposed as a key strategy for contributing towards the reduction of urban sprawl (art. A.2). Paying attention to urban productivity, the declaration aimed not only at quality improvement, raising attractiveness to highly skilled workers and business, but also at local residents' identification within a community (art. C.2). The values of democracy, coexistence, exchange, civic progress, diversity, living together, and freedom are key factors in the culture of the European city. Integrated urban regeneration was proposed as a planned process that addresses the city as a functioning whole and its parts, with the objective of fully developing and balancing the complexity and diversity of the social, economic, and urban structures, while at the same time stimulating greater environmental eco-efficiency (art. 3). This concept aims to optimize, preserve or revalue all the existing urban capital (social, built environment, heritage, etc.). From an operational viewpoint, the tools that could favor an integrated urban regeneration include the physical upgrading of buildings and urban spaces, the management of uses, protection of the landscape, and cultural heritage (art. 4). In 2011, the Valletta Principles [37] recognize that historic towns and urban areas, as living organisms, are subject to continual changes (art. 1). When appropriately managed, these can be an opportunity to improve the quality of built environments on the basis of their original characters (art. 2). The loss and/or substitution of traditional uses and functions, such as the specific way of life of a local community, can have major negative impacts on the productivity of settlements (art. 4). New activities must therefore be carefully managed to avoid secondary negative effects such as transport conflicts or traffic congestion. At the same time, the speed of change is a parameter to be controlled. Excessive speed can adversely affect the integrity of the original values. The extent and frequency of intervention must be embedded in and compatible with feasibility and planning documents and studies (art. 3).

The 2011 ICOMOS Paris Declaration on heritage as a driver of development outlined the need for a return to the art of building [38]. This document also underlined the centrality of affordability, developing the economic impact of heritage (art. 4). Local people, civil society, and elected local and national officials play a key role in the design and implementation of heritage as a driver of development, and, through raised awareness, they have ownership of processes (art. 5). Within the Recommendation on the Historic Urban Landscape [17], heritage was conceived, including its tangible and intangible components, as a key resource in enhancing the livability of urban areas; it is able to foster economic development and social cohesion in a changing global environment (art. 3). As the future of humanity hinges on the effective planning and management of resources, conservation has become a strategy to achieve a balance between urban growth and the quality of life. The historic urban landscape approach aims at preserving the environmental quality, enhancing the productive and sustainable use of urban spaces, while recognizing their dynamic character and promoting social and functional diversity (art. 11). It integrates the goals of urban heritage conservation and those of social and economic development. The historic urban landscape provides tools to manage physical and social transformations, ensuring that contemporary interventions are harmoniously integrated with heritage (art. 12). When properly managed through the historic urban landscape approach, new functions, such as services and tourism, are important economic initiatives, contributing to the communities' well-being and the built conservation. The Burra Charter for the conservation of places of cultural significance in its last version [39] states that the conservation, interpretation, and management of a place should provide for the participation of people for whom the place has significant associations and meanings, or who have social, spiritual or other cultural responsibilities (art. 12). Conservation may include the processes of retention or reintroduction of a use; retention of associations and meanings; maintenance, preservation, restoration, reconstruction, adaptation, and interpretation; and will commonly include a combination of more than one of these (art. 14). Adaptation is acceptable only where it has minimal impact on the cultural significance of the place (art. 21).

(c) Documents linking the issues of built environment repurposing with systems effectiveness promotion. The selected documents deal with the idea that only the recircularization of resources with waste reuse and containment can positively impact on sustainability with the reduction of growing pressures on built environment, through a proactive commitment to future generations. Introducing the UN Sustainable Development Goals and the New Urban Agenda, ICOMOS suggested that cultural heritage, historic cities, and settlements are a reference model for sustainable development. Historic cities demonstrate mixed uses, human scale, density, and vibrancy [40]. By their repurposing, economically, environmentally, and socially, they also demonstrate resilience. The Operational guidelines for the implementation of the World Heritage Convention declared that properties may support a variety of ongoing and proposed uses that are ecologically and culturally sustainable and which may contribute to the quality of life of communities concerned [41]. In 2018, ICOMOS with the EU–Cherishing Heritage–Quality principles for intervention on cultural heritage provided a guidance for any stakeholder directly or indirectly engaged in EU-funded heritage conservation and management [42]. Cultural heritage is a resource for society, retaining and transmitting the many and diverse values of Europe's culture to the future (art. 1). Cultural heritage has value in its own right: An inheritance or legacy that is not only material, since it embeds ideals, principles, and values that constitute a shared source of remembrance, understanding, identity, dialogue, cohesion, and creativity for Europe. The European Union supports cultural heritage conservation. Quality in interventions on cultural heritage is a crucial and challenging issue (art. 2.1); stakeholders (citizens, the public sector, the voluntary sector, the private sector, politicians, and heritage professionals) have points of view on quality (art. 2.2). Referring to the issue of stakeholders' involvement, the Faro Convention and its Action Plan Handbook 2018–2019 marked a cultural change in heritage-led design strategies. The commitment and capacity for resources mobilization suggested as opportunities for contexts' adaptability are supposed to empower communities to take an active role in decision making [43].

Linking the circular economy vision to the imperatives of social cohesion and built environment protection, from this moment on, design strategies for regeneration are built on a community active involvement, promoting trade-offs between the users' needs and design requirements, accounting for our planet's needs. The Ellen MacArthur Foundation approach to growth crosses all these visions, suggesting that ever-growing economic profitable development can happen without an ever-growing pressure on the environment [19]. Its assumptions are endorsed by the World Economic Forum [44].

#### 4. The International Research Framework

This section proposes a critical review of some research experiences on built environment repurposing. Five geographical contexts were selected (Japan, the Netherlands, Australia, Hong Kong City, and the USA). The methodological approach was based on an observation of the design policies developed and a deductive analysis of the selected research through peer review papers.

##### 4.1. Repurposing the Built Environment in Japan

In Japan, the buildings' life expectancy has always been conceived as shorter than in European countries. For a long time, there has been no policy for adaptive reuse; "Scrap & Build", "Demolish & Rebuild" are the slogans that better synthesize common approaches both to the built environment and heritage. Reuse perspectives matured within the post-war housing policies, with the aim of the Japanese construction market to reach, by 2008, a number of houses larger than the number of families. The key entry point for research is the repetitiveness of the traditional Japanese home. Since the 1970s with the Kodan—Experimental Housing Project (KEP), the Japanese Housing Corporation has paid particular attention to flexibility and adaptability. In the 1990s, the Skeleton Infill SI system provided buildings in two phases; first, "S" (skeleton), indicating the enduring part and the social property, and second, "I" (Infill/fit-out), representing the short-lived part and private property. In 2006, the Basic Housing Plan promoted the "200 years of housing", initiative aimed at extending the useful life by designing buildings with excellent durability, answering to maintenance and management requirements [45].

Buildings conversion for temporary use is the effective way to overcome the vulnerability of the depressed areas. In the public sector, reuse policies are characterized by a growing awareness about the link between the demand for new uses and the economic and social changes. The building must be the core of the settlement development, which is why repurposing and temporary uses are supposed to be more effective if they are part of a redevelopment plan. Regeneration strategies are based on the definition of periods for temporary use but not on buildings conservation. Administrative procedures are, therefore, shorter than demolition and reconstruction [12].

In 2007, Toru Eguchi, at Yokohama National University, coordinated a group of Japanese academics to analyze the buildings conversion for temporary use in the public sector (see Table 1 for a detailed analysis).

**Table 1.** Conversion costs for temporary use in the public sector [12].

<b>Methodology/Tools</b>	Deductive analysis, qualitative and quantitative data; term of urban planning; depreciation term of the steel and reinforced concrete for office buildings, residential use and commercial use; period of use; conversion/completion year; conversion costs
<b>Case studies</b>	17 samples of reuse of large department stores: 4 for temporary use; 23 samples of reuse of public school: 16 for temporary use
<b>Findings</b>	No difference between temporary use or not, for large department store; demolition of schools after temporary use; temporary use established by urban planning; reduced costs and risks for limited periods of use; shorter administrative procedure to scrap and build; temporary use conversion to attracts private investments

The following research assumptions informed his work: (1) The public sector is interested in the reuse of existing buildings to save funds, but conversions can change the character of settlements. Furthermore, costs are a high-risk factor; and (2) the global economic and social crisis of the 21st century led to the closure of a large number of commercial activities with the creation of marginal and depressed urban areas. The number of closed schools increased due to the decline in birth-rate, especially in metropolises.

Issues research has focused on temporary use to limit costs, with the aim of attracting the investment of privates for urban regeneration. The choice is based on two reasons: The first is the term of urban planning (10 to 15 years). The second is buildings' depreciation term: Steel and reinforced concrete structures for offices' use is 50 years, while for residential use it is 47 years and for commercial use 39 years. The local government bought land and buildings. The national government subsidized the costs for reactivation of the local economy. In the public sector, buildings should be used as long as possible. The residents are expected to participate in the decision-making process, often deciding to demolish and rebuild. The national government contributes to the costs of building public schools if they keep their use for the present time, otherwise money should be returned.

In the last few years, an international team led by Eguchi has worked on adaptability criteria referring to buildings, highlighting the maturation of design concepts in technical innovation, and priorities and critical issues for the realization of adaptable projects (see Table 2).

**Table 2.** Cultivation of adaptability [45].

<b>Methodology/Tools</b>	Deductive analysis and qualitative data; semi-structured interview six professional architectural firms: Large general contractors, Large architectural design firms, Small design studios
<b>Case studies</b>	Takenaka Corporation Tokyo Main Office (Large general contractor); Mokuzaikai Kaikan (Large architectural design project); c-MA1 (Small design atelier)
<b>Findings</b>	Six levels of adaptive strategies: refitable, scalable, mobile, recyclable, available, flexible for different layers of the building

Their aim is to understand if architecture practice can be an arena of change, outlining the role of architects as facilitators. The issues the research focused on are as follows: (1) There is no single solution for the adaptability of buildings; (2) focusing on the private sector, adaptability requires good relationships, communications, integrations, and shared aims among stakeholders; (3) various solutions are illustrated in the design of modern office buildings to increase convertibility over time; and (4) when reusing an existing building, design should aim to develop a business model for residential construction and, at the same time, an investment model.

#### 4.2. Repurposing the Built Environment in the Netherlands

In the Netherlands, 50% of consumption of raw materials is absorbed by the construction sector. This is responsible for 35% of the national waste production. In 2012, the Dutch government with the companies in the construction sector promoted the development of a method to assess the adaptive capacity of buildings. There is a direct connection between adaptive reuse and sustainable development. Through reuse, buildings extend their functional life cycle, promoting the circular economy. The interest in buildings' adaptability increases in relation to their high structural availability, economic crises, and greater awareness of an interest in sustainability issues. The circular economy is a new key to understand the sustainability concept. It depends on the long-term utility value of buildings [46].

A team of researchers led by Rob Geraedts at the Delft University of Technology focused on the study of the adaptive capacity of buildings, already existing or in the design phase [14,15,46,47]. To this end, they worked on the development of a method aimed at evaluating adaptive attitudes, taking into account several aspects (see Table 3 for a detailed analysis). The research assumptions were

as follows: (1) Any building can have six functional levels, distinguished by the technical, functional, and economic life span: Site (eternal life span); structure (50 years life span); skin (about 20 years life span); services (from seven to 15 years life span); space plan (three years life span); and stuff (continuously moved) [48,49]. (2) There are three possibilities to manage a building that does not meet the users' needs: Conversion/transformation; design and construction of a new one; functions transfer to an existing building that meets the requirements. (3) The building adaptive capacity assessment guarantees its preservation for the next generations of users. The adaptive capacity of buildings is given by its long-term utility value. (4) To secure future uses, the current users and owners need to be involved.

**Table 3.** Adaptive capacity of buildings [46]; the CE meter assessment tool to evaluate the level of a building's circular economy [14]; development of a tool to evaluate the adaptability of school and office buildings [15]; improvement of FLEX 3.0 [47] and FLEX 4.0 [47].

<b>Methodology/Tools</b>	Deductive analysis, qualitative and quantitative data; evaluation method to shape a requirements system of adaptability for new building or to define a performance system to map the adaptability of an existing building; setting of: transformation dynamics indicators for owner and for users; dedicated spatial/functional flexibility indicators and specific construction/technical flexibility indicators for owner and for users; scale of 5 values for flexibility requirements of spatial/functional and constructive/technical characters; involvement of 2 groups of experts: customers, construction companies and supplier; new requirements to rearrange flexibility, extend flexibility, reject flexibility for location/building/unit; 5 different layer of building; indicators of transformation dynamics and indicators of dynamics use for buildings; dedicated flexibility performance indicators for school building; specific indicators of flexibility performance for office buildings; scale of values for all performance indicators; variability of weighting factor; 5 class of flexibility scores
<b>Case studies</b>	Schools, hospitals, offices or residential buildings: feasibility assessment for investment decisions; to formulate the request for or evaluating flexibility; to determine the economic-financial profitability; to determine the sustainability impact of the several measures
<b>Findings</b>	FLEX 2.0: 147 flexibility performance indicators; FLEX 3.0: reduction of 147 indicators in 83 new flexibility performance indicators of buildings; FLEX 4.0: combination of 3 adaptability assessment instruments; reduction of 83 indicators in 44 flexibility performance indicators of buildings

The research issues were as follows: (1) Building flexibility can be determined by spatial/functional and constructional/technical characteristics; (2) stakeholders involvement; (3) location of a building in the urban context; (4) use and transformation dynamics on three different levels: Location, building, and unit; (5) legal, organizational, and constructional preconditions; and (6) year of construction, the last renovation, and category of users. Further refinements of the developed methodology first led to the creation of the CE Meter, an assessment tool that evaluates the level of a building's circular potential [14], and then to the development of a specific tool to evaluate the adaptability of schools and offices [15]. FLEX 3.0 and FLEX 4.0 are an update of the previous versions [47].

#### 4.3. Repurposing the Built Environment in Australia

An increasing awareness of the sustainable development principles marks the young Australian continent's approach towards built heritage conservation [50]. Built heritage conservation and



environmental preservation are key issues for economic, cultural, and social benefits [51]. Nevertheless, historic buildings repurposing is not yet considered profitable by many owners and developers due to the difficulties in adapting to current users' needs.

There are four fundamental themes in the urban regeneration programs in many Australian cities: Conservation-led regeneration; conservation and sustainability; conservation and planning process; and governance. The cultural value of historical buildings is at the origin of the main conflicts [23]. Reusing and adapting old buildings through performance adjustments is less expensive than demolishing and rebuilding, reducing the consumption of materials, energy, transport, and pollution. Guidelines support new buildings designed for a short life cycle that can easily be discarded and demolished. Obsolescence and cost containment limit repurposing. Due to cost containment, the achievement of performance levels equal to those of a new construction cannot be reached [23]. An adaptive reuse strategy is preferable only to demolition if it is possible to achieve the objectives of environmental sustainability and reduction of energy consumption [28].

The aim of Peter Bullen at the Curtin University was to carry out a preliminary survey about the building owners' opinions in Western Australia regarding adaptive reuse and how it is possible to achieve acceptable levels of performance by improving sustainability (see Table 4).

**Table 4.** Sustainability perspective for owners and managers on commercial buildings in Western Australia [23].

<b>Methodology/Tools</b>	Inductive analysis, qualitative data; interviews tool of 30 members of a multi-stakeholder group with 5 open-answer questionnaires sent by email
<b>Case studies</b>	Commercial building in Western Australia
<b>Findings</b>	Adaptive reuse preferable to demolition and reconstruction; adequate strategy to make the built environment more sustainable; critical issues: high conversion and maintenance costs; underestimation of social and environmental benefits

Another objective was to evaluate how existing buildings adapted to change, identifying at the same time principles and strategies for new adaptable and sustainable buildings. The research assumptions were as follows: (1) A horizon of sustainability supports the adaptive reuse of buildings; (2) the active role of the main stakeholders in promoting the adaptive reuse of buildings; and (3) extension of the life cycle is preferable to demolition and reconstruction. The issues the research focused on were: (1) There are divergent opinions about the extent of the benefits and obstacles to the adaptive reuse of buildings. (2) There are obstacles concerning the economic aspects due to higher conversion costs, maintenance costs compared to new buildings. (3) There is a growing awareness that the assessment of the feasibility of adaptive reuse focuses on economic criteria, with the exclusion of social and environmental aspects.

A key issue for the decision-making process of adaptive reuse or demolition emerges from the awareness that buildings are unique systems and that not all are adaptive. The decision-making process depends on the commercial performance of the building during its life cycle. If for building managers, energy and water consumption, CO<sub>2</sub> emission, maintenance costs, and management are prevalent, for owners, the results of the adaptive reuse of a building depend on the flexibility of interior space to accommodate new functions. The buildings' typology, the adaptability performance, and dimensional flexibility mark the final suitability to repurposing, as well as system integrability.

Bullen and Love proposed a model to support the decision-making process of adaptive reuse for owners and users given by four complex interdependent systems of criteria that concerned the social, economic, environmental, and sustainability governance aspects [50]. Often, in the operating practices, building owners, designers, and construction companies are reluctant to promote buildings repurposing due to their layout adaptability, the costs of reconversion and maintenance, and the

inevitable risks and uncertainties for their placement in the real estate market [50]. Bullen and Love argued that the crux of the decision-making process is given by the evaluation of the extent of conversion with the profitability resulting from adaptation during the life cycle. Through adaptive reuse, sustainability can be improved if costs and social benefits are optimized. In a further study, the scholars focused on the social, natural, and economic impacts (see Table 5). Three key factors were outlined in the decision-making processes for adaptive reuse: (1) Capital investment; (2) asset condition; and (3) regulation. Regarding this issue, any law is not required to entrust projects of adaptive reuse. However, it was observed that the adaptation to the regulations for safety and fire protection and for the removal of architectural barriers constitutes a deterrent and an obstacle for repurposing due to the high economic costs. The flexibility in the interpretation of mandatory rules, without compromising users' safety, could instead encourage alternative strategies to demolition and construction.

**Table 5.** Procedural strategies to the decision-making process for owners, users and contractors [50]; improving procedural strategies to the decision-making process [28].

<b>Methodology/Tools</b>	Inductive analysis, qualitative data; interviews, 81 multi-stakeholder (architects, planners, building contractors, owners and building manager) active in Perth City; conversations recorded and transcribed; anonymity of interviewees; QSR Nvivo tool
<b>Case studies</b>	Perth City
<b>Findings</b>	Social, economic, environmental and sustainability governance systems supporting the decision-making model for adaptive reuse; assessments reliant on commercial performance of building, on costs of adaptive reuse, productivity and viability levels from the new function; assessment of reuse convenience influenced by physical building conditions, structural integrity, transformation and maintenance costs, adaptation to standards safety and fire protection

#### 4.4. Repurposing the Built Environment in Hong Kong City

Before 1997, in Hong Kong City, built heritage preservation was rarely supported by the British government. In the name of urban development and economic prosperity, many historic buildings were demolished. After 1997, with the change in sovereignty, built heritage conservation became a strategy to protect local identity and to transmit cultural heritage to future generations. The government undertook a series of institutional and administrative initiatives aimed at protecting public and private heritage; adaptive reuse assumed a pre-eminent role through the revitalization of sites.

Hong Kong is the city that produces more greenhouse gas emissions and one of the most densely populated all over the world. The island is faced with an increasing number of inhabitants, and the lack of housing and land to build. Although the Housing Authority provides public residencies for over 2 million inhabitants, and every year, 15,000 new public housing units are rented, the severe lack of housing is a structural problem [52]. This shortage of available space and the high population density lead to the demolition of obsolete buildings and replacement with new ones. In 2008, the Hong Kong government activated the "Revitalizing Historic Buildings Through Partnership Scheme". This reflects the need to preserve identities and characters through the use of a sustainable financial model. Finally, today, there is a growing interest in the revitalization and conservation of old private owned buildings, part of an ancient urban building fabric that is disappearing.

The studies carried out by a team of international researchers led by Craig Langston at the Hong Kong Polytechnic University aimed at the definition of a conceptual framework for the assessment of potential projects of adaptive reuse through financial, environmental, and social factors [30]. The research assumptions were as follows: (1) Although obsolete, abandoned or demolished buildings are mines of raw materials for new projects, the adaptive reuse approach has gained greater strength because it allows environmental and social benefits and contributes to the conservation of built heritage. (2) The life cycle of a building can be compromised by one or more phenomena of physical, economic,

functional, technological, social, and legal obsolescence. (3) Buildings can become obsolete long before their physical life has come to an end. The issue the research focused on is the definition of a conceptual framework for the assessment of potential projects of adaptive reuse through financial, environmental, and social factors.

Langston, Wong, Hui, and Shen developed an algorithm estimating the useful life of buildings based on potential obsolescence determined by physical, economic, functional, technological, social, and legal aspects [24]. A multicriteria methodology approach was proposed to identify and rank the adaptive reuse potential (ARP) model for existing buildings. It compares the building's estimated physical life in years with its current age. It is based on the physical, economic, functional, technological, social, and legal obsolescence assessment in order to estimate the reduction in life expectancy. The studies conducted enabled the creation of SINDEXTM. It is a sustainability assessment tool that can replace the current conventional net worth methodologies to classify and select projects. Shen and Langston, in a subsequent advancement of studies based on two contemporary studies, applied the ARP model in two different geographical contexts, Hong Kong and Melbourne City [52]. The validation of the effectiveness of the ARP model showed that its impact is indifferent to the urban or peri-urban location of the examined case studies. What varies is the value of the ARP because it is influenced by the cultural approach and by the operational practice (see Table 6 for a detailed analysis).

**Table 6.** Sustainability assessment tool to classify and select reuse projects [30]; application of the adaptive reuse potential (ARP) model in Hong Kong City and in a non-urban area of Melbourne City [24].

<b>Methodology/Tools</b>	Deductive analysis, qualitative and quantitative data; multi-criteria approach for ARP model: assessment of physical, economic, functional, technological, social and legal obsolescence; 4 criteria for Sustainability index (SINDEXTM): return on investment, increase of functional performance, reduction of energy consumption, loss of habitat; validation of the indicators underlying the ARP model; observations and inspections to integrate databases in Australia and Hong Kong City
<b>Case studies</b>	Western Market in Hong Kong City; 12 urban case studies in Hong Kong City; 12 case studies in rural areas of the Melbourne City
<b>Findings</b>	Adaptive Reuse Potential (ARP); SINDEXTM software; effectiveness of ARP model indifferent to urban or non-urban location of buildings; ARP score varies for different cultural approaches and operational practices; feasibility in different contexts to orientate the setting and management of adaptive reuse

The aim of the research carried out by Tris Kee at the University of Hong Kong was to identify the strategies for disused industrial buildings (vips = vacant industrial premises), investigating the technical and administrative feasibility of repurposing [52]. The research highlighted the possibility of converting disused industrial buildings to temporary public housing on the basis of technical feasibility and town planning verification (see Table 7).

The research assumptions were as follows: (1) In Hong Kong, institutional investors and real estate companies hold industrial properties, and change in the nature of industrial production, in a place of residential activities, requires consensus on zoning, adjustments to regulatory conditions, and changes in ownership models; (2) the benefits of converting to temporary housing in Hong Kong, for young professionals who cannot make a first down payment for home ownership in the current real estate market. The issues the research focused on were: (1) The capacity for adaptive reuse of industrial buildings is based on three approaches: structural integrity, architectural layout feasibility, and urban planning assessments; (2) the involvement of focus groups of stakeholders (representatives of the district council, owners of private factories, architects, and planners and real estate developers) to deepen their understanding of the potential and constraints in adaptive reuse.

**Table 7.** Integrated urban regeneration strategy and adaptive reuse of vacant industrial buildings for residential use in Hong Kong City [52].

<b>Methodology/Tools</b>	Inductive and deductive analysis, qualitative and quantitative data; structural integrity and architectural layout feasibility criteria, urban planning assessments approaches; 2 phases of research: 1- inspections and archive research of 256 industrial buildings; 2- set of 511 questionnaires to a sample of local housing authorities; 5 separate focus groups of stakeholders for discussion of emerging themes
<b>Case studies</b>	Industrial district Kwun Tong in Hong Kong City
<b>Findings</b>	Potential conversion industrial buildings into temporary public housing through check of accessibility requirements for safety and fire protection, luminous, acoustic and thermo-hygrometric welfare for residential buildings; urban feasibility assessments on the needs of the examined districts and loading capacity of existing/project infrastructural systems; feasible adaptive reuse of industrial buildings in Kwun Tong district into temporary public housing for disadvantaged people

#### 4.5. Repurposing the Built Environment in the United States of America

A reversal of trends marks the USA experience, with the predominance of direct interventions on research. In Pittsburgh, the first post-industrial adaptive reuse strategy dates back to 1945, when the city administration and the business community dealt with the end of the peak of war production, and a large number of factories were abandoned. It is necessary to wait until the second half of the 20th century for a debate on industrial heritage with the creation of industrial archeology associations.

In the 1960s, in New York City, adaptive reuse was a bottom-up operational practice, a fragmented and self-taught process, as evidenced by the revitalization of the SoHo District in Manhattan [53]. Slowly, the town planning committee accompanied the change due to the positive role played by artists in a repurposing process, through the editing of the Artist in Residence Law (AIR), to rent lofts at favorable prices. With the establishment of the community of artists, the first art galleries moved, the spaces were adapted to the requirements of new users. In 1973, the district was declared the SoHo-Cast Iron Historic District by the New York City Landmarks Preservation Commission [54]; rental costs increased, and many artists and art galleries moved to the Chelsea district, leaving space for luxurious commercial activities. In 2010, the New York Monuments Conservation Commission extended the district's borders, including 135 more buildings [55]. In a different way, an adaptive reuse was promoted for the industrial settlement of Chelsea, transforming it into a contemporary art district, with restaurants, bars, boutiques, hotels, and luxury residential buildings. Since 1997, the industrial complex of the former Nabisco has undergone important transformations; in 2011, the former industrial complex was sold to Jamestown Properties. In March 2018, Google Alphabet Inc. [56] purchased Chelsea Market for \$2.4 billion, defining the second most expensive real estate transaction in New York history [57–64]. A unique mix of functions was settled, combining laboratories of taste and technological innovation [65]. The Chelsea Market is located within the Gansevoort Market Historic District, recognized by the State of New York and the National Register of Historic Places [66]. A different repurposing approach was adopted for the Meatpacking District, a small neighborhood in Southwest Manhattan. Its regeneration began in the 1990s due to 30 years of physical, economic, and social degradation. The transfer of luxury fashion shops and artists' studios, the organization of fine restaurants, the opening in 2015 of the Whitney Museum of American Art, and the reuse of High Line as Hanging Garden, strongly supported by a committee of resident citizens, contributed to this. In 2003, the New York City Landmarks Preservation Commission designated the Meatpacking District as the Gansevoort Market Historic District. The repurposing process was based on a skillful process of negotiation between developers and old tenants [66]. Retail rents in the Meatpacking District increased by 5% between the first quarters of 2017 and 2018; the District is a destination for pioneer companies

looking for new retail concepts. Samsung’s digital playground, Hermes headquarters, the Lexus and Tesla showrooms, and the future Starbucks Roastery and Restoration Hardware hotels’ Starwood Capital Group’s office enrich the list of tenants.

Other cities with a rich industrial past such as Chicago, Philadelphia, and Detroit have creatively revived their abandoned spaces for cultural activities, leisure, sport, research, and housing through public–private partnership initiatives, the bottom–up approach, and involvement of the local community. Their approach, less constrained compared to the European urban planning policies but with a more deep-rooted civic commitment, makes continuous innovation possible for attracting investments and people and shows the enormous potential of the industrial urban fabric for contemporary urban life.

In the USA, research on the issues of conversion and regeneration is based on deductive analysis methods of practices carried out with top–down approaches and fiscal incentives to encourage new functions in existing buildings, bottom–up approaches with the involvement of communities, and public/private partnership projects.

The Bullen and Love research’s aim was to analyze the adaptive reuse program and the related ordinances for commercial buildings in Los Angeles City [67], as shown in Table 8.

**Table 8.** Adaptive reuse program and ordinances of Los Angeles City [67].

<b>Methodology/Tools</b>	Deductive analysis, qualitative data of Downtown Los Angeles; incentive Area, Adaptive Reuse Program, Adaptive Reuse Ordinances; income and property tax reductions; flexibility for the building code requirements
<b>Case studies</b>	Downtown area of Los Angeles City
<b>Findings</b>	Effectiveness of adaptive reuse policies in urban regeneration programs; catalyst effect for the promotion of investments in important development projects; greater environmental and economic benefits than social equity for small share of affordable housing

The adaptive reuse program is part of a strategy to regenerate the downtown settlement of Los Angeles. Ordinances supported the program, facilitating the application process and granting flexibility to the planning and construction codes (requirements for density, height of the building, internal surface, parking areas, etc.) for underused commercial buildings. Furthermore, they introduced financial incentives in the form of tax deductions. The successes of the first years allowed the program to be extended to other city districts, given the flexibility for zoning and construction for residential, cohousing, and co-working destinations. The strategies implemented enabled the achievement of environmental, economic, and social sustainability objectives, including housing for different social groups (rental and/or sale for people with low, medium, and high income) and a mix of cultural and entertainment functions.

The research carried out by Matteo Robiglio [68] during his stay in 2015 in the USA was aimed at understanding how creatively American citizens have transformed abandoned spaces into potential resources and how they have reused abandoned industrial infrastructures in places for innovation, in lively urban spaces. The fluid social practices of adaptive reuse were analyzed on bottom–up approaches and public–private partnership, taking care of the participatory approaches, to some extent independent from buildings, but able to promote the dialogue of past function with new functional layouts. The researcher developed an informal vademecum for any stakeholder in the participatory process, dividing it into eight phases and based on the analysis of selected case studies in Pittsburgh, Detroit, Philadelphia, Washington, Chicago, and New York (see Table 9).

**Table 9.** Adaptive reuse of industrial buildings for new factories [68].

<b>Methodology/Tools</b>	Deductive analysis, qualitative data of adaptive reuse practices based on bottom-up approaches and public-private partnerships
<b>Case studies</b>	20 old disused industrial buildings in Pittsburgh, Detroit, Philadelphia, Washington, Chicago and New York cities
<b>Findings</b>	Success of participatory processes in adaptive reuse practices; effectiveness and efficiency of reuse depending on flexibility of industrial buildings and compatibility between old uses and new functional layouts; a toolkit for all participants in the adaptive reuse participatory process of disused industrial heritage

## 5. Results and Key Entry Points for Future Research

The aim of this paper was to verify the cultural alignment on built environment repurposing between the international debate and research approaches. Within the last 20 years, theoretical studies and visions have progressed beyond purely technical matters at the level of single buildings to broader cultural, social, and economic considerations for sites and their setting. The crossing of data emerging from the analyses (of policies commitment and research experiences carried out in different contexts) returns a complex framework, characterized by (a) values preservation, (b) resources optimization, and (c) systems' effectiveness.

The international documents analysis (Section 3) shows a widening of approaches and perspectives, along with the possibility of intervening on ancient and modern buildings, historical centers, and suburbs. Since 1994, the international debate links diversity protection to sustainability. Economic and social transformations connote visions and approaches, contributing to facing issues related with conflicts between fragile resources and latent potentialities. International strategies progressively take into account systems effectiveness, following the increase of awareness about the limits of a development based on uncontrolled consumptions. Documents testify that only the recircularization of resources can positively impact on sustainability through a proactive commitment to future generations. The international research framework (Section 4) deals with strategies and solutions to preserve heritage values, communities' knowledge, and to promote environmental and social benefits. In the five examined geographical contexts, the research aimed at promoting systems' effectiveness that brings into the field a design dimension linked not only to the materiality of places, to the consequences on the physical and degenerative level of events, but also and above all, to the relationships between the built and its users. The strengths and weaknesses of a temporary conversion are analyzed for disused built environments, taking into account the opportunities of hosting the social cultural activities or informal and co-working businesses and laboratories of informal economies. Dynamic fruition or dynamic transformation are tested, redesigning the spatial layout of the building, focusing on the technical and constructive characters. Research takes into account the attitude to accommodate different users or different functions over time, progressively satisfying changing requests, through a dynamic use of spaces, splitting or expanding each environmental unit. Traditionally linked to the issues of adaptability, flexibility, and space-use relations, architectural culture becomes progressively sensitive, through research, to the problems posed by the closure of loops between resources and waste. The acknowledgment of the wealth of layers witnessed by places and architectures becomes a driver for a renewal of approaches to the project, against waste and abandonment.

By comparing the results of Section 3 with those of Section 4, iteratively reading through data and interpreting them, we have pointed out three key entry points for future research, shown in Table 10.

**Table 10.** Key points for future research.

Focus	Country	Author
1 Communities involvement: New alliances between stakeholders	Japan	Eguchi T. et al. [45]
	The Netherlands	Geraedts R.P. et al. [14,15,46,47]
	Australia	Bullen P.A. [23]; Bullen P.A., Love P.E.D. [28]; Bullen P.A., Love P.E.D. [50]
	Hong Kong City	Kee T. [52]
	U.S.A.	Robiglio M. [68]
2 The potential of technologies: Combining resources' protection and affordability	Japan	Eguchi T. et al. [12]
	Hong Kong	Langston C. et al. [30]
3 Renewed productivity to preserve values and uses	Hong Kong	Langston C. et al. [30]; Kee T. [52];
	U.S.A.	Robiglio M. [68]

1. As suggested within the international debate, an alliance between stakeholders is pursued as fundamental for the built environment adaptability and flexibility to new uses. Social innovation and the change in collective practices slowly impacts on the scientific approaches by redesigning the framework of the involved actors. Dialogue and interaction mark the commitment of owners, users, tenants, professionals with public administrations, the property sector, and finance, through the institutionalization of partnerships. In the perspectives outlined by scholars, the synergy between construction companies and suppliers, and building managers and contractors slowly becomes a prerequisite for success. Bottom-up processes of conversion and regeneration are promoted through extended partnerships between expert knowledge, research centers and cultural institutions, and social enterprises and the third sector. Awareness and responsibility are the two poles around which the prefiguration of project strategies attentive to contextual relations revolves. The social protection of settlements, guaranteed in the past, because it was entrusted to a widespread inhabited and used built environment, has faded with transformations due to economic reasons, wild urbanization, and depopulation. For this reason, several studies have focused on the vertical subsidiarity between public bodies, enterprises, and universities, with the horizontal one of associations and foundations. The priority task for the scientific community becomes promoting the settled community awareness and commitment. Further research topics stem from this perspective, declined in several experiences and tested in the USA: Communities' empowerment [58–66]. It progressively emerges as essential for the transition towards a circular economy.

2. Matching value preservation, resource optimization, and systems effectiveness technology emerges as a privileged medium for passing on to the future past identities. An imbalance between the growing demand for innovation and compatible solutions marks the repurposing scenarios. The research tries to carry forward issues related with technological affordability, focusing on the compatibility of solutions aimed at raising previous performances. Life cycle lengthening is related to the ability to reinvent new performances for spaces and devices, with the redesign of technologies, able to fit within a built system, with high prior degrees of stiffness, imagining working procedures, operators, and scheduled times. Integrating technologies in addition to the existing ones is a way to manage the aging processes, transferring, planning and testing their suitability. The assumption of the system concept applied to buildings and the recognition of the specific technical and constructive characters for the functional-spatial system strictly informs those studies that take into account issues related with buildings' technology and innovation. The systemic approach gives research the opportunity to address the issues of materials and techniques renewal for single units, adopting appropriate life cycle controls. Working on the connections between technology and convenience, several scholars have focused on the affordability of repurposing and regeneration. Under this perspective, several studies outline the hypothesis of financial and fiscal incentives, in order to stress the building asset to contain costs and

reduce the interventions' duration, increasing the property value. Joint contributions made by the theoretical debate and research have the merit of widening the boundaries outlined in the international documents to test compatible approaches for built environments, resulting, over time, from the encounter between resources and technological thought. Moreover, compared to the emergence of new needs on the one hand and new skills of the professionals involved on the other, the research provides the following framework of supportive key issues, still not implemented or underdeveloped within the theoretical debate: Financing and tax relief, in Japan [12] and Hong Kong [24,30,52].

3. The comparison between what emerges from the international debate and the study of the research experiences highlights an increasing commitment towards productivity. The space–function relation is one of the main discriminating factors within research, both with regard to the buildings' first life cycle and to the new one envisaged by the project. New models of public and private space use connote strategies for future design, through temporary, transitory, and dynamic approaches, often supported by cost analyses. Returning a plurality of functions to indoor and outdoor places around private buildings, the research answers to the circular economy imperatives. According to the last decade's advancements, utility value is assumed as a prerequisite for sustainability: It can guarantee future uses. The comparison between international documents and research experiences shows the need to take into account issues related with regulations and technical codes, in the perspective of achieving through repurposing, environmental, and social benefits [54,67].

Overall, the frameworks coming from the content analysis highlight the need for an enlargement of investigation perspectives, conceiving built environments as permanent reminders where through design, new legacies for the future are created. Widening the action field from buildings' adaptation to settlements regeneration, design, and research for repurposing pave the way to a cultural, social, economic, and physical sustainability, contrasting and reducing vulnerabilities.

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