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Adaptive Reuse of Heritage Buildings: From a Literature Review to a Model of Practice

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ABSTRACT

The Adaptive Reuse (AR) of heritage buildings is a complex process, which aims to preserve the values of heritage buildings while adapting them for use in the present and transferring them to the future. This paper aims to identify steps in this process and develop a structured model. The model is an 'ideal', it needs validation in practice; however, it is expected that following this model can help to preserve and conserve the values of heritage buildings. To come to an overview of the process and to identify its main steps, a literature review at an international level has been conducted. The analysis of the literature revealed that the AR process as a whole in relation to heritage buildings has not been widely studied. Based on the results of this review, a conceptual model representing the AR process of heritage buildings has been defined. This model consists of 10 steps: 'initiative', 'analysis of heritage buildings', 'value assessment, 'mapping level of significance', 'definition of adaptive reuse potential', 'definition of design strategy', 'final decision-making', 'execution', 'maintenance', and 'evaluation after years'. This model can act as a comprehensive theoretical basis for further studies on the AR process of heritage buildings.

KEYWORDS

Adaptive reuse; process; heritage buildings; built environment; built heritage; conservation; sustainable development; literature review; model

Introduction

In today's world, more and more attention is being paid to the adaptive reuse of buildings in general and heritage buildings in particular. There are many buildings, which have lost their main function and which could be adapted to accommodate new functions. Adaptation has its roots in a combination of 'ad' (to) and 'aptare' (fit) and means action or the process of fitting.[1] Although implementing new uses in old structures is not new, the term 'Adaptive Reuse' (AR) emerged in the 21st century.[2] In its classic definition, it refers to change in use. Therefore, many of its definitions revolve around the 'performance change' concept, i.e. a process of converting a building for a new use, different from the initial aim of its construction.[3]

The process of adaptive reuse (AR), from initiative to evaluation, is complex.[4] This complexity is even greater in relation to heritage buildings, because of their cultural significance, the large number of involved stakeholders, and their varied ambitions.[5] Different authors have argued that several steps should be considered in the AR process

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to preserve the essential qualities and values of a heritage building while improving it to be used in the present and transferring it to the future.[6] Some studies have investigated the steps to be taken during the different phases of the overall process.[7] However, none of the studies has outlined the stages in this complex process in a comprehensive model. Several studies have noted that this process needs further investigation and analysis from the perspective of different stakeholders.[8]

Adaptive reuse of heritage buildings has also been considered in different internationally recognised charters. For example, the ICOMOS Burra Charter mentions adaptive reuse as a strategy towards the conservation of heritage buildings, which sustains its heritage values while enhancing its functionality and usefulness for the future.[9] The UNESCO Recommendation on the Historic Urban Landscape also mentions the necessity of applying 'conservation through transformation', an approach which highlights managing changes in the historic urban area.[10] However, this recommendation as well as the guidebook which developed from it[11] focuses on the engagement of local communities and other stakeholders in the process at the urban scale. Despite proposing six critical steps to be followed in managing the urban historic area, these documents do not specify the steps that should be taken at the building scale level.

The present paper aims to fill the gap by reviewing the literature and to propose a comprehensive model, detailing the steps in the AR process of heritage buildings. In general, four main phases can be identified which form the framework of this review:

- Pre-project phase
- Preparation phase
- Implementation phase
- Post-completion phase

Materials and Methods

In this study, a systematic literature review in accordance with the Preferred Reporting Items for Systematic Reviews (PRISMA)[12] was performed to identify the relevant studies on the topic 'adaptive reuse process of heritage buildings'. This was complemented by applying the snowball method[13] in the selected literature.

This research followed four stages:

(1) Formulation of the research questions and the aim of the review

This literature review was conducted to respond to the question 'what is the available knowledge of adaptive reuse process of heritage buildings at an international level?'

(2) Screening of the available publications and selection and evaluation of the relevant studies

To answer the research question, data were searched for on the Scopus database. Firstly, a specific search on 'adaptive AND reus*[14] AND process AND heritage' was conducted, which resulted in 92 publications. To increase the reliability of the research, several broad search syntaxes were added, which were 'adaptive AND reuse', 'adaptive

AND reus* AND heritage', and 'heritage AND reuse'. The researchers applied no limitations during the search process, to have a higher quantity of results to be analysed in the next stages.

The previous stage resulted in the identification of 1095 publications. After a preliminary screening, 742 publications were removed due to duplication and irrelevance to the field of architecture and the built environment. Then, the abstracts of the 353 remaining publications were reviewed and 265 removed as irrelevant. Only publications addressing a specific phase of the AR process, the process as a whole, or having a methodological approach aimed at the definition of a framework/model for the process, have been considered.[15] Publications on the topic of adaptive reuse of building component and disassembly,[16] or on specific technical aspects, such as the internal envelope[17] were excluded. Similarly, papers which focused on specific political, legal, or administrative issues and the consequent problems in reusing heritage buildings have been disregarded.[18] Papers that largely reported the lack of professional education and experience in the process were also excluded.[19] Similarly, papers discussing the advantages and necessity of integrating adaptive reuse in the built environment suggesting it comply with particular regulations were excluded,[20] as were several papers related to designing adaptable (new) buildings in the future.[21]

(3) Analysis of the publications

In the next stage after applying the criteria mentioned above, the full-texts of 88 publications were reviewed. Among the reviewed literature, 20 publications proposed a clear methodological approach related to the analysis of the adaptive reuse process for existing buildings (covering more than one phase). A further check of the available literature was done by applying the snowball method to the references of these 20 publications. Consequently, eight books, four PhD dissertations, three master theses, and two other non-academic documents were added to the analysis.

(4) Organisation of the literature and development of a conceptual model for the AR process of heritage buildings.

The literature was screened according to four main phases of the AR process (Pre-project, preparation, implementation, and post-completion phases). Based on the results, a conceptual model for the AR process for heritage buildings has been developed.

The definitions which were followed in the literature review are as follows:

- Adaptive reuse: The definition of adaptive reuse which has been used throughout the paper is 'the process of converting a building to a function which is significantly different from the original function'.[22] The ICOMOS Burra charter also mentions 'adaptive reuse' as the adaptation of a place for a new use.[23]
- Cultural Heritage: Based on the definition of UNESCO, the term 'cultural heritage' includes: "a. monuments: architectural works (e.g. monumental sculpture and painting, elements or structures of an archaeological nature, etc.); b. groups of separate or connected buildings, which have outstanding value from the point of view of history,

art, or science; c. sites: areas including archaeological sites or works of man or the combined works of nature and man, which are of outstanding value from the point of view of history, art, ethnology, or anthropology.[24]

Adaptive Reuse of Heritage Buildings

In the section which follows, the literature, which forms the evidence base of this review, is discussed and organised according to the four main phases of the AR process. The pattern of the literature reviewed from 2003 to 2021 (Figure 1) shows that most publications relate to the preparation phase whilst the fewest are concerned with implementation.[25]

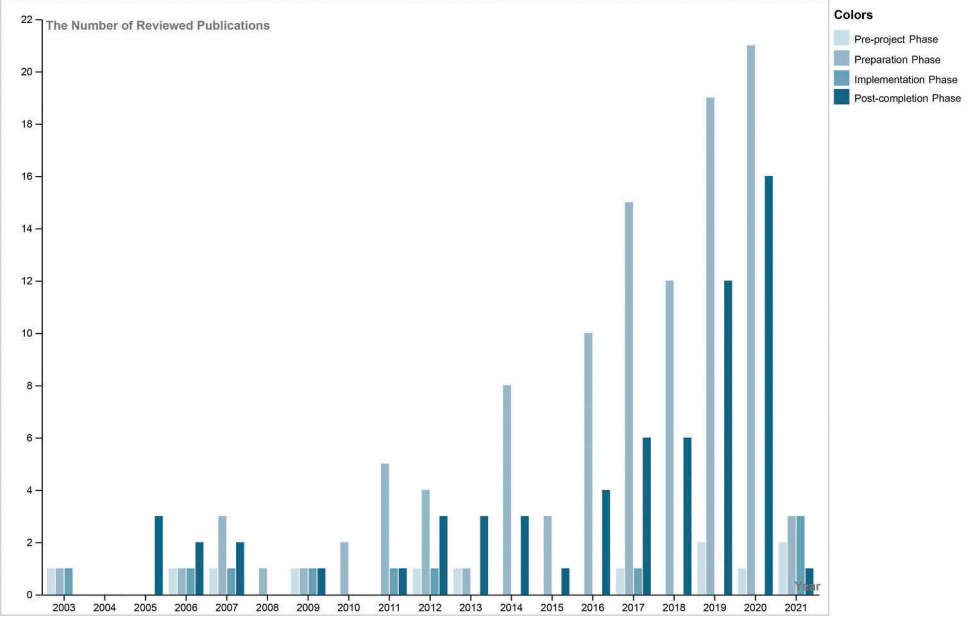

Figure 1. The intensity of the reviewed literature in each phase of the adaptive reuse process (105 reviewed publications).

Pre-project Phase

This initial phase focuses on the decision to preserve, reuse or demolish a building,[26] at the start of the AR process. Most researchers describe the main aspect of this phase as 'initiative'.

The 'initiative' may include various actions from different perspectives.[27] This is a phase in the process during which the actors, needed for the following phases, are selected.[28] In this phase, Cultural Heritage officers or agencies are consulted, and the ambitions of different stakeholders are discussed.[29] This is also the phase in which preliminary discussions among the client and the architect about the design brief take place and may include general user requirements, expectations of the client, costs, and the completion date of the project.[30]

In the Rijksdienst voor het Cultureel Erfgoed (RCE)[31] guideline for building archaeological research, 'initiative' has been mentioned from two perspectives, the client and the party conducting the research. From the perspective of the client, this guideline states 'initiative' is the part of the process in which the scope is defined, the research plan is requested from the other party, and the tender procedure and commission are requested. From the perspective of the party conducting the research, RCE states 'initiative' as a part of the process in which the basis of the research plan and the survey plan is quoted. The research plan is also commissioned.[32]

In his Spiral-model on the thinking process from the perspective of architects, Roos reports 'initiative' as an initial step in which the architect may also play an important role.[33] For example, in the adaptive reuse process of the Van Nelle factory, De Jonge explains his key role in promoting the inclusion of the building in the list of protected monuments.[34]

Other researchers focused on developing models to identify and rank adaptive reuse potential in existing buildings to ensure that all the heritage values are optimised and attempted to calculate this potential quantitatively. For example, Langston & Shen used the Adaptive Reuse Potential (ARP) model to ensure that buildings with high capacities will be retained to serve their societies.[35] The model was tested on an historic building in Hong Kong to validate the decision not to demolish it. Several researchers have applied this model to heritage buildings[36] while others have used the model to propose design strategies, such as the ADAPT Star model, for the future design of adaptable buildings.[37]

Figure 2 represents the most repetitive aspects mentioned by the authors in the reviewed literature in phase 1.

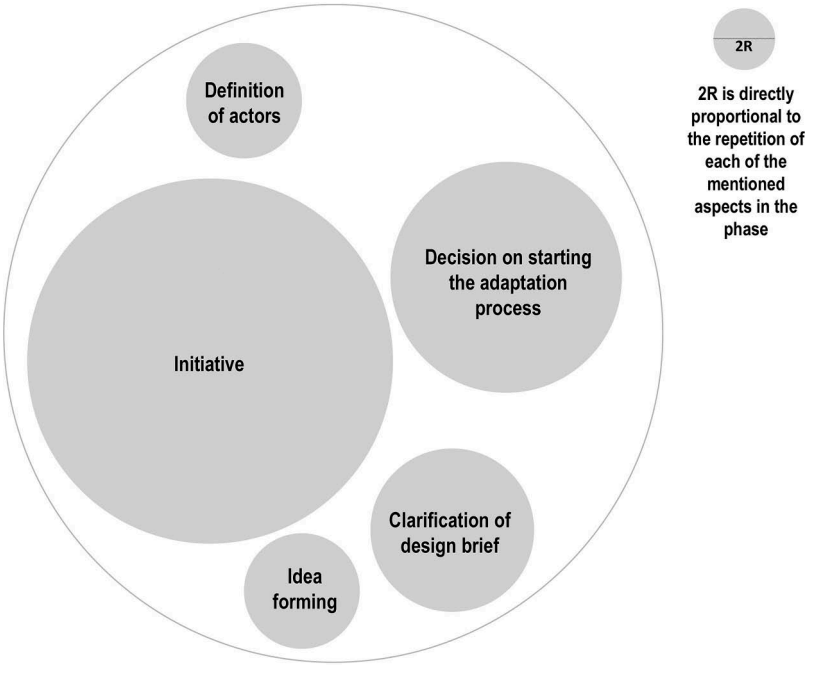

Figure 2. The most repetitive aspects mentioned by the authors in the reviewed literature in phase 1; the size of the circles is proportional to the repetition of each of the mentioned aspects.

Preparation Phase

The adaptive reuse of a building differs from new build as the architect's starting point is not so much a blank page, but an existing building.[38] This is especially important in relation to heritage buildings where the process of reuse involves existing attributes which require comprehensive recognition, analysis, and assessment before becoming embedded in design strategies.[39] The majority of reviewed literature in this phase focused on reading, analysing, valuing and re-designing the building.

The fact that the AR process starts with an existing building, makes the analysis necessary. This is usually limited to a short history, spatial and technical aspects.[40] However, the analysis of heritage buildings should include mapping the evolution of the building and analysis of its development over time,[41] demonstrating how and when the building has evolved to its current state.[42] It is essential that reliable information should be gathered about the site, its materials, nature of construction, constituent elements, and its surroundings. Information conventionally includes archival and historiographical data such as maps, drawings and photographs, and publications but can also include interviews, and, evidently, the visual observation of the heritage building.[43] A clear picture of the existing situation is crucial to the AR process to support a value assessment.[44] Moreover, as Roos argues analysis, investigation, and research of the existing heritage building is essential to provide the information necessary for the initial designs by the architect. Investigation of the building's history by an independent researcher is not always carried out, though this often depends on the complexity of the building and project. According to Roos, in some cases, the architect's investigations are considered to be enough. However, he underlines that the client should be informed of the importance of this step.[45] In some countries, there are specific guidelines (e.g. the RCE guideline[46] or the Historic England Guideline[47]) for building archaeological research that detail which aspects of the historic research on buildings are needed. Categorising the different types of analysis, Roos identifies architectonic, geographical, urban, and technical analysis.[48] Joudifdar et al. consider architectural analysis, value analysis and historical analysis as the basic types,[49] while Misirlisoy & Günçe, define four types of analysis from original functions, physical character, heritage values, and the needs of the district.[50]

In contrast, Zijlstra has developed a research methodology 'ABCD in Time', for the analysis of buildings from context to the development over time. She highlights the importance of gathering as much information as possible before starting visual observation of the building and its context to understand why things change over time. The sources of information include published literature, the building itself, interviews with its architects, or those who have dealt with the building and its archives.[51]

The assessment of values embedded in a heritage building is crucial to the AR process and can only be conducted when a profound and comprehensive analysis of the building and its context has been undertaken. One of the first publications on this topic is the research conducted by Riegl, in which he categorises values as age, historical period, commemorative value, use, and newness in an influential study[52] followed by several others.[53] In her PhD thesis, Roders broadened the traditional approach to include values in the built heritage by highlighting a categorisation which included the ecological, social, economic, scientific, age, aesthetical, historic, political, and (other) primary values.[54]

However, the question (assignment) here is broader than naming the values. The assignment is to assess the values of different layers of the heritage buildings. In 2008, Van Balen published a tool for assessing the values of heritage buildings based on the Nara document.[55] Called the Nara-Grid, this refers to six aspects: 'form and design, materials and substance, use and function, tradition, techniques, and workmanship, location and setting, spirit and feeling', and four dimensions 'artistic, historic, social, scientific' for assessing the values of built heritage. This matrix tries to connect qualities (values) to physical aspects (attributes). In 2017, the Heritage & Architecture section of TU Delft developed a matrix for use by students Figure 3[56] for the assessment of values in which the layers of Brand[57] (with the addition of three more layers), and the values proposed by Riegl[58] (with the addition of two more values), form a value assessment matrix.

BRAND + / RIEGL +	AGE value	HISTORICAL value	INTENTINAL COMMEMORATIVE value	NON INTENDED COMMEMORATIVE value	USE value	NEW-NESS value	(relative) ART value	RARITY value [+]	OTHER relevant values [+]
SURROUNDINGS / SETTING [+]									
SITE									
SKIN (exterior)									
STRUCTURE									
SPACE PLAN									
SURFACES (interior) [+]									
SERVICES									
STUFF									
SPIRIT of PLACE [+]									

Figure 3. The H&A value matrix- TU Delft.[59]

Roos considers the 'value line' in his model as a continuous line during the whole process; in fact, the architect needs to take into account several values and aspects during the different steps in the process.[60] Not all the elements of a heritage building, though, have the same ranking in a value assessment. One of the main complexities in the AR process is the determination of the significance of different values, mapping the level of significance.[61] In directing the process, it is necessary to distinguish between values that have been recognised and categorised in the value assessment. By doing so, the most significant elements deserving conservation will

be determined. This always results in the choice between conservation and change, between blending and contrast, and between continuity and partial renewal. However, it is the role of architects to unite, balance, and strengthen both the historic values and future functionality as well as other values.[62] Pre-assumptions about design strategies should not affect the mapping of the level of significance, although consideration of possible interventions can be helpful.[63]

Adaptive reuse poses formidable challenges for the architect,[64] identifying a function that preserves the existing values of the building and its site while improving and adding appropriate contemporary layers.[65] Many studies of adaptive reuse consider conceptual models for the prediction of the best function for the building, assessing the adaptive reuse potential of a building,[66] in developing a framework for the selection of the best option for a new function. In such frameworks, which follow analysis, several options for new functions are often defined. These are proposed to the stakeholders of the building (local community, cultural tourists, end-users, and heritage experts) via a questionnaire and, based on the results, appropriate functions are proposed. Many studies adopt similar approaches: several criteria and possible functions are proposed by the authors while the opinions of experts or the local community are collected via the Delphi method,[67] or through the distribution of a questionnaire.[68]

Despite the frameworks and models proposed by researchers to arrive at the selection of an appropriate function for heritage buildings, in real projects, there are many limitations to their actual application. These limitations are often due to the ambitions of different stakeholders.[69] Parsi cites the difficulty caused by the discrepancy between the new function proposed by the client at the early steps of the project, and that resulting from the analysis of the building.[70] According to Parsi, it is usually the role of the architect to inform the other stakeholders on the conflicts of their ambitions and the potential of the building. In some cases, the experienced architect can balance the wishes of stakeholders with the potential of the heritage buildings but this is not always the case. There are several examples where the whole project stops due to such conflicts.[71]

Many frameworks and methods for reaching consensus on the appropriate function for a heritage building have been defined, such as the framework developed by Aigwi et al. and Ribera et al.[72] who proposed MCDM (multiple-criteria decision making) and MCDA (multiple-criteria decision analysis) methods to weight different criteria for new functions. The principal aim of these studies is to define the most appropriate function for heritage buildings based on their values and benefits (e.g. social, economic, environmental, etc.)[73] or selecting the suitable reuse alternative among several buildings.[74]

Once the appropriate function for the building is determined and agreed, different strategies towards design can be used and many studies on adaptive reuse focus on this aspect of the design process. In 1989, Robert categorised this approach into seven different strategies when adding new elements to existing buildings: building within, building over, building alongside, building around, adapting to a new function, and building in the style of, and recycling materials of vestiges.[75] In 2004, Brooker and Stone categorised the strategies with other terms: insertion, intervention, and installation.[76] Several other studies, including those by Bloszies, Cramer and

Breitling, and Plevoets and Van Cleempoel, have addressed the same strategies using alternative terminologies.[77] Evidently, researchers have more or less similar ideas about possible strategies but have defined them using different terms, though many have highlighted how such usage can create confusion.[78] Some researchers have defined strategies for specific functions, such as primary schools[79] where the selection of the appropriate strategy is based on a value assessment, and the approach of different architects when dealing with these values.

Once the possible strategies have been defined, decisions need to be taken to proceed further in the AR process. In several publications, decision-making has been highlighted as the moment when all the stakeholders reach consensus on the design strategy and achieve the design freeze.[80] The design strategy proposed may be presented by the architect to the client or owner and other stakeholders. This is a key moment when negotiation led by the architect may be necessary in order to achieve a final decision.[81] The scope of such discussion may be wide-ranging and include the contract, costs, time management, and selection of the appropriate stakeholder (contractors) to execute the plan.[82]

Figure 4 represents the most repetitive aspects mentioned by the authors in the reviewed literature in phase 2.

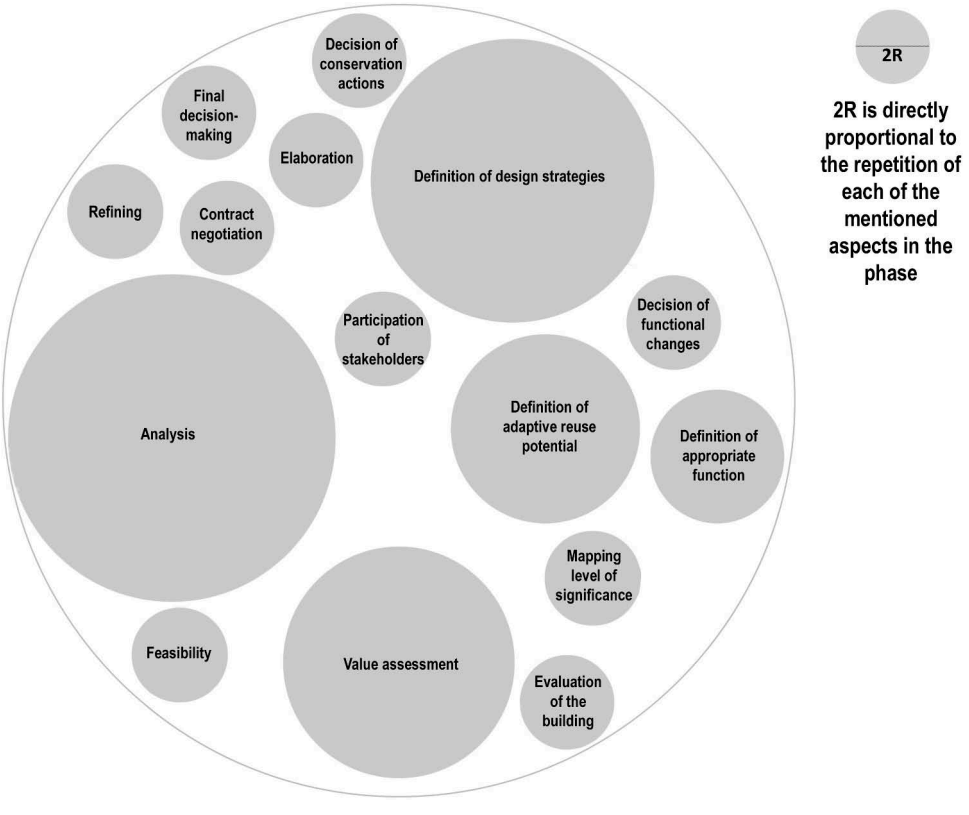

Figure 4. The most repetitive aspects mentioned by the authors in the reviewed literature in phase 2; the size of the circles is proportional to the repetition of each of the mentioned aspects.

Implementation Phase

The third phase of the AR process consists of implementing the agreed design strategies, which may involve the removal, preservation, or addition of a specific part to an existing building. In this phase, several factors such as time management, costs, and expertise of the executive team, need to be considered. Most publications report this phase, which is often defined as 'execution' and the final phase of the reuse process.[83]

In her analysis of three reuse projects, Kurul argues that the complexity of execution is higher in projects where there is higher variance in the types of activities to be undertaken.[84] Comparing the duration of the preparation and implementation phases in three projects to highlight the influence of the preparation phase on implementation, her analysis showed that the longer and the more detailed the preparation phase, the shorter and less complex the implementation. In contrast, Gieleber et al., underline the need for architects to be more involved in site supervision during reuse projects than for new projects, due to the prevalence of less precise planning inherent in AR projects.[85] As on-site work progresses, the uncertainties decrease and the degree of supervision becomes similar to that needed for new constructions.[86] It is also evident that architects should have a continuous presence and supervision in reuse projects where issues can only be resolved satisfactorily by their insight and expertise.[87]

In general, longer construction times impose higher costs. In the case of existing buildings, extra costs may occur due to the uncertainties inherent in heritage buildings.[88] In some cases extra costs may be partially covered by the extra governmental tax incentives, which are provided to reuse existing buildings, for example by Tax Reform Act in the U.S.[89] or by tax write-offs such as those available in Germany.[90] Similar incentives and funding may be available in other contexts; for example the Dutch policy programme (2018–2021) 'Heritage Counts', in which financial support is given by the government for adaptive reuse of heritage buildings.[91]

Figure 5 represents the most repetitive aspects mentioned by the authors in the reviewed literature in phase 3.

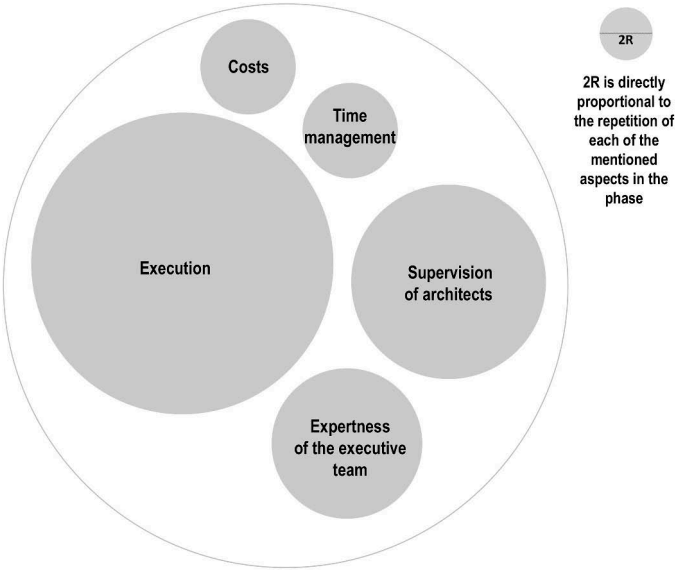

Figure 5. The most repetitive aspects mentioned by the authors in the reviewed literature in phase 3; the size of the circles is proportional to the repetition of each of the mentioned aspects.

Post-completion Phase

After completion of the project, in order to ensure the long-term quality of the outcome,[92] further action is necessary. Whether these actions are considered in the development process, depends on the approach of the stakeholders and their contract with the producers.[93]

First of all, maintenance is important. Despite its relevance, maintenance has been explicitly mentioned as part of the adaptive reuse process of heritage buildings by very few researchers such as Cramer and Breitling, Hendriks and van der Hoeve, and Misirlisoy and Günçe.[94] Vervloed sees this part of the process, as 'aftercare' and considers it important as it prolongs the service life of the building.[95] According to Parsi, maintenance should be considered an integral part of the process.[96] He proposes that some instructions need to be defined for the building and the users should refer to them and if needed to the architect.[97] The importance of maintenance is shown for example by the conservation management plans published by the Getty Conservation Institute (GCI),[98] for some of the most significant US heritage buildings.[99] Moreover, GCI financially supports the development of conservation management plans of outstanding heritage buildings all over the world.[100]

Finally, the evaluation of an AR project years after its execution can be considered as the final part of the AR process. According to the Royal Institute of British Architects (RIBA) Plan of Work,[101] this evaluation is usually conducted six months after completion of the planned design, and an architect should carry out a post-occupancy evaluation (POE) on the building.

Evaluation in this final stage aims to identify successes and failures and to provide feedback for future projects. It will also provide the maintenance manager with information for preparing an aftercare strategy for the heritage building. In the publications related to the adaptive reuse process, this part of the process has been mentioned as the post-occupancy evaluation (POE) and various methods from different perspectives have been proposed. For example, some studies analysed the socio-cultural sustainability of some reused heritage buildings through the distribution of questionnaires to the users.[102] For evaluation of environmental aspects, some studies focused on the user satisfaction and energy performance of reused heritage buildings[103] whilst others focused on the economic impact of reused heritage buildings on the surrounding environment.[104] Rodopoulou analysed the process, program, architecture, cultural values, finance, and social dimensions of several reused heritage buildings which provide a comprehensive framework of guidelines for future projects.[105] Lastly, it should be emphasised that 'evaluation' may bring up the need for further intervention of the building and consequently, the start of a new 'process'.[106]

Figure 6 represents the most repetitive aspects mentioned by the authors in the reviewed literature in phase 4.

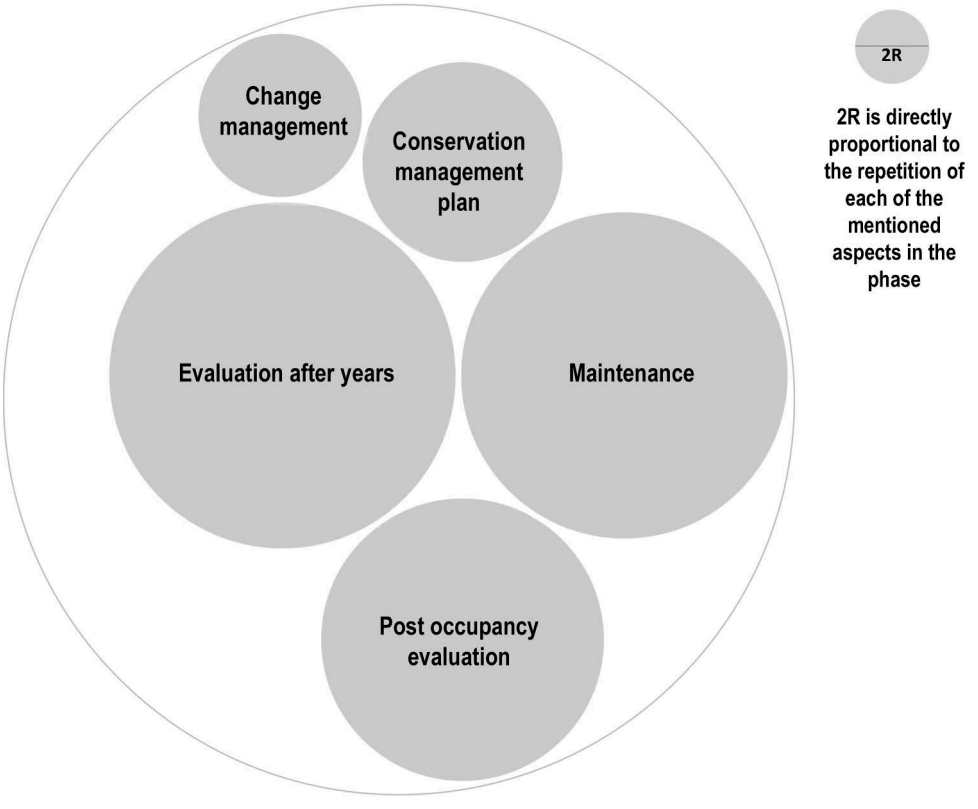

Figure 6. The most repetitive aspects mentioned by the authors in the reviewed literature in phase 4; the size of the circles is proportional to the repetition of each of the mentioned aspects.

Discussion and Conclusions

The analysis of the literature in this study has revealed that the adaptive reuse (AR) process of heritage buildings, as a whole, has not been widely studied. Many publications have focus on different aspects or phases of the process, such as analysis, value assessment, or design strategies, but few consider the full adaptive reuse process. Several sources and charters highlight the need to change the approach to heritage from conservation to 'conservation through transformation'. However, no specific guideline or model has been proposed and this review shows that research into AR is still sporadic and mainly focused on different parts of this complex process. To develop a comprehensive model for the AR process, this literature review has been organised according to the four main phases of the reuse process: pre-project, preparation, implementation, and post-completion. This categorisation helped to group and analyse better published research and to identify overlaps or repetitions.

The review indicates that despite the wide range of research conducted on AR no overarching model of the process which may assist the preservation and conservation of cultural and historic values of heritage buildings has been proposed. Several studies which have guided the development of the comprehensive model for AR of heritage buildings have been identified and are presented in Figure 7.

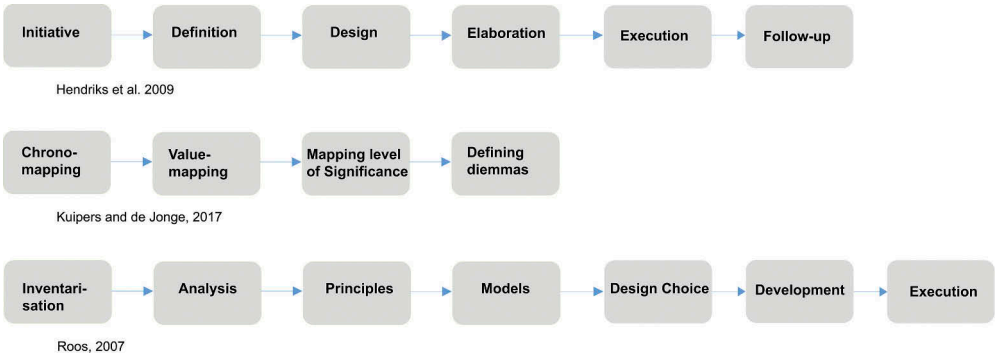

Figure 7. Some of the published models (covering more than one phase) in the AR process.

Figure 8 combines the information shown in Figures 2, 4, 5, and 6 to identify the most mentioned and highlighted aspects in each phase of the AR process. Analysing and comparing these aspects with three of the most relevant reviewed studies (Kuipers et al.,[107] Hendriks et al.,[108] and Roos[109]- see Figure 7) led to the selection of the relevant sub-phases, here called 'steps', in the AR process. While these models have been proposed with different aims rather than the current research, they have had a substantial role in guiding this research and developing the model. This has resulted in a comprehensive model for the adaptive reuse of heritage buildings.

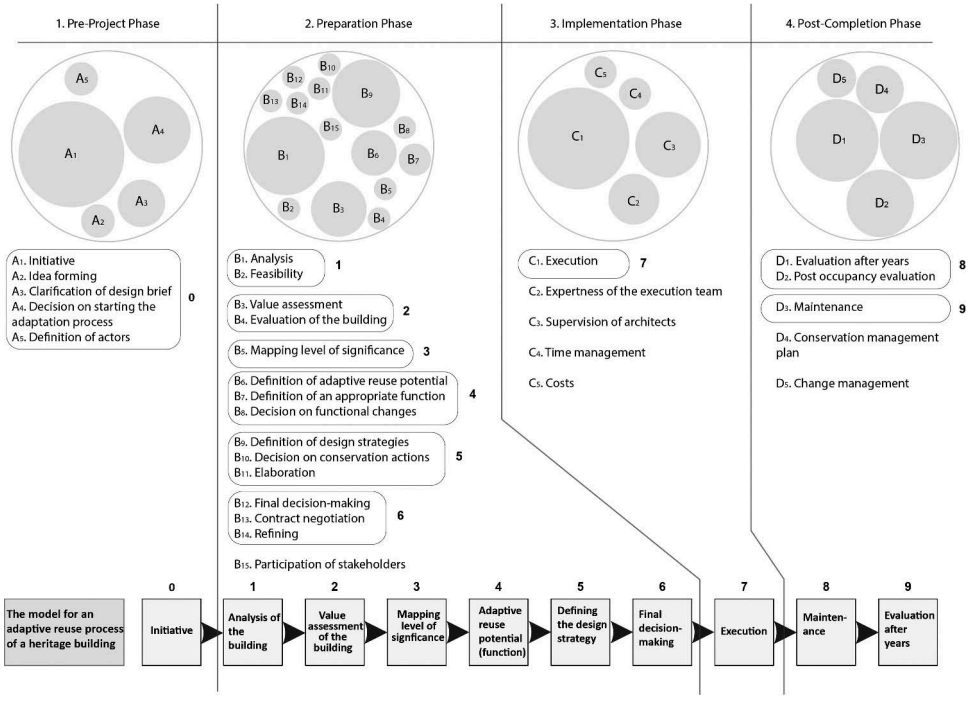

Figure 8. The procedure toward the definition of the sub-phases, the so-called "10 steps" of the adaptive reuse process of heritage buildings.

In the pre-project phase, the 'initiative' was highlighted as the first step of AR. In this step, actors are selected, and the design brief of the project is discussed. Review of the literature, based on either the architects' experience or that of other stakeholders, indicates that while this step may seem straightforward, it requires considerable input from all stakeholder groups.

It is this step in which differences in profitability or an interested party's stake in a building, may lead to proposals to demolish a heritage building despite its outstanding values, rather than its reuse. This review makes it clear that the outcome of this step is directly related to the policies and established practice of reuse in specific contexts. Where researchers visibly struggle to prove the advantage and benefits of reusing heritage buildings, even when quantifying the values of heritage buildings, this review demonstrates the wide range of stakeholder perspectives and their influence on the decision to initiate the reuse process.

In the preparation phase, 'analysis', 'value assessment', and 'mapping the level of significance' are the relevant steps in identifying 'adaptive reuse potential'. The object of this phase is to recognise an appropriate function for the heritage building. Based on the reviewed literature, in the initiative step, the owner or other stakeholders (involved in the project) may have certain expectations and ambitions. In the 'adaptive reuse potential' step, architects consider whether the requested function is possible and propose their suggestions.

The literature reviewed in relation to this phase consists mostly of publications based on educational projects or written by architects. The objective of these groups is the preservation and conservation of the historic, cultural, and other values of heritage buildings. Accordingly, the steps in the preparation phase are those which form the basis of an effective reuse scheme. In the literature, emphasis is placed on the significance of these steps and the methodology employed, whether achieved through analogue or digital tools in analysis, value assessment, or mapping the level of significance in heritage buildings.

This review demonstrates that from the perspective of many researchers, selecting an appropriate function and predicting its effectiveness for the future is a considerable and significant issue. Such views are largely restricted to the scientific literature rather than that based on the experience of architects or other stakeholders. The implication of the review is that the influence of local organisations in determining the ultimate role for the heritage buildings is limited when faced by the systematic and structured models which the researchers have proposed.

The next step is the 'definition of the design strategy' to deal with a heritage building. From reviewing the literature, it is clear that the researchers used a wide range of terms to discuss these strategies, though they are essentially the same. This review also shows that researchers on AR have had a significant interest in labelling the strategies and preparing different lists as strategies to deal with heritage buildings. These are often based on their cultural-heritage values rather than critically analysing their possible effects on the other values of heritage buildings. However, according to some publications based on the practical experience of architects, the selection of the design strategy in practice is dependent on many other factors in addition to cultural-heritage values.

Once the architect has reached a decision on a design strategy, it is reviewed with the other stakeholders involved in the AR process. In the literature, this aspect is often referred to as 'final decision-making', in which both design strategies and the necessary contracts or permits are negotiated. The review shows that while this is one of the most significant steps before the implementation phase, little interest has been expressed in

the process. Most of the reviewed publications have been written by architects who see this step as intrinsically connected to the experience of architectural practice. It requires architects to manage and balance their proposals and suggestions, whilst persuading other stakeholders to their view.

In the reviewed literature, the preparation phase highlights steps such as 'analysis', 'value assessment', 'adaptive reuse potential', and 'definition of the design strategy'. Although 'mapping level of significance' was not constantly highlighted, this has been added to this phase because of its importance in influencing the steps which follow and because of the emphasis placed on it in the material written by architects.

In the implementation phase, which is often defined as 'execution', many challenges need to be tackled. This is seen as one of the principal steps of the AR process, having a significant influence on the final quality of the project. However, few of the studies which covered several phases of the AR process have mentioned and discussed this step. Evidently, investigation of the implementation phase of AR of heritage buildings in practice and more specifically the execution step, need greater attention in research.

In the post-completion phase, two steps, 'maintenance' and 'evaluation after years', have been identified and are considered necessary to guarantee the long life of a heritage building. This step has also received little attention from the researchers. 'Maintenance' has usually been considered only as a technical intervention to heritage buildings. The specific issue of strategic planning to prolong the life of the heritage building and the varied aspects related to change management, although considered at the process level, have not been sufficiently investigated.

Evaluation sometime after completion is consistently recommended, as it provides insights for the maintenance and management of the buildings and for future AR projects. The attention of researchers in the scientific literature to this step is considerable; especially in relation to the analysis and assessment of the different dimensions of sustainability in the reused building. However, in the practice-based literature, this step has not been significantly highlighted. This difference between approaches and the relationship between the possible impacts and the process should be investigated more in future research.

In conclusion, the conceptual 10-step-model (Figure 8) developed in this paper can act as a basis for the AR process of heritage buildings. Although the model requires validation in real-world AR projects, it is comprehensive and sets out a means which has the potential to contribute to the preservation and conservation of the values of heritage buildings while preparing them for a significant role in enhancing the qualities of current and future cities and societies.

Notes

1. Douglas, *Sustainable Adaptation*, 583.
2. Carswell, in Cohen, *Green Cities: An A to Z Guide*.
3. Austin, *Adaptive Reuse: Issues and Case Studies in Building Preservation*; Brebbia, Clark, *Defence Sites II: Heritage and Future*; Murtagh, *Keeping Time: The History and Theory of Preservation in America*.
4. Langston and Shen, "Application of the Adaptive Reuse Potential," 193–207; Kurul, "A Qualitative Approach to Exploring Adaptive," 554–70.
5. Roos, *Discovering the Assignment*, 11–31.

6. Kuipers and de Jonge, *Designing from Heritage*; Department of Heritage Buildings (DEH), *Adaptive Reuse*.
7. Misirlisoy and Günçe, "Adaptive Reuse Strategies for Heritage Buildings," van Hout, *"Successfully Reusing Heritage,"* 91–8.
8. BOEi, "Eerste Hulp Bij Herbestemmen," in van Hout, *"Successfully Reusing Heritage"*, 18.
9. ICOMOS, "The Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance)," 2013; ICOMOS, "The Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance)," 1999.
10. UNESCO, "Recommendation on the Historic Urban Landscape,"
11. Veldpaus et al., *THE HUL GUIDEBOOK Managing Heritage*.
12. Moher et al., "Preferred Reporting Items for Systematic Reviews and Meta-Analyses,"
13. Wohlin, "Guidelines for Snowballing in Systematic Literature Studies," 1–10.
14. '*' was used to search for variations of the word.
15. For example, this paper: Langston and Shen, "Application of the Adaptive Reuse," 193–207.
16. For example, these papers: Sanchez et al., "Deconstruction Programming for Adaptive Reuse of Buildings,"; Sanchez, "Selective Deconstruction Programming for Adaptive Reuse of Buildings,"
17. For example, this paper: Guo and Zhao, "'Internal Envelope', a Practical Exploration," 1–11.
18. For example, these papers: Bylemans and Vallet, "Adaptive Reuse of Historical Heritage Sites," 135–45; Cizler and Soriani, "The Role of Bottom-up Initiatives in Waterfront Development," 229–51; Elsorady, "Adaptive Reuse Decision Making," 658–77; Kotval-K et al., "Creating Public Assets from Brownfields," 60–78; Soewarno, "Adaptive Reuse as an Effort to Preserve," 89–100; Olivadese, "Reuse into Housing," 165–80.
19. For example, this paper: Tsai, "Field Investigation of Retrofitting and Adaptive Reuse," 1–18.
20. For example, this paper: Fuertes, "Embodied Energy Policies to Reuse Existing Buildings,", 431-39; Rani et al., "Transforming Heritage Building for Commercialisation,", 135-46.
21. For example, these papers: Chow, "Continuity and Change,", 114–21; Conejos et al., "Designing for Better Building Adaptability," 85–91; Conejos, Langston, and Teng, "Designing for Future Building Adaptive Reuse Using AdaptSTAR,"
22. Brooker, G. and Stone, "Interior Architecture and the Design," 11; Douglas, "Sustainable Adaptation," 583; *Fourth Dimension in Building, 65*; Arfa et al., "Criteria of 'Effectiveness' and Related," 3.
23. ICOMOS, "The Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance),"
24. UNESCO, "Heritage Sustainability," 134.
25. As only 2 reviewed sources were published before 2003, the starting point of the graph is 2003.
26. Wilkinson et al., *Sustainable Building Adaptation*, 121.
27. Aigwi et al., "Characterisation of Adaptive Reuse Stakeholders," 141–51.
28. Misirlisoy and Günçe, "Adaptive Reuse Strategies for Heritage Buildings," 95.
29. Pallada, *"Heritage Reloaded,"*; Van Hout, *"Successfully Reusing Heritage,"*
30. Giebeler et al., *Refurbishment Manual*, 22.
31. Rijksdienst voor het Cultureel Erfgoed (Cultural Heritage Agency of The Netherlands)
32. Hendriks and van der Hoeve, *Guidelines for Building Archaeological Research*, 9.
33. Roos, *Discovering the Assignment*, 34.
34. De Jonge in Backer, *Van Nelle*, 221–23.
35. See above 15, 207.
36. For example, these two paper: Sharifi and Farahinia, "Evaluation of the Adaptive Reuse Potential,", 493–507; Langston et al., "The Application of ARP Modelling," 233–43.
37. Conejos et al., "Improving the Implementation of Adaptive,"
38. Giebeler et al., *Refurbishment Manual*, 22.
39. Cramer and Breitling, *Architecture in Existing Fabric*, 45.
40. Giebeler et al., *Refurbishment Manual*, 22.
41. Misirlisoy and Günçe, "Adaptive Reuse Strategies for Heritage Buildings," 45.

42. Augelli et al., *Preservation and Reuse Design*.
43. Kuipers and Jonge, *Designing from Heritage*, 73.
44. Cramer and Breitling, *Architecture in Existing Fabric*, 10–12, 66, 92.
45. Roos, *Discovering the Assignment*, 35.
46. Hendriks and van der Hoeve, *Guidelines for Building Archaeological Research.*
47. Lane, Understanding Historic Buildings, A Guide to Good Recording Practice.
48. Roos, *Discovering the Assignment*.
49. Joudifar et al., "A Reuse Projection Framework Based," 202–31.
50. Misirlisoy and Günçe, "Adaptive Reuse Strategies for Heritage Buildings," 95–6.
51. Zijlstra, *Analysing Buildings from Context to Detail in Time.*
52. Riegl, cited in Riegl, "The Modern Cult of Monuments," 69–83.
53. Lipe, "Value and Meaning in Cultural Resources," 1–11.
54. Pereira Roders, *"Re-Architecture,"*
55. Van Balen, "The Nara Grid,"
56. Clarke et al. "Embedding Built Heritage Values," 867–83.
57. Brand, "Shearing Layers," In *How Buildings Learn*.
58. See above 52, 83.
59. Clarke et al. "Embedding Built Heritage," 867–83.
60. Roos, *Discovering the Assignment*, 37.
61. See above 59, 83.
62. Roos, *Discovering the Assignment*, 33-41.
63. Cramer and Breitling, *Architecture in Existing Fabric*, 92.
64. See above 15, 207.
65. Department of Heritage Buildings (DEH), *Adaptive Reuse: Preserving Our Past, Building Our Future*, Misirlisoy and Günçe, "Adaptive Reuse Strategies for Heritage Buildings," 91.
66. Joudifar et al., "A Reuse Projection Framework, " 202–31.
67. Crawford and Wright, "Delphi Method,"
68. For example, this paper: Hong and Chen, "Evaluating the Adaptive Reuse Potential of Buildings in Conservation Areas,", 202-219.
69. Roos, *Discovering the Assignment*, 171–85; Parsi, "Adaptive Reuse Process of Masoodieh Maison", 125–45.
70. Parsi, "Adaptive Reuse Process of Masoodieh Maison," 125–45.
71. Ibid.
72. Aigwi et al., "A Performance-Based Framework to Prioritise," 1–10; Ribera et al. "A Multicriteria Approach to Identify," 166–77.
73. Fedorczak-Cisak et al., "Fuzzy Model for Selecting," 1–24; Giuliani et al., "Reusing Grain Silos from the 1930s in Italy," 145–59; Shehada et al., "Developing Methodology for Adaptive Reuse," 216–29.
74. Della Spina, "Adaptive Sustainable Reuse for Cultural Heritage," 1-20; Morkūnaitė et al., "A Bibliometric Data Analysis of Multi-Criteria," 76–99.
75. Plevoets and Van Cleempoel, "Adaptive Reuse as an Emerging Discipline: An Historic Survey," 13–32.
76. Brooker and Stone, *"Re-readings: Interior Architecture and the Design Principles of Remodelling Existing Buildings,"*
77. Bloszies, *Old Buildings, New Designs*; Cramer and Breitling, *Architecture in Existing Fabric*; Plevoets and Van Cleempoel, "Adaptive Reuse as a Strategy,"; Plevoets and Van Cleempoel, *Adaptive Reuse of the Built Heritage*.
78. Giebeler et al., *Refurbishment Manual*, 10; Plevoets and Van Cleempoel, *Adaptive Reuse of the Built Heritage*; Wilkinson et al., *Sustainable Building Adaptation*, 15.
79. Broekhuizen et al., "Conversion Strategies for Dutch Primary Schools,"
80. Roos, *Discovering the Assignment*; van Hout, *"Successfully Reusing Heritage,"*; Vervloed, *"Herbestemmen van Rijksmonumenten,"*
81. Roos, *Discovering the Assignment*, 173–93.
82. Giebeler et al., *Refurbishment Manual*, 26; Van Hout, *"Successfully Reusing Heritage,"*

83. Bond, *"Adaptive Reuse,"*; Pallada, *"Heritage Reloaded,"*; Van Hout, *"Successfully Reusing Heritage,"* ; Roos, *Discovering the Assignment*; Vervloed, *"Herbestemmen van Rijksmonumenten: Een Handleiding Voor Het Herbestemmingsproces van Rijksmonumenten,"*
84. Kurul, *"A Qualitative Approach to Exploring,"*
85. Giebeler et al., *Refurbishment Manual: Maintenance, Conversions, Extension*, 27.
86. Ibid.
87. Cramer and Breitling, *Architecture in Existing Fabric*, 189.
88. Giebeler et al., *Refurbishment Manual*, 27.
89. Bond, *"Adaptive Reuse,"*
90. Veldpaus, Fava, and Brodowicz, "Mapping of Current Heritage Re-Use Policies," 95.
91. Ibid, 127.
92. Cramer and Breitling, *Architecture in Existing Fabric*, 199–204.
93. Parsi, "Adaptive Reuse Process of Masoodieh Maison," 125–45.
94. Cramer and Breitling, *Architecture in Existing Fabric*; Hendriks and van der Hoeve, *Guidelines for Building Archaeological Research*; Misirlisoy and Günçe, "Adaptive Reuse Strategies for Heritage Buildings,"
95. Vervloed, *"Herbestemmen van Rijksmonumenten,"*
96. See above 93, 45.
97. Ibid.
98. The Getty Conservation Institute.
99. Sheridan et al., "Eames House Conservation Management Plan,"
100. "Keep It Modern,"
101. See above 1, 509.
102. Aydin et al., "Evaluation of Domestic Architecture," 305–17; Abdullah et al, "Sustainable Heritage," 6179–83; Rezaei, Rasouli, and Azhdari, "The Attitude of the Local Community," 105–25.
103. Boschmann and Gabriel, "Urban Sustainability," 221–33; Sharpe and Shearer, "Adapting the Scottish Tenement," 55–67; Lisitano et al., "Energy in Cultural Heritage," 1591–99.
104. Hoxha, "Sustainable Impact of Adaptive Reuse," 202-31; Kee and Chau, "Adaptive Reuse of Heritage Architecture," 1597–1608.
105. Chatzi Rodopoulou, "*Control Shift," Volume 1 and 2*.
106. Van Balen and Vandesande, *Innovative Built Heritage Models*, 63-72.
107. Kuipers and Jonge, *Designing from Heritage*, 65-97.
108. See above 32, 9.
109. See above 62, 41.

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