

SUSTAINABLE-DRIVEN ADAPTIVE REUSE: EVALUATION OF CRITERIA IN A MULTI-ATTRIBUTE FRAMEWORK

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ABSTRACT

The purpose of this paper is twofold. First, the strong connection between adaptive reuse and sustainable development is addressed; the economic, cultural, and environmental contributions of adaptive reuse could be successful proponents of sustainability-driven development, or redevelopment, of the built environment. Second, within this framework, some criteria emanating from the foundations of sustainability, which are included in the analysis of potential adaptively reused units, are discussed. The paper concludes by outlining the statistical importance of the specific criteria concerning such analyses, the knowledge of which could be valuable to decision makers and involved stakeholders aiming to achieve successful sustainable adaptations. Although the majority of the findings presented in this paper derive from the application of multiple regression analysis in the context of empirical research based on the specific region of Cyprus, the implemented methodology could be applied to a broader context, hence leading to more universal observations.

Keywords: adaptive reuse, sustainability-driven development, multi-criteria analysis.

1 INTRODUCTION

In contemporary conservation practices focusing on sustainable development, there are some apparent considerations to take into account: both fields of research and practice encompass the themes of cultural identity and community cohesion, and, at the same time, both tangible and intangible matters are identified. However, the emergence and quantification of different capacities are challenging tasks falling into the dynamic process of sustainable development; the trends of lifestyle and the condition of the state, the economy, and the environment are constantly changing, thus changing the framework into which regeneration policies are developed and implemented.

Since the late 1980s, the European Union has been encouraging economic and cultural developments within the scopes of its common heritage. Adaptive reuse as a practice has held a prominent role in such developments, benefitting the specific regions involved; many architecturally significant buildings in historic cores have been preserved, and abandoned areas have been transformed into vibrant communities through corresponsive initiatives, and, simultaneously, both residents and visitors have been positively affected. Deliberate architectural and culturally appropriate adaptive reuse projects appear to be an entrepreneurial tool in achieving sustainability-driven urban regeneration.

2 ADAPTIVE REUSE AS A TOOL FOR SUSTAINABLE DEVELOPMENT

2.1 Defining adaptive reuse

A simple definition for adaptive reuse is “to re-use a building or structure for the purpose of giving it new life through a new function” [1] and it “is described as developing the potential of additional use and wear for functionally obsolete buildings – it is essentially the recycling of a building” [2]. Ijla and Broström [2] appropriately separate adaptive reuse from restoration and renovation, as these practices aim to restore buildings to a certain period or



to upgrade them, respectively. Moreover, it is argued that adaptive reuse seeks to find a new use for the building. By the same token, Bullen [3] uses the term “adaptive reuse” without necessarily implying a change of use but, more generally, as works including “rehabilitation, renovation or restoration”. Adaptive reuse, semiotically, means to reuse in order to fit (from Latin Ad + aptar which means to + fit). However, to fit what is an interesting question; changes could occur in the needs of contemporary lifestyle, the new use, the climate, or the context.

In contemporary times, older buildings are reused to fit contemporary lifestyle and changing needs. Most of the time, a new use is introduced to the existing shell, sometimes requiring restoration, upgrading or repairing works to the degree of which depends on the case. Some adapted units are, indeed, recycled to accommodate new uses and exist in the inherited built fabric; contemporary approaches are followed and viable solutions found. Adaptive reuse concerns both highly important buildings historically (or museum pieces), and ordinary buildings and various housing typologies existing in the built context (Jane Jacobs also praised this approach as early as 1961), which is an essential aspect of the practice. However, not all buildings are good candidates for adaptation, as their configuration and physical condition do not allow viable solutions. The main objective of a potential adaptation is not for the buildings to perform poorly, but for them to meet the occupants’ needs and to stand the test of time. Consequently, their useful life could be extended in a viable way, and possible adaptations could be seen as the medium to extend the useful life of buildings. Hence, their sustainable nature would also be embraced by corresponding adaptations [2], possibly in an entrepreneurial kind of way.

2.2 Adaptive reuse seen as a proponent of sustainability-driven developments

There is evidence that adaptive reuse can benefit both the local community and the existing built fabric. It has positive attributes in (1) socio-economic, (2) ecological/environmental and (3) cultural matters; these are considered to constitute the pillars of sustainability, and so adaptive reuse can potentially fall under its scope as well.

Given that historic preservation is a great proponent of adaptive reuse, the following excerpt highlights the central argument for why adaptive reuse is considered to be a sustainable practice: “Historic Preservation, in addition to being the ultimate form of recycling, plays a crucial role in preserving regional flavour while minimizing impacts on the environment” (Ewald [4]). Undoubtedly, recycling involves having an attitude aimed towards a more sustainable way of living by taking more viable paths when it comes to materials and sources, and the grey energy associated with these.

In addition, potential abandonment is minimized, along with its adverse effects on both the social and built fabrics. Several projects aimed at regenerating distressed areas through unit adaptation were presented as capitalizing on traditional cultural assets. Undoubtedly, financing is another critical player in adaptive reuse, “but the financial and economic design is more than cost – it should be the subject of creative thinking. This can take the form of research into different funding models and partnerships and into how a project becomes viable” [1]. Economic opportunities could be catalytic to the decision-making process, although, at the same time, all aspects of sustainable development should be considered.

Financial investment and human capital could both be secured while retaining the distinctive nature of certain places [5]. “Core social values such as pride, memory and participation can all be enhanced by careful consideration of adaptive reuse strategies” [1], which highlights that adaptive reuse, in connection with the international charters praising the value of authenticity, contributes to maintaining the character and the vitality of the built



fabric. Also, adaptive reuse as a practice involves contemporary means and approaches, and this enhances the inherited value and helps to expand the heritage being left for future generations.

By connecting the new version of the building to its original character and the embedded narrative, the sense of place can be retained, and certain values are conserved (such as social, cultural, and historical values). Relevant links to the past and significant memories are kept, and historical or cultural landmarks are preserved.

To sum up, sustainability-driven development is geared towards strengthening the ranks of residents and to spur economic growth. The aforementioned points have a direct impact on environmental, social, and cultural matters, but, at the same time, they can have an indirect impact on economic issues. More specifically, adaptive reuse can produce new visitor attractions (local or touristic), which have an effect on economic growth [6]–[8]. Hence, economic benefits, similar to all contributions, could exist at a range of scales (owner, community, urban scale).

2.3 Life cycle and the notion of futurity in adaptive reuse

The notion of futurity and the inclusion of the future generations address both fields of adaptive reuse and sustainability. First, regarding historic preservation and as seen through the Declaration of Amsterdam (1975) and the Declaration of ICOMOS (1999), the “common future” is highlighted. Arguably, the same expression holds a prominent role in sustainability circles; “Our Common Future” is the name of the publication of the United Nations, also known as the Brundtland Report, which was formulated in order to set “a global agenda for change” [9]. The report also provides the following definition: “Sustainability is to meet the needs of the present without compromising the ability of future generations to meet their own needs.”

Considering these established statements, adaptive reuse is, indeed, a sustainable practice; the continuous life cycle of a building is ensured as the building of interest is prevented from destruction [10]. The life cycle is also connected with economic and environmental matters. Firstly, the environmental load is lowered through the potential reuse of existing buildings, and this is connected with the environmental footprint and the grey energy of the buildings. In the assessment of the potential adapted asset, such matters should not be underrated. The building’s grey energy is a crucial element as it revolves around energy consumption related to the transportations of materials and resources, construction, or demolition works and the embodied energy of the materials. In addition, environmentally speaking, other benefits from adaptively reusing buildings include: a decrease in carbon emissions and pollution as opposed to new constructions, the minimization of demolition waste, and the reuse of contained energy, all of which have a positive effect on the affected communities [1]–[3], [10]. Hence, the practice of adaptive reuse should be cherished and applied more thoroughly as this corresponds to the notion of recycling in the talk around sustainability.

In this light, attention should be paid to the building stock, since the disciplines of restoration and adaptive reuse fall into, and coexist with, the practice of recycling [11], which Michael Braungart and William McDonough also praise with their work promoting the “cradle-to-cradle” philosophy and their ideas of repurposing built/manufactured elements. Furthermore, Davenport [12] argues that the adaptive reuse of the existing building stock can have a beneficial outcome on the local communities, the economy, and a region’s culture, and can contribute to the achievement of a sustainable behaviour in terms of how the precepts of the past could be transferred to the future. Along the same lines, Wilkinson and Reed [13]



discuss how the adaptation and reuse of an existing building can sometimes be faster and more economical than the demolition of an old building followed by the erection of a new construction.

2.4 Case studies assessment

Arguably, although adaptive reuse is highly correlated with sustainable development, not all adaptively reused units are good candidates towards sustainable solutions. As Bullen [14] states, “there will be cases where old buildings have reached such an advanced state of disrepair that makes their adaptation uneconomical or their internal structural layout may be totally inappropriate for any change of use.” Furthermore, the cultural significance of the original structure in similar cases would be altered at such a level to meet the standards of the new conditions that the authenticity would be lost and the charters’ guidelines would be overlooked.

In terms of performance, new constructions have a significant advantage over the adapted units (e.g. [3], [15]). Socio-economic growth and new technological means will always demand (and open the horizons for) new forms and new facilities to accommodate the changing regimes, and new buildings will still be essential in satisfying changing lifestyles and trends, as well as growing human needs. Consequently, the developing strategies, concerning both new constructions and reused units, should accommodate sustainability; fundamentally, all parameters should be taken into consideration to achieve maximum performance and high standards in combination with meeting efficiency and addressing all aspects towards a viable future. This leads to the necessity that each case is assessed individually based on the cost-benefit analysis of both tangible and intangible attributes.

3 MULTI-CRITERIA ANALYSIS

3.1 Rating systems

Although certain existing rating systems assessing a unit’s performance deal with a number of criteria and sustainable design strategies and practices, their implementation shows that a lot of important aspects pertaining to the sustainable development of a listed building or a small-scale community are not included. For example, when a historic vernacular building is adaptively reused, the adapted form and function impact the scale of the whole community and the surrounding built fabric. Matters revolving around this aspect should be added to rating systems evaluating a reused building’s sustainable character.

However, such rating systems should not be superficially criticized; with their implementation, users and owners are introduced to a mode of thinking where sustainable living and ideas, revolving around well-being, take the lead. The application of popular rating systems force users and owners to evaluate some points and, in a way, to evaluate their mentality and current mode of living, which should be praised. Such an application of these systems is noble, as long as it is not aimed at eco-branding, as Parr [16] discusses.

3.2 Alternative multi-attribute frameworks

Concerning adaptive reuse approaches for urban regeneration, different methods of categorization can be found in the literature. An example is given by the planning scholar, Urry [5], who identifies four measures: stewardship of the designated stock; investigation of the related space; visual consumption; and economic exploitation. Alternative yet similar categories are also found in indexes developed by scholars in relevant realms (e.g. Langston’s



ARP model [17] and Ding's AdaptStar [18]), in popular rating systems (e.g. LEED, BREEAM) and alternative assessment methodologies (e.g. Willingness-to-Pay model).

The necessity to incorporate different criteria emanating from different realms or frameworks is recognized through several theoretical and empirical projects. The process of adapting a potential asset is, by default, driven by sustainability principles, and, simultaneously, sustainable thinking is followed in consideration of the corresponding (re)development schemes. Therefore, the criteria participating in such studies should be directly connected with sustainable development, yet their contribution to the success of a project is not expected to be measured in equal parts.

In sum, although popular rating systems and assessment methods point to some interesting tectonic contributions that could be made, and they refocus users towards upgrading their buildings, they sometimes confuse green or eco-friendly practices with sustainability. A more beneficial effort would be the development, or upgrading, of specific evaluation processes so as to have universal application and to include more criteria, not only for the buildings as units but also for their surrounding contexts.

4 THE MULTI-ATTRIBUTE FRAMEWORK IN EMPIRICAL RESEARCH PROJECTS

Realized projects based on empirical research concerning a multi-criteria analysis could be used as a vehicle to draw conclusions for the purposes of this paper. More specifically, some researchers [19]–[21] have been using multiple regression models with several different criteria acting as the independent variables aimed to investigate the statistical significance of certain determinants of sustainability-driven development or adaptive reuse.

Such analyses, although including different criteria from the foundations of sustainability, and although taking into consideration all essential elements constituting a viable adaptation, do not target, and do not expect, equal contributions from each. On the contrary, given that sustainability is less a descriptive term and less an object's status than it is an endless process where time holds a key role, it would be unwise to seek an achieved balance. The multi-attribute framework of any project celebrates the uniqueness of each case study and the realization that each is characterized by a particular identity carrying a particular story in its own right.

Concerning the criteria involved in empirical research projects, good candidates could include the maintenance of the structure's scale within the surrounding context, if it is considered to be viable and practical, or the use and reuse of local and indigenous materials and construction techniques. The latter point addresses all aspects of sustainability while being in agreement with the international charters and declarations on historic preservation. Also, a new addition could be the continuation of the cohesiveness that characterizes the entire built fabric of the community, providing the possibility for its historical and aesthetic value to be preserved.

Moreover, the addition of a new use in a former residential building provides the foundations for the opening of new work opportunities, it promotes economic growth in a variety of scales, and, also, it revolves around the individual user as it proposes a new space for social interaction within a community where the population, and especially the number of younger people, is decreasing. Therefore, some points could be added concerning the revenue that is created when adapting a unit or a settlement.

Finally, the findings of certain empirical studies unfold at the data collection stage and upon analysis of the practice of adaptive reuse. Apart from taking a glimpse at the character of adaptive reuse in the affected regions, the correlations among the several parameters or criteria could possibly affect decision-making when it comes to the decision of whether to



adapt a building or not. For example, cost-benefit methodologies and multiple regression models provide insights into the trends of the present practice of adaptive reuse and, therefore, the involved stakeholders could benefit from such studies; policymakers could have a more extensive knowledge on interconnected subjects around adaptive reuse and their approaches could be more ethical and holistic towards a sustainable future.

5 OVERVIEW OF THE STATISTICAL IMPORTANCE OF THE PARTICIPATING CRITERIA

Some scholars (e.g. [22]–[24]) argue that sometimes economic matters take the lead when sustainable development is at stake. Adaptive reuse is, indeed, of a sustainable nature, and incorporates salient aspects of sustainability, yet empirical projects show that economics is not the main driving force when it comes to a successful reuse, or sustainable re-development [19], [20].

Concerning economic matters, some criteria that are expected to hold a prominent role in a sustainable adaptive reuse can be proven not important statistically. First, surprisingly, the expectation that the real cost of the adaptation could be the most significant contributor to a successful reuse (high costs could indicate works of better quality) was overturned. Of course, although cost is a good indicator, one could argue that the real cost is irrelevant if not seen in relation to the units' size or state of obsolescence. However, these scenarios were also tested and overturned again [19].

As far as the location is concerned, the findings are interestingly contrasting. The locational aspect is proven statistically significant in potentially successful adaptations in Brigg's research [25], whereas in Parpa's model [19] the location of a property is not only of minor statistical significance in a successful reuse but could even be omitted from the model entirely (this is according to the several f -tests conducted to test whether some variables could be omitted from the model).

Concerning utilitarian matters, the original materiality of an old traditional shell usually reflects a more sustainable nature because it features vernacular techniques and is indigenous. Arguably, contemporary materials have an advantage over the traditional materials and techniques as they provide more possibilities, especially when it comes to adaptations of much older units. As with non-organic materials, organic materials also have mechanical or technical drawbacks, even though they are greener with a minimized ecological footprint. Nonetheless, after running a multiple regression analysis, the findings revealed that the original material does not hold a significant role with regards to the continuation of the building's life and the expansion of its life-span (although the coefficient estimate shows that organic materials have a minor advantage over non-organic materials) [19].

By the same token, some peers do not see the potential sustainable effects from the reuse of concrete buildings dating back from the modern era, with the most frequent argument being the material's poor behaviour related to ecological, bioclimatic, and mechanical aspects. The misperception that the reuse of concrete buildings cannot represent ameliorating effects towards a more viable future has been formed. However, it is argued that a subtle meaning can be found in the reuse of concrete buildings concerning social, historical, and cultural matters; these points are often overlooked and underestimated, which is in agreement with Volberg [26] and Kresevic [27].

Consequently, the general picture should be taken into consideration when assessing the potential reuse of a building or a complex; the primary material should not be seen as a barrier, neither should some materials or whole structures be overlooked because their original status is not "green" enough, if other aspects of sustainability are dealt with and met



[26], [27]. For this reason, interdisciplinary approaches, involving stakeholders from different backgrounds, are important as the weighting of the parameters and the assessment of each case study requires serious work [28], [29].

Finally, another criterion could be proven important, yet it cannot be easily measured, nor can it be predicted – the human factor. Maybe the human factor and each person's uniqueness, free will, and distinctive way of thinking in decision-making should be considered as an essential parameter. However, contemporary trends are difficult to quantify and insert in a model, and, more specifically, in a regression.

It is also likely that the mentality characterizing a specific demographic or social or ethnic group can affect the success of a newly introduced use. Trends change all the time, and fashionable uses and places come and go. People seem to progress and change habits and interests, and, therefore, when it comes to an introduced use in an existing shell, the choice itself could be equally proven to be both a success or a failure. The trends in the general market, as it is in fashion, can influence a given owner's decision to put an existing structure into use over building something new (see also Bullen [3]; Bullen and Love [30]).

6 CONCLUSIONS

By adaptively reusing buildings, their useful life is extended and their sustainable nature is also strengthened. Bullen [3] suggests that old buildings should be treated as a reusable source and not as a product, because most products are consumed and then they become waste. The purpose of this paper was to investigate the strong connection between adaptive reuse and sustainable development, and to provide an overview of some statistically important variables in successful adaptive reuse aimed at sustainability, mostly based on conducting research using multiple regression analysis and empirical data from Cyprus [19]. First, establishing the variables that contribute the most to a successful adaptation can be both a crucial and challenging task. Therefore, variables emanating from all fields of economics, ecology, society, and preservation ethics were selected as most appropriate to be tested for the multiple regression analysis model [19].

After running this model, which consists of 12 independent variables (or criteria) [19], the most significant variables to surface included the price index of the construction materials at the time of the adaptation and the construction era of the original structure. On the one hand, the price index is strongly connected with economic factors, which enhances the general idea that money is one of the main components not only of the viability of a sustainability-driven development but of the decision-making process as well. On the other hand, in this study, the construction era is strongly connected with the legislative background and development in Cyprus. Consequently, the decisions made after weighting formal and bureaucratic processes, as opposed to informal and silent actions, may significantly affect the success of a potential adapted building. However, other variables are also vital to a successful adaptive reuse, although they are not so prominent. The appraised project highlights that the following different factors also participate in establishing a project's success: the covered area of the property, the annual GDP growth, the viability score achieved by a manufactured rating system, and the introduction of a built extension.

To summarize, there can be economic, physical, legislative, and utilitarian variables that affect an adaptation positively, although their contributions to achieving viable practice are not equal. The realization that it is not just economic factors that drive adaptive reuse is fundamental; economics taking the lead can be both limiting and intimidating, especially in the decision-making process of whether to reuse a unit or not. Consequently, based on such observations and predictions, certain units or areas of great potential for redevelopment could



be targeted by individuals or the state to be retained and filled with life; obsolete buildings can only result in a region's disrepair, not only at the neighbourhood scale but a larger scale as well. Safekeeping the built heritage should provide a lot of benefits to both the individuals and the affected communities: the traces of history maintain the context's narrative; feelings of insecurity and distaste are eliminated within a coherent and preserved environment; and energy-related consumption, time, and costs are minimized. These are some of the reasons adaptive reuse is also considered as sustainable.

Lastly, there is the question of how the state, stakeholders, or policymakers can make good use of the observations or findings and put them to practice. Development and re-development plans are frequently discussed by planning committees and within local and community circles. Hence, it is crucial for all of the stakeholders to acknowledge all aspects of a potential rehabilitation, whether this concerns a single unit, a complex, or a neighbourhood. Existing paradigms and justified scientific results could provide food for thought or contribute significantly to the process of decision-making. More specifically, statistical tests conducted in empirical projects can provide robust remarks with a significant effect on the decision of which unit to adaptively put into good use, providing new purpose. The results of such investigations could contribute to better resource management practices, cost and benefit processes, effective assessments, and well-justified decisions based on different aspects by taking into consideration several matters coming from different realms.

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