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Design for Circularity. Experimentation and Innovation for the Construction Sector offers a critical and multidisciplinary reflection on the concept of circularity applied to the built environment, addressing the challenges and opportunities arising from the transition from a linear to a regenerative model.
The volume examines the regulatory, design, production, and educational implications of circularity, aiming to outline a theoretical and operational framework useful for both research and professional practice. Circularity is understood here as a systemic process capable of guiding transformations in the construction sector toward more sustainable, reversible, and adaptable models.
Through contributions from diverse disciplinary fields - architecture, design, and management engineering - the book explores the relationships between design, production, and management, highlighting how technological and methodological innovation can support the rethinking of material and spatial life cycles. One section of the volume is dedicated to the educational experience of the Circular Design Challenge, which involved companies, faculty members, young stratupper, and students in a collaborative design process.
This initiative provided an opportunity to connect theoretical knowledge, design practice, and industry, fostering the acquisition of cross-disciplinary skills and a deeper understanding of real-world processes. The organization, topics addressed, and final presentation in an innovation-oriented context helped consolidate the scientific and communicative value of the experience. Design for Circularity is intended for designers, researchers, students, and professionals interested in understanding and applying circularity principles in a conscious and practical way. Combining theoretical reflections, case studies, and experimental approaches, the volume offers an updated overview of innovation prospects in the construction sector, with particular attention to the role of education and the need to build effective connections between research, design, and industry.

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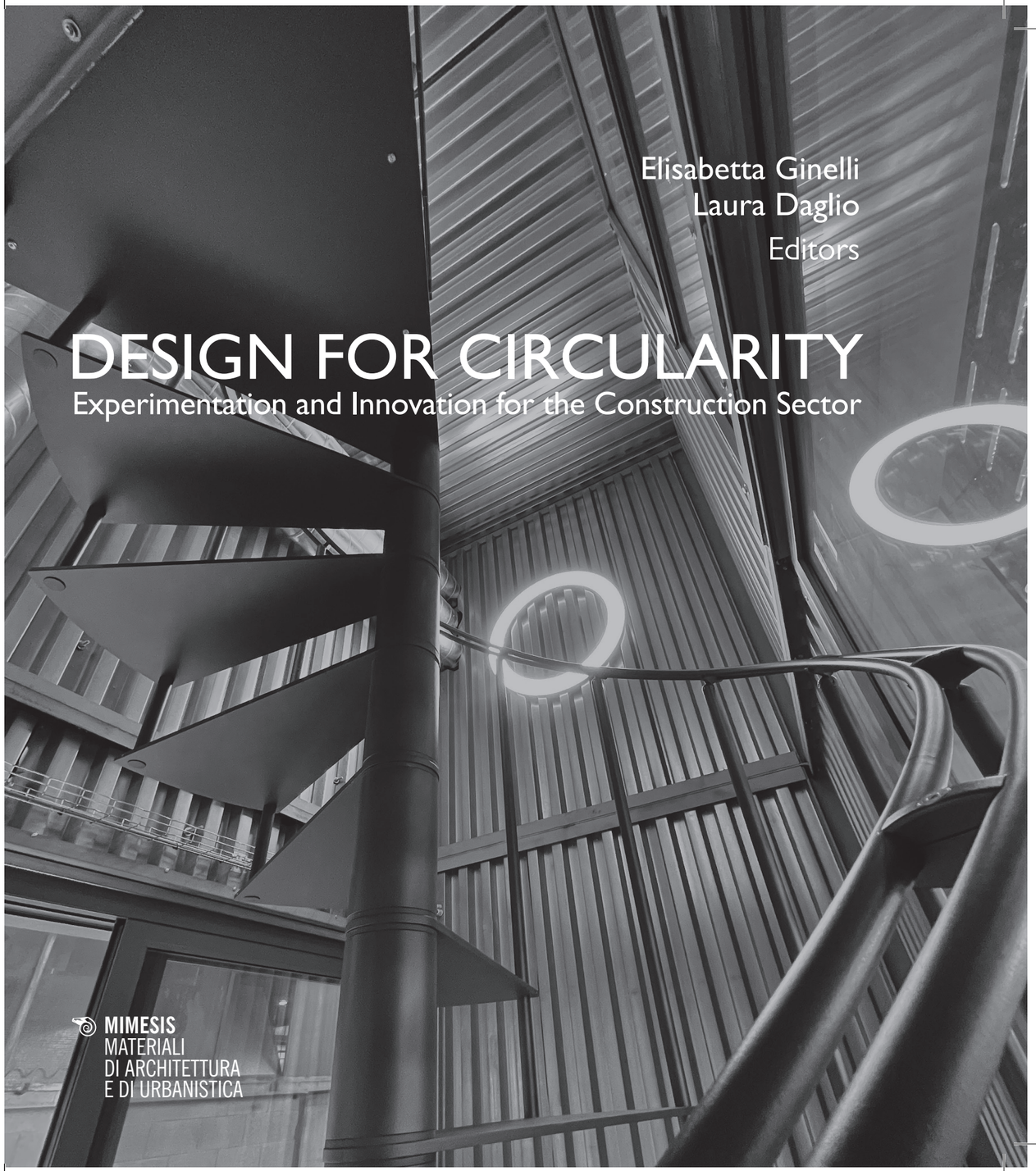

Elisabetta Ginelli
Laura Daglio
Editors

DESIGN FOR CIRCULARITY

Experimentation and Innovation for the Construction Sector

MIMESIS
MATERIALI
DI ARCHITETTURA
E DI URBANISTICA

Materiali di architettura e di urbanistica

Collana di progetti, piani, paesaggi

La collana, avviata nel 2014 da docenti del Politecnico di Milano, raccoglie lavori di architettura e di urbanistica anche distanti per argomento e impostazione ma sempre improntati al rigore del metodo, alla dimostrazione degli assunti, alla fondatezza e ripercorribilità dei cammini analitici e progettuali. È stato scelto di non assumere limiti di scala e di confine promuovendo così la pubblicazione di studi che spaziano dai temi della dimensione regionale al progetto della cellula residenziale e, di conseguenza, intersecando e confrontando competenze disciplinari diverse. I *materiali* della collana sono destinati a chi, anche privo di radicati fondamenti specialistici, intenda farne uso nella prospettiva d'una architettura e urbanistica di reale cambiamento, come impone l'evoluzione della società, della cultura e delle scienze.

Architecture and Urban Planning Materials

Collection of projects, plans, landscapes

The collection, launched by professors of the Politecnico di Milano in 2014, collects a variety of architectural and urban planning works. Though these works concern a wide array of arguments and settings, they are shaped to the rigor of the method, to the demonstration of assumptions, and to the legitimacy and retracement of analytical and project paths. The decision was made to not adopt limits of scale and boundary, thereby promoting the publication of studies that range from themes of the regional dimension to the plan of a single residential cell. In this way, different disciplinary competences are intersected and compared. The collection's materials are intended for those who, even if devoid of rooted specialized foundations, intend to use them in prospect of an architecture and urban planning of true change, as the evolution of society, culture, and science today imposes.

建筑与城市规划材料

项目、规划和景观集锦

本书在2014年由米兰理工大学建筑与城市研究学院的三位教授推出，收录了多个建筑和城市规划的项目。这些项目涉及了广泛的内容和议题。通过严谨的方法，对假设的论证、重演分析的基础和功能、以及展示项目的过程等来形成最终项目。本书观点并不拘泥于项目规模和范围的限制，而是促进扩展性的研究，范围可从区域性尺度到住宅单元，以应对交叉学科和不同学科的能力。如今随着社会、文化和科学的各方面急需转变，因此书中所提供的材料的目的是在于提供建筑和城市规划真正的前景，即使是对非本专业的认识也将有所启迪。

Cover photo of cHOMgenius, an off-site prototype designed for complete disassembly and serving as the headquarters of OFFLAB Hard Circe[DC] at the ABC Department of Politecnico di Milano. Cover photo, graphic design and editorial supervision by Giulia Vignati.
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DESIGN FOR CIRCULARITY

Experimentation and Innovation for the Construction Sector

Elisabetta Ginelli
Laura Daglio
Editors

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THE "PROTEIFORME" MEANING OF CIRCULARITY

Circularity in the construction sector is imbued with four interrelated - and at times surprising - systemic characteristics: "creative" design, the multiscalar nature of its applications combined with multidimensional relationships, and the mastery of the "closed loop" of resources operating within an open and porous system responsive to inputs and outputs. In its institutional definition, the circular economy represents an economic model of production and consumption (we prefer the term utilisation) based on sharing, lending, reusing, repairing, refurbishing, and recycling materials and products, thereby extending their life cycle[1].

A BRIEF OVERVIEW

From this definition, it is already clear that the circular economy takes on various forms and involves a range of actions - all aimed at reducing environmental impact and achieving synergistic results through the promotion of strategic relationships among the diverse skills of the actors involved.

These forms and actions are all grounded in the principle of resource self-generation and in a logic of sustainable competitive economy[2], where cooperation among stakeholders becomes a driver of innovation and re-generation.

Circularity is therefore a transformative strategy: it seeks to convert waste into resources, reduce wastefulness and pollution by eliminating residues, and enable materials and products to "circulate" while maintaining their highest value - thereby fostering the regeneration of nature[3].

In other words, like the sea god Proteus, capable of changing form, circularity reveals itself as a dynamic system of actions that transform, adapt, and take shape across various disciplinary and operational domains.

This mutability, however - unlike in the myth - should not be seen as elusive but as generative: it represents potential that calls for the proactive will and capability of the actors involved, who must share knowledge, strategies, and practices to address the environmental crisis. Such collaboration is directed towards the search for solutions increasingly aligned with the goal of safeguarding the environment, through the discovery of new relationships and strategies inherent in circularity itself.

It therefore demands a form of "creative design" - one that reorganises the elements at play, remains open to new and multiple responses, and operates within a multidimensional and multiscalar network of symbiotic intentions and correspondences among researchers, designers, enterprises, institutions,

[1] See https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits (accessed on 20 October 2025).

[2] In line with the European Green Deal: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en (accessed on 20 October 2025).

[3] We have now reached a real turning point: not only are we consuming more than the planet can produce, but we have also surpassed the first climatic point of no return. As stated in the Global Tipping Points Report 2025, compiled by the University of Exeter together with international partners - including the Stockholm Resilience Centre - the report underlines that the only way to avert catastrophe is to act with urgency, triggering the so-called "positive tipping points": https://www.stockholmresilience.org/research/research-stories/2025-10-13-world-reaches-first-climate-tipping-point---widespread-mortality-of-coral-reefs.html (accessed on 20 October 2025).

On the left:
Detail of cHOMgenius, an off-site prototype built using dry construction and mechanical and magnetic fasteners to allow complete disassembly, serving as the headquarters of OFFLAB Hard Circe^{DC}, ABC Department of Politecnico di Milano (photo by E. Ginelli).

regulators, and users. By promoting an open, multidirectional, proactive, and flexible approach, creative design integrates, enhances, and unveils the diverse aspects that the circular economy both connects and embodies - today and in the future - fostering a dynamic global vision capable of identifying new links and generating innovative solutions. In this way, our understanding of the positive complexity that characterises the circular economy is strengthened - an economy that is regenerative and a source of innovation, provided its deeper systemic meaning is not lost.

Genetically, the circular economy therefore requires a culturally revolutionary approach - one that engages thought, methods, technologies, and practices on multiple levels, starting from the strategic role of design, understood as the conscious and responsible anticipation of the transformative effects it produces on the social, economic, and ecosystemic environment, while simultaneously enabling the innovation it should convey.

To give just one example: design today is being redefined by the concept of servitisation (Siagri, 2021) - a challenging yet disruptive notion. It encapsulates the shift from ownership to access, embodying a business model (Chiaroni, 2022) that implements circularity strategies "upstream rather than downstream." The strategy of purchasing a service rather than a product - the so-called product-service system - demonstrates that selling a product is not necessary to postpone responsibility for its end-of-life.

Instead, it involves caring for all phases of its life cycle by offering a service - one that emphasises, for instance, product maintenance and, at the same time, the degree of maintainability inherent in its design, its transformability, and its ease of disassembly.

Clearly, this approach requires, on one hand, a leading role for the designer - one capable of bringing the ethical and responsible dimension of design back to the forefront, adding value to the professional, economic, social, and environmental fabric - and, on the other hand, collaborative conditions among the various actors (Dalenogare, Le Dain, Ayala, Pezzotta, Frank, 2023; Pezzotta, Cavalieri, Gaiardelli, 2012)[4].

This new mode of product management clearly expresses a cultural orientation towards the notions of borrowing and sharing resources, and thus towards the intention of reducing their consumption[5].

Hence, supported by the Ellen MacArthur Foundation's definition[6] of the circular economy, a profound cultural shift is underway - one that overturns the traditional notion of "resource scarcity", a concept bound to a linear model that prioritises resource needs in a simplistic arithmetic and economic correspondence with patterns of demand and consumption.
Instead, this scarcity is being reinterpreted as "potential resource" availability within a "regenerative process", where the continuous search for new connections, relationships, and interactions among elements within the closed loop of circularity becomes the key driver of action.
This regenerative process, conscious of its place within an open ecosystem[7], leads to a cultural recognition that the current "polycrisis"[8] is the outcome of linear economic models and of a widespread inability to engage with complexity in truly transdisciplinary terms.

[4] See also the interview with G. Pezzotta: https://economiacircolare.com/pezzotta-asap-benefici-servitizzazione/ (accessed on 10 September 2025).

[5] It is equally clear that both the design process and the project outcome change radically from the very conception stage, which anticipates the phases of realisation and management throughout the product's life cycle.

[6] The circular economy is a system where materials never become waste and nature is regenerated. In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting. The circular economy tackles climate change and other global challenges, like biodiversity loss, waste, and pollution, by decoupling economic activity from the consumption of finite resources: https://www.ellenmacarthurfoundation.org/topics/circular-economyintroduction/overview?gad_source=1&gad_campaignid=18189424489&gbraid=0AAAACb4JAcujnlSSxUkNRkIKxH_ZelL0&gclid=CjwKCAjwjffHBhBuEiwAKMb8pKEOwEqEBUHCSJg3loYXxgAYiD1E4WWbO0PhbUq-EvVNdt4EN1CU_hoCXnUQAvD_BwE (accessed on 10 September 2025).

[7] For an introduction to the systemic vision in architecture, see, by way of example, the works of L. von Bertalanffy, C. Alexander, C. Price, R. Banham, and S. Kwinter; for a broader perspective, see G. Bateson, I. Prigogine, B. Grosz, F. Capra, and E. Morin.

[8] A term coined by E. Morin and A.B. Kern in 1999 to describe "interwoven and overlapping crises" - no longer representing a single threat, but rather "the complex interconnection of problems, antagonisms, crises, and uncontrolled processes within the planet's overall crisis." In particular, see Morin (2011) and TECHNE Journal, 23, (2022), *Inside the polycrisis. The possible necessary*. https://oaj.fupress.net/index.php/techne/issue/view/733/242 (accessed on 10 September 2025).

PRELIMINARY REFLECTIONS ON THE "PROTEIFORME" CHARACTER OF THE CIRCULAR ECONOMY IN ARCHITECTURE

The construction sector has a significant impact on the environment, as has been repeatedly and forcefully stated: it is a devourer of raw materials, energy-intensive, and responsible for enormous quantities of waste and emissions[9]. The sector's impacts are generated from the earliest stages of project conception - through production, the selection and management of materials, products, and components, and the technologies and construction methods that define and realise both the building organism and the collective and public open space - extending to the urban context and the city as a whole. The negative effects are multiscalar, just as the opportunities offered by the circular economy are multiscalar and multidisciplinary.

Circular design dynamics can, for example, be based on Design for Product-Service System and/or Design with Biobased Materials, extending to the concept of cities as material banks within the broader framework of Urban Mining. The resulting examples at different disciplinary and scalar levels already demonstrate that the circular economy possesses multiple facets of research, reflecting its intrinsic value - a fertile, potential value understood as a strategy for addressing the complexity of architectural design in its cultural dimension, design practice, process, and management.

This value emerges from the network of relationships intentionally activated among the components and construction methods of the work and its parts over the medium and long term, in correspondence with the interconnections among the actors in the building process.

The extension of a building's useful life - and even more, its enhancement over time[10] - in response to requirements of durability, ease of maintenance, functional and spatial flexibility, adaptability, and disassembly of components, has led to the concept of Building as Material Bank and to the End-of-Life approach. This in turn has introduced related evaluation criteria such as Design for Adaptability–Flexibility–Durability (DfA)[11] to facilitate the upgrading and transformation of the building organism, and Design for Deconstruction and Design for Disassembling (DfD)[12] - essential design approaches that support both the recovery and longevity of components, products, and materials, and the adaptability of the architectural work itself. From here, a further dual design track emerges: Design for Reuse and Design with Reuse - two potentially consecutive design perspectives that share two key aspects.

The first concerns the need and potential to apply construction technologies and methods such as off-site production and dry assembly systems, which - in their genuine and not misleading sense[13] - eliminate the use of water, adhesives, foams, and waste, enabling real disassembly and therefore true "deconstruction." This goes far beyond the traditional concept of "demolition," however selective it may be.

The second aspect concerns the regulatory and normative framework. On the one hand, it determines the procedural structure for the certification of materials, products, and components, and the environmental and sustainability assessments of buildings[14] through defined criteria and scoring systems;

[9] See EEA Report 09/2024, *Addressing the Environmental and Climate Footprint of Buildings*, which presents data and a set of principles for future action: https://www.eea.europa.eu/en/analysis/publications/addressing-the-environmental-and-climate-footprint-of-buildings (accessed on 10 September 2025).

[10] A term which, for us, acknowledges its meaning in an "ecologising" sense, combining its value in economic, social, cultural, natural, and historical terms, all in reciprocal relation.

[11] JRC Techinical Report, Level(s) (2020) Indicator 2.3: Design for adaptability and renovation.

[12] JRC Technical Report, Level(s) (2021) *Indicator 2.4: Design for deconstruction.*

[13] Alongside the responsible and active ethical dynamism centred on the circular economy, there also emerge phenomena of greenwashing pursued for obvious economic or speculative purposes, as well as highly specialised, niche actions that dissipate the systemic value of the circular economy. Within this framework, the vague and sometimes inconsistent definitions of technical terms found in institutional documents, together with the lack of clarity regarding their fields of application, contribute to shaping a confused picture that hinders innovative prospects - particularly when anchored to the scale of the building organism.

[14] Principal ircular economy evaluation systems: BREEAM (2025); DGNB (2020); GBC Italia (2022); UNI/PdR 13 (2025).

on the other hand, it authoritatively dictates the feasibility (or otherwise) of innovations emerging from design research and university experimentation, often without a notion of a "Permis d'innover"[15].

Such feasibility is certainly influenced by context and market conditions, but above all by political choices and visions regarding environmental issues. Regulatory frameworks also determine the possibility of transforming the current fragmented role of enterprises in the design process into one of shared and collaborative design - a process of correspondence in which the project's sustainability principles and objectives are mutually understood and assimilated by clients, financiers, designers, companies, manufacturers, suppliers, managers, institutions, and users. A collaborative attitude allows not only significant reductions in environmental impact but also improvements in productive structures, fostering reciprocal growth in knowledge and skills with positive economic outcomes.

Given these premises, it seems logical to relate the thematic structure of the circular economy to the myth of Proteus[16], where the "proteiforme"[17] character takes on a transformative value of vision and initiative - activated through transdisciplinarity[18] and through the will and capacity of the actors involved to share knowledge, goals, practices, strategies, and methodologies.

All this aims to achieve, across various fields, "nourishing" results that confront, balance, and overturn environmental challenges - an interpretation less aligned with certain current policies[19], which tend more toward the subtractive attitude of the sea deity himself.

We believe we have introduced the protean value of the circular economy, but one clarification is still required. The starting point remains the transformative capacity of the mythological Proteus, mutable and unstable yet also endowed with the gift of foresight. If we transfer this quality to the circular economy, and based on what has already been stated, we can affirm that it is multifaceted because it encompasses articulated actions, all stemming from the single principle of self-generation of resources.

It is capable, through its cultural dimension and diverse applications at multiple scales, of contributing to sustainable outcomes that are themselves articulated - yet it also holds within itself the potential for future developments through predictive models and experimentation, typical of scientific reasoning. This, in turn, points to the methods by which circularity should be studied and explored. Given the infinite possible relationships among the themes inherent in its condition as a "closed loop within an open system", it must always be examined systemically - never in a unidirectional or reductive way - because it will never possess a "stable" character.

Current boundary conditions are changing and may change ever more rapidly; thus, the principle of circularity, as an open-system process, must by nature be able to adapt and reorganise itself in response to transformations and innovations introduced in the sector.

Circularity also contains an "anticipatory" faculty: being a closed loop, it harbours unexplored relationships that are genetically part of the principle of self-generation. Once identified, these unexplored relationships require equally innovative solutions, which must be validated through flexible and

[15] An interesting example is the "Permis d'innover" introduced in France and described in Ginelli, Daglio, Zinna (2024).

[16] The myth of Proteus, a sea deity from Greek mythology endowed with the ability to assume any animal form, or even that of an element - fire, wind, or water - in order to evade those who sought to question him: https://www.treccani.it/vocabolario/proteiforme/ (accessed on 10 September 2025).

[17] The meaning of protean, as given in dictionaries, refers to the ability to assume or suddenly reveal very different aspects or attitudes, but also to being versatile and multifaceted, like ingenuity itself. It is thus associated with the adjectives eclectic, composite, and many-sided.

[18] A design and research approach that goes beyond disciplinary boundaries, not merely relating disciplines as separate parts of a whole, but recognising them as bearers of new relationships through which to address the complexity of reality. For an initial exploration, see: https://apre.it/transdisciplinarita-come-paradigma-di-ricerca-per-comprendere-la-complessita/ (accessed on 10 September 2025).

[19] See the recent cautious international and national political positions, as well as the stances of environmental issue denial, with their evident and potentially dramatic consequences.

adaptable tools capable of assessing their effectiveness - otherwise, circularity risks becoming static and denying its multiform essence.

At this point, the evolving, metamorphic, protean character of circularity calls upon the researcher not to succumb to perceptual habituation but to go beyond the obvious (Polidoro, 2025). It demands the capacity to perceive alternative perspectives, to seek non-ordinary data, and to transcend disciplinary and monolithic boundaries.

Only in this way can truly extraordinary results be achieved - results that are documentable, testable through flexible evaluative tools, ensuring that innovation is not merely controlled but, above all, valued for the possible outcomes it can generate over time. In short, perhaps the circular economy is more than a strategy.

THE ARTICULATION OF ACTIONS FOR THE CIRCULAR ECONOMY A CULTURAL METAMORPHOSIS

We have already highlighted the characteristic of the circular economy as one that evolves over time and therefore possesses the ability to "keep up". This is clearly demonstrated by the continual expansion of the "R" framework that defines it, leading to new thematic connections. The circular economy originally rested upon the three Rs: Reduce, Reuse, Recycle[20].

Reducing is understood as the continuous and growing action of using fewer resources, thereby generating less waste until its potential elimination.

Reusing means employing materials, products, components, and building assets more than once in their original form instead of discarding or demolishing them after use.

Recycling refers to converting waste materials into new products by altering their original form and function through physical and chemical processes.

To these, a fourth R - Recover - was added, encompassing both Reuse and Refurbish. "Return a product to good working order. This can include repairing or replacing components, updating specifications, and improving cosmetic appearance". Reuse implies employing a product for new functions, while refurbish aims to restore it in its original form[21].

Subsequently, a fifth R, Regenerate, meaning "to give new life", was introduced - a concept dating back to 1976[22] that opens the way to contemporary regenerative design.

The sixth R, Repair, appeared institutionally in 2009[23], aimed at dismantling the practice of products with "planned obsolescence" and reinstating a management model rooted in the traditional act of mending. Combined with maintenance for product durability, Repair transcends the "use and dispose" production model, recognising the value of the resources employed in manufacturing.

In 2003, an explicit multidimensional dimension of the Rs emerged. It consists of a set of eight actions, each beginning with an "R", aimed at creating an alternative, fairer, and more sustainable society. Latouche (2003) introduced these as part of his concept of degrowth, a vision for a society that is more equitable and sustainable.

[20] Origin of the Concept: 1966: K.E. Boulding publishes the article "The Economics of the Coming Spaceship Earth", which lays the theoretical foundations for the circular economy. 1976: W. Stahel and G. Reday present a report to the European Commission defining the principles of the circular economy. 2005: The Ellen MacArthur Foundation is established.

[21] According to BS 8887 Standard (2009), reuse is the operation through which a product is refunctionalised for the same purpose at the end of its life cycle, whereas repurposing (or reutilisation) involves assigning a new use to a product in a role that differs from the original purpose for which it was designed. In both cases, no material modification process takes place.
See also: Green Building Council Italia, *Economia circolare in edilizia*, May 2019: https://gbcitalia.org/wp-content/uploads/2023/01/2019_GBC-PP-Ec.-Circ.-Rev2.pdf. And the Ellen MacArthur Foundation glossary on the circular economy: https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/glossary (accessed on 10 September 2025).

[22] See the European Commission in Brussels: W. Stahel and G. Reday, "The Potential for Substituting Manpower for Energy" (1976), which outlined the vision of an economy in loops - the foundation of what is now known as the circular economy.

[23] Directive 2009/125/EC on Energy-related Products (ErP), also known as the Eco-design Directive, establishes a framework for setting out eco-design requirements for energy-related products. This action has been further strengthened by Directive (EU) 2024/1799 on the Right to Repair, which entered into force on 30 July 2024.

This represents a clear commitment: these interrelated actions, in their essence and variations, define a field of application that extends across all sectors. In other words, they form a cultural manifesto of key actions: Re-evaluate / Rethink - the values that guide productive, social, economic, and everyday life; Recontextualise - to shift perspective and discover new meanings in situations; Restructure - to adapt according to changing values;

Relocalise - to restore value to the local scale; Redistribute - ensuring fair access to resources, work, and a dignified life for all; Reduce - the impact on the planet through new ways of producing and consuming; Reuse - by repairing; Recycle - by recovering waste materials.

In particular, Latouche's position helps us to understand the systemic meaning of circularity embodied in the key action of Re-evaluating, which implies a complete reform of thought (Morin, 2011; Capra, 1996).

Alongside this, Capra and Henderson's (2009) theorisation of qualitative growth explores the relationship between quantity and quality and explains the scientific concept of Quality.

Starting from a systemic conception, the authors emphasise that the quality of a complex system - such as the outcome of an architectural design process - refers to the system's properties "which are not exhibited by any of its parts." Moreover, the overall quality, both measurable and non-measurable, arises from relational processes and patterns among the parts, which require mapping, rather than a simplistic summation.

However, in the sequence of the new Rs, we can go further by introducing an articulation that makes multiscalarity explicit within the framework previously defined by multidimensionality, overlapping and developing together the ten R actions proposed by Walter Pardavé Livia[24] (2007). To the primary triad - Reduce, Reuse, Recycle - Pardavé adds:

Re-order, to which he attributes the meaning of re-regulating; Reformulate, to design bio-based products; Reward and Revalue energy, to which we may add the action of enhancing energy over time; Renew current practices; Redesign products, tools, and processes.

The tenth and final term proposed by Pardavé expresses the systemic character of architectural work: Re-manufacture - that is, to change the way we build.

Renewing production processes is an action that connects to the values of disassembly, adaptability, and transformability, as a means of countering degradation and functional obsolescence-both of individual products and of buildings as a whole-thus making processes and/or products more useful and less impactful.

Re-manufacturing, we believe that it is an indispensable action when viewed through the lens of the overall quality of a work, as it is the aspect that most effectively expresses the systemic value of the individual parts. Recognising that the methods of assembling products and components - even within current production practices - allow full and responsible adherence to the principles of circularity becomes a necessary act.

Despite awareness of the critical issues affecting the construction sector - specific to each geographical, industrial, and cultural context - this subject remains a neglected aspect, perhaps deliberately so, considering the significant

[24] W. Pardavé Livia, 2007, *Estrategias ambientales: de las 3R a las 10R*, ECOE Ediciones.

role it plays within circularity. It has not yet been examined with the depth and expertise it requires.

Although an ISO Standard[25] (2020) now provides, perhaps for the first time, a clear definition of re-manufacturing, current regulatory frameworks for architectural design - such as the Minimum Environmental Criteria (CAM) - still fail to acknowledge its importance beyond the characteristics of products themselves.

Yet, Re-manufacturing represents one of the most promising frontiers of circularity, capable of integrating technical innovation, cultural value, and environmental, social, and economic sustainability - all under the banner of a truly regenerative systemic Quality.

SOME CONCLUSIONS TO OPEN A DEBATE

The progressive increase in the number of "R", together with the growing awareness of the need to make today's resources available for tomorrow, demonstrates that the approach to the circular economy is not a static or purely material practice, but rather a dynamic process, one that must remain open to new Rs that form the foundational principles of design.

R as Cultural Revolution. The circular economy is, first and foremost, a cultural and design conviction that calls for a broad transformation: it overturns the very way we think about design, architecture, and construction, introducing the conceptual pairing of resources and time. As Chiaroni (2022) argues, circular economy strategies are most effective when tackled "dalla testa" - that is, from the design stage - rather than "alla coda", when intervention occurs only at the end of the life cycle. The true potential of circularity thus lies in the conceptual and strategic phase, where decisions are first shaped. This calls for a renewal of design thinking, grounded in creative planning, rooted in the reform of education, research, design, and production. A new organisation of knowledge is needed-alongside a revision of education, professional identity, and specialisation-to generate a genuine reversal of vision and perspective. As Edgar Morin (1999) observed, what is needed is a "la tête bien faite", one that promotes a more conscious and responsible political and cultural attitude.

R as Revelation. Circularity reveals the importance of adopting a systemic approach, not only to problems but to reality as a whole. It allows for the creation of long-term value, the identification of informed strategies, the anticipation of future scenarios, and the enhancement of system resilience and adaptability over time. It is therefore a constantly evolving condition, intrinsically fertile with potential solutions-solutions to be uncovered through continuous Research.

R as Complex Relationships. The circular economy embodies an infinite web of interrelations among environmental, economic, social, and cultural dimensions. Research and design practice must focus on discovering and consolidating new synergies across these domains. This demands deep inquiry, capable of exploring unknown connections between already recognised elements, thereby opening new frontiers of application. When accompanied by rigorous analysis, verification, and monitoring, such exploration leads to

[25] INTERNATIONAL STANDARD ISO 20887/2020, *Sustainability in buildings and civil engineering works - Design for disassembly and adaptability - Principles, requirements and guidance. 3.30*_Remanufacturability: ability of a product to be disassembled and refabricated at the end of its useful life in a manner that provides restoration to a condition suitable for resale; 5.3.5.4 Remanufacturability_Remanufacturability is the ability of a product to be disassembled and refabricated at the end of its useful life in a manner that provides restoration to a condition suitable for resale.
Remanufacturing differs from refurbishing in that ownership of the product is transferred to the original manufacturers or to another party that provides the restoration services. Remanufacturable products are designed in a manner that allows for complete upgrading: products can be inspected and assembled to their individual elements, and damaged pieces can be repaired or replaced. The product is therefore restored to an "as new" condition for resale by the fabricator. The use of construction components that revert to the ownership of the original manufacturer (e.g. via take back programs) can reduce waste and lower costs.

increasingly effective and innovative solutions, generating further avenues for experimentation and progress.

R as the Research of Design Essentiality. While design is inherently complex, it must also strive for essentiality in its outcomes-minimising environmental (social, ecological, economic, cultural) impact. Essentiality means conserving land, rejecting unnecessary new construction, enhancing the existing built environment, and pursuing durable, adaptable results that gain value over time through flexibility and multiple uses and implementation. It also implies functional convertibility of the built environment (Vignati, Pozzi; Sdino, Dell'Ovo, Ginelli, 2022), transformability and disassemblability, functional reversibility, and the rejection of superfluous components. Projects should improve efficiency by reducing high-carbon materials and embracing the product–service model. This can be achieved through core design measures and strategies , defined within a coherent terminological framework , allowing us to identify a contemporary meaning of Quality for the future-an idea of architecture's non-finiteness (Ingold, 2013).

R as Re-evaluation of Project Quality. The verb Re-evaluate perhaps best captures the deepest meaning of circularity: it is the focal point where design and designers must now pause, to reaffirm the ethical and political value of architecture. At a time when we have surpassed the environmental point of no return, there is an urgent need to strengthen a new science of Quality (Capra, 2002) - one that integrates environmental, social, and cultural values into actions aligned with a single systemic vision.

Such an integrated approach creates the fertile ground necessary to preserve and continue inhabiting our home - Planet Earth - sustained and regenerated through the contribution of architectural design itself.

SUGGESTED READINGS

Bateson, G. (1984), *Mente e natura. Un'unità necessaria*, trad. G. Longo, Adelphi, Milano, IT.

Braungart, M., McDonough, W. (2002), *Cradle to Cradle: Remaking the Way We Make Things*, North Point Press, New York, NY, US.

Capra, F. (1996), *The Web of Life*, Doubleday-Anchor Book, New York, NY, US.

Capra, F. (2002), *The Hidden Connections*, Doubleday, New York, NY, US.

Capra, F., Henderson, H. (2009), *Qualitative Growth*, The Institute of Chartered Accountants in England and Wales, London, UK.

Chiaroni, D. (2022), *L'impresa circolare: Modelli di business, sistemi di misura, leve manageriali*, EGEA, Milano, IT.

Dalenogare, L.S., Le Dain, M.A., Ayala, F., Pezzotta, G., Frank, A.G. (2023), "Building digital servitization ecosystems: an analysis of inter-firm collaboration types and social exchange mechanisms among actors", in *Technovation*, Elsevier, New York, US.

European Commission (2020), *Circular Economy Action Plan: For a Cleaner and More Competitive Europe*. Available at: https://ec.europa.eu (accessed on 10 September 2025).

Ginelli, E., Daglio, L., Zinna, F. (2024), "A Regulatory Culture for Design. For a Systemic Quality of Transformations," in *TECHNE Journal*, 27, pp.46–53, Firenze University Press, Firenze, IT. doi: 10.36253/techne-15168.

Ingold, T. (2013), *Making: Anthropology, Archaeology, Art and Architecture*, Routledge, Taylor & Francis Group, London, UK.

Latouche, S. (2003), *Petit traité de la décroissance sereine*, Mille et une Nuits, Paris, FR.

Morin, E. (1999), *La tête bien faite. Repenser la réforme, réformer la pensée*, Seuil, Paris, FR.
Morin, E. (2011), *La voie*, Librairie Arthème Fayard, Paris, FR.
Pezzotta, G., Cavalieri, S., & Gaiardelli, P. (2012), "A spiral process model to engineer a product service system: An explorative analysis through case studies", in *CIRP Journal of Manufacturing Science and Technology*, 5(3), Elsevier. doi: 10.1016/j.cirpj.2012.07.008.
Polidoro, M. (2025), *Una vita ben spesa. Trovare il senso delle cose con Leonardo, Einstein e Da win*, Feltrinelli, Milano, IT.
Siagri, R. (2021), *La servitizzazione. Dal prodotto al servizio*, Guerini e Associati, Milano, IT.
Vignati, G., Pozzi, G., Sdino, L., Dell'Ovo, M., Ginelli, E. (2022), "The regenerative design for hybrid evolutionary buildings Active resilience Convertibility Enhancement", in *TECHNE Journal*, 24, pp. 166-176, Firenze University Press, Firenze, IT. doi: 10.36253/techne-12870.
Vignati, G., Pozzi, G., Ginelli, E. (2023), "Life cycle thinking per l'organismo edilizio: il valore del processo progettuale nella circolarità", in *IDA Ingegneria dell'Ambiente*, 10, 2. doi: https://doi.org/10.32024/ida.v10i2.461.

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