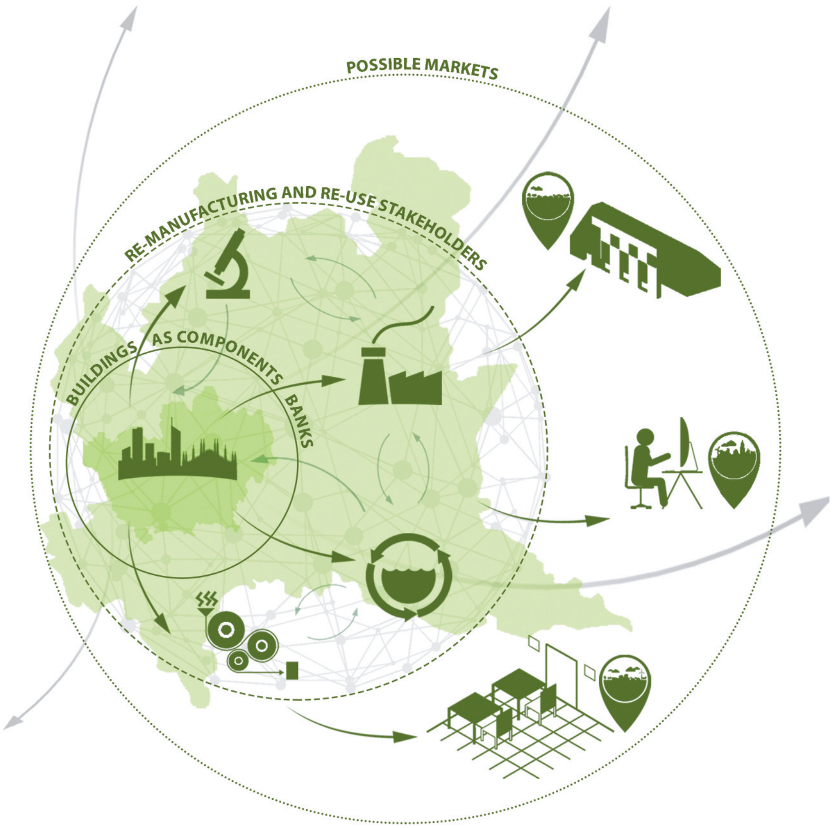
Re-manufacturing networks for tertiary architectures

Innovative organizational models towards circularity

edited by Cinzia Maria Luisa Talamo



Ricerche di tecnologia dell'architettura
FrancoAngeli

RICERCHE DI TECNOLOGIA DELL'ARCHITETTURA

diretta da Giovanni Zannoni (Università di Ferrara)

La collana *Ricerche di tecnologia dell'architettura* tratta prevalentemente i temi della progettazione tecnologica dell'architettura e del design con particolare attenzione alla costruibilità del progetto. In particolare gli strumenti, i metodi e le tecniche per il progetto di architettura alle scale esecutive e quindi le modalità di realizzazione, trasformazione, manutenzione, gestione e recupero dell'ambiente costruito.
I contenuti scientifici comprendono la storia e la cultura tecnologica della progettazione e della costruzione; lo studio delle tecnologie edilizie e dei sistemi costruttivi; lo studio dei materiali naturali e artificiali; la progettazione e la sperimentazione di materiali, elementi, componenti e sistemi costruttivi.
Nel campo del design i contenuti riguardano le teorie, i metodi, le tecniche e gli strumenti del progetto di artefatti e i caratteri produttivi-costruttivi propri dei sistemi industriali.
I settori nei quali attingere per le pubblicazioni sono quelli dei progetti di ricerca nazionali e internazionali specie di tipo sperimentale, le tesi di dottorato di ricerca, le analisi sul costruito e le possibilità di intervento, la progettazione architettonica cosciente del processo costruttivo.
In questi ambiti la collana pubblica progetti che abbiano finalità di divulgazione scientifica e pratica manualistica e quindi ricchi di spunti operativi per la professione di architetto.

La collana nasce sotto la direzione di Raffaella Crespi e Guido Nardi nel 1974.
I numerosi volumi pubblicati in questi anni delineano un efficace panorama dello stato e dell'evoluzione della ricerca nel settore della Tecnologia dell'architettura con alcuni testi che sono diventati delle basi fondative della disciplina.
A partire dal 2012 la valutazione delle proposte è stata affidata a un Comitato scientifico, diretto da Giovanni Zannoni, con lo scopo di individuare e selezionare i contributi più interessanti nell'ambito della Tecnologia dell'architettura e proseguire l'importante opera di divulgazione iniziata quarant'anni prima.

Contents

Part III – Insights

8. *Design guidelines for product re-manufacturing*

by *Luca Macrì, Carlo Vezzoli*

8.1 Background literature and practices about design guidelines for re-manufacturing

The chapter focuses on the topic of design for re-manufacturing (DfRem), presenting a set of guidelines that can facilitate product re-manufacturing processes toward more circular and sustainable organizational models in specific contexts, with particular attention on the tertiary sector.

The concept of design guidelines to ease re-manufacturing is inherently linked with the evolution of design for re-manufacturing (DfRem) itself and in particular with the end of the eighties, when the relevance of early design stages toward the prevention of barriers during re-manufacturing processes started to be observed and acknowledged (Hatcher *et al.*, 2011; Ijomah *et al.*, 2007; Keoleian and Menterey, 1993; Manzini and Vezzoli, 1998; Yang *et al.*, 2015). Indeed, research interests started to focus on how to intervene during early stages of the product development process in order to satisfy re-manufacturing requirements in advance, i.e. adopting DfRem tools like guidelines (Vezzoli, 2018; Yang *et al.*, 2015).

The following lines go through some peculiar approaches adopted along the years for the development of product DfRem guidelines, in order to outline the framework behind the guidelines presented in the next section.

Early contributions in this sense were mainly focused on comparing proposed designs to current re-manufacturing standard processes in order to develop metrics and tools to improve the ease of re-manufacturing (Ijomah *et al.*, 2007). This included a DfRem-specific approach together with other aligned and complementary approaches for re-manufacturing, like design for product lifespan extension. It is the case of RemPro matrix by Amezquita *et al.* (1995), in which some selected product properties (e.g. ease of identification, ease of access, ease of separation) are crossed with re-manufacturing steps (e.g. inspection, cleaning, disassembly). A slightly different approach was adopted in the RePro 2 tool by (Gehin *et al.*, 2008), in which proposed design are supposed to be compared with 'Re-manufacturable Product Profiles' in order to detect and enhance preferable features to facilitate re-manufacturing.

Other research efforts tried to bring together the literature on DfRem heuristics and some best practices from the industry, in order to develop guidelines that are more and more relevant for re-manufacturing practices. It is the case of Prendeville (Prendeville *et al.*, 2016), who conducted a literature review on existing general DfRem guidelines, identifying four main design areas to facilitate re-manufacturing and successively making a detailed comparison with design features of twelve best practices from different industries. The results highlighted a still very limited application of DfRem guidelines in the industry, mainly because the design potential at the early stages of the product development is overlooked under many points of view (e.g. marketing, innovation, engineering).

More recently, the research focus on specific DfRem contexts has also raised: a study by Shahbazi *et al.* (2021) focused on the potential use of automation technologies to enhance re-manufacturing and how to design products in order to facilitate the process. Through an empirical study based on a case study, the authors put together not only insights from product design evidence, but also about the specific context of automation, in order to facilitate its implementation by specific design guidelines and enhance remanufacturability.

In the outlined framework, active contribution came also from LeNSlab Polimi, a team based in Politecnico di Milano that has been doing research, consultancy and education on Design and System Innovation for Sustainability (DIS) for more than twenty years in multiple international research projects, as part of the Learning Network on Sustainability (LeNS)[1].

Over the years, the group actively contributed to the definition of Life Cycle Design (LCD) guidelines to facilitate re-manufacturing or broadly product lifespan extension – e.g. design guidelines facilitating upgrading and adaptability, maintenance, repair, and disassembly (Vezzoli, 2018). The guidelines – as well as tools containing them – have been mostly outlined

1. An international network of Higher Education Institutions aimed at the development and the diffusion of the Design for Sustainability (DfS) discipline in worldwide curricula with a multipolar, open and copyleft ethos.

and refined through several company consultancy projects on Life Cycle Design, resulting in outcomes that have been also integrated into companies' product development processes, e.g. handbook of LCD guidelines. This is also due a structured and validated methodology with solid foundations in the consultancy experience with several companies (e.g. NECTA Vending Solutions, Kone (elevator), Bonaveri), that have been successively formalized and improved over the years to elaborate product-specific LCD guidelines to be more effective in company practice than general ones (Vezzoli and Sciama, 2006).

All this considered, the next paragraph introduces a set of design guidelines to facilitate product re-manufacturing, selected as promising for tertiary architectures products in the context of the research Re-NetTa (Re-manufacturing Networks for Tertiary Architectures) (see Chapter 1).

8.2 Toward specific design guidelines for re-manufacturing: a selection in the context of tertiary architecture

In this section, a set of design guidelines for re-manufacturing and broadly for lifespan extension (connected to the former) is presented as a selection from the ones developed and used in LCD company consultancy by the LeNSlab Polimi (Vezzoli, 2018). This is made as far as they could be extended (as they are or with adaptations) to short-time architectural components in the tertiary sector. In this sense, a structured process to move from the selected general Life Cycle Design guidelines toward specific ones – e.g. to elaborate guidelines for the design of a precise typology of building components – is also introduced at the end of the section.

The guidelines selection has been carried out along with activities and learnings from the above-mentioned Re-NetTA project, which allowed to gather different inputs from multiple sources. Among the others, relevant insights came from: a desk research on international best practices in terms of business and organizational models based on design for product lifespan extension (see Chapter 3); interviews to practitioners from different areas in the tertiary architecture sector – exhibitions, office, retail (see Chapter 5,6,7); multiple roundtables with stakeholders and practitioners from the industry (see Chapter 5,6,7). Here below guidelines are introduced and listed.

8.2.1 Design guidelines for re-manufacturing

The first bunch of selected design guidelines gathers the ones specifically aimed at facilitating re-manufacturing processes, which means to design in order to facilitate the re-collection of used products as well as to make them suitable for storage, since they will be reintroduced into a new structured industrial process. In this sense, design interventions related to easy disassembly operations would be appropriated and are presented as the last group of this section. Guidelines are:

- Design and facilitate removal and substitution of easily damageable components;
- Design structural parts that can be easily separated from external/visible ones;
- Provide easier access to components to be re-manufactured;
- Calculate accurate tolerance parameters for easily damageable connections and components;
- Design for excessive use of material for easily deteriorating surfaces.

As anticipated, the set contains also other guidelines for product lifespan extension, since they could be potentially connected with re-manufacturing. It is the case of design guidelines facilitating reuse, upgrading and adaptability, maintenance, repair, and disassembly.

8.2.2 Design guidelines for reuse

To design for product reuse means to preserve its conditions and facilitate the transition toward a second end-user, which include all the maintenance and repair operations to assure its integrity. Guidelines are:

- Increase the resistance of easily damageable components;
- Arrange and facilitate access to and removal of retrievable components;
- Design modular and replaceable components;
- Design components according to standards;
- Design reusable auxiliary parts.

8.2.3 Design guidelines for facilitating upgrading and adaptability

The easy upgrade or adaptation of products is particularly important in terms of Life Cycle Design because allows to extend their lifespan even in case of changing conditions (technological, cultural, geographical etc.). In particular, speaking about eco-efficient upgrade we refer to interventions in which a significant part of products stays unaltered. Differently, designing for adaptation is meant as making products suitable to be continuously used in relation to environments that are changing. Guidelines are:

- Enable and facilitate software upgrading;
- Enable and facilitate hardware upgrading;
- Design modular and dynamically configured products to facilitate their adaptability for changing environments;
- Design multifunctional and dynamically configured products to facilitate their adaptability for the change in individuals' cultural and physical backgrounds;
- Design products that are upgradeable and adaptable on-site;
- Design complementary tools and documentation for product upgrading and adaptation.

8.2.4 Design guidelines to facilitate maintenance

Designing to facilitate precautionary adjustments through maintenance allows to avoid costs and environmental impacts related to product repair or substitution (which cause untimely disposal). Indeed, maintenance operations are often crucial to assure products proper durability (e.g. proper protection, cleaning etc.).

- Simplify access to and disassembly of components to be maintained;
- Avoid narrow slits and holes to facilitate access for cleaning;
- Prearrange and facilitate the substitution of short-lived components;
- Prearrange the usage of easily available equipment;
- Equip products with diagnostic and/or automatic diagnostic systems for maintainable components;
- Design products for easy on-site maintenance;
- Design complementary maintenance tools and documentation;
- Design products that need less maintenance.

8.2.5 Design guidelines to facilitate repair

High value of a product can be recovered through repair operations after a damage. Design to facilitate this process means to reduce as much as possible the complexity and the costs related to the required interventions. Guidelines in this sense are:

- Arrange and facilitate disassembly and reattachment of easily damageable components;
- Design components according to standards;
- Equip products with automatic damage diagnostics system;
- Design products for facilitated on-site reparation;
- Design complementary repair tools, materials and documentation.

As anticipated, here below are described also a selection of the guidelines for Design for Disassembly (DfD), since they are useful to make the separation of either parts or materials easier and more convenient. Indeed, the facilitation of parts separation makes product re-manufacturing, reuse, maintenance, repair, upgrade and adapt easier.

8.2.6 Design guidelines to facilitate disassembly

A first set of guidelines to facilitate disassembly is about *minimising and facilitate operations of disassembly and separation*:

- Overall architecture:
  - Prioritise the disassembly of more easily damageable components;
  - Prioritise the disassembly of the parts more subject to technological and/or aesthetic obsolescence;
  - Engage modular structures;
  - Divide the product into easily separable and manipulable sub-assemblies;
  - Minimise hierarchically dependent connections among components;
  - Minimise different directions in the disassembly route of components (and materials);
  - Increase the linearity of the disassembly route;
  - Engage a sandwich system of disassembly with central joining elements.
- Shape of components and parts (in case of automatic disassembly):
  - Avoid difficult-to-handle components;

  - Avoid asymmetrical components, unless required;
  - Design leaning surfaces and grabbing features in compliance with standards;
  - Arrange leaning surfaces around the product's centre of gravity;
  - Design for an easy centring on the component base.
- Shape and accessibility of joints:
  - Avoid joining systems that require simultaneous interventions (on more than one joint) for opening;
  - Minimise the overall number of fasteners;
  - Minimise the overall number of different fastener types (that demand different tools);
  - Avoid difficult-to-handle fasteners;
  - Design accessible and recognisable opening for dismantling;
  - Design accessible and controllable dismantling points.
- The second and last set of selected guidelines that facilitate disassembly are related to the *engagement of reversible joining systems*:
  - Employ a two-way snap-fit;
  - Employ joints that are opened without tools;
  - Employ joints that are opened with common tools;
  - Employ joints that are opened with special tools, when opening could be dangerous;
  - Design joints made of materials that become reversible only in determined conditions;
  - Use screws with hexagonal heads;
  - Prefer removable nuts and clips to self-tapping screws;
  - Use self-tapping screws for polymers to avoid using metallic inserts.

As already mentioned, although the presented set of guidelines is a selection of the ones that could be relevant for the tertiary construction sector, the highest effectiveness to enable re-manufacturing practices would be given with more specific guidelines in relation to the product to be designed. To give a more precise idea of the shift from general to specific Life Cycle Design guidelines, please refer to the following example:

General LCD guideline: Design multifunctional and dynamically configured products to facilitate their adaptability for changing cultural and physical individual backgrounds.

Product-specific LCD guideline: Design reconfigurable office walls that can adapt to changes in relation requirements, such as with adjustable corners or length extensions, e.g. by using rotating edge hinges.

Even though the focus of the chapter is not to outline a methodological framework, it is useful to introduce an abstracted example of the process behind guidelines specification, to enhance further research and practice in the specific context of short-term components for tertiary architectures. As anticipated, the process has solid foundations in consultancy experiences that have been successively formalized and improved over the years (Vezzoli and Sciama, 2006).

Going step by step, for a proper specification of Life Cycle Design guidelines a preliminary assessment of the environmental impact (either qualitative or quantitative) of the product life cycle should be conducted, as well as a consequent prioritisation of LCD strategies to reduce the overall impact. This framework represents the knowledge basis for a successive collaborative workshop, usually involving expert stakeholders in relation to the specific product or sector. After being updated about the assessment result and the prioritisation of LCD strategies, the core activity of the workshop is a structured process that is adopted for each guideline taken into analysis, allowing participants to apply a variety of specifying actions: integrate a guideline in relation to any precise product or typology; add a new guideline related to any precise product or typology; add note/remainder related to any precise product or typology; erase a guideline. As a result of the workshop, a draft of specific guidelines is achieved, followed by a further stage of review and refinement to integrate final improvements.

In order to bring further the connection between the presented guidelines and the practice of re-manufacturing in the tertiary architecture sector, the next session goes in depth with a series of examples, able to exemplify and clarify the meaning of some relevant guidelines.

8.3 Guidelines and examples to facilitate Design for Re-manufacturing in the tertiary architecture sector

8.3.1 Gispen furniture

A first example (Gispen, 2022; LeNS International, 2022) to better understand guidelines in practice is represented by some product collections designed by of Gispen, a dutch brand producing furniture and outfitting products for different kinds of environments (e.g. education, healthcare, office). Looking at the company's chair collection, it is reported that the design is based on a 75% of standard components that are universal for other product groups, such as different chairs, bar stools or tables. For example, the backrest of a chair can also become the backrest of a bar stool. In other words, the modularity of components and their ease to be replaced helps to extend product's lifespan and could be valuable also for re-manufacturing, since it facilitates the replacement of parts for required rework operations. The backrest can be replaced or swapped on site by one person within ten minutes, without causing any damage, due to one single screw connection. Moreover, material blends are avoided, and the steel frame is separable from the wood and foam parts, as well as from the cover made of fabric. Gispen goes also beyond furniture, adopting the same approach even to higher scale solutions like conference room fittings, which are again designed to be modular and can be constantly re-arranged.

The main DfRem guideline applied in the example is the *design of modular and replaceable components,* which is actually a complementary guideline that could be valuable for many different processes to extend the product lifespan, e.g. reuse, upgrade, adaptation and in some cases even maintenance and repair. This is coherent with feedbacks received from the industry, since modularity turned out to be one of the most applied concepts in the industry and well as a desirable design approach for interviewed stakeholders and practitioners within the Re-NetTA project. It is implicit that the example presented could be also connected to other guidelines among the ones presented, e.g. *design modular and dynamically configured products to facilitate their adaptability for changing environments; design components according to standards etc.*

8.3.2 Brummen Town Hall

The second selected case (RAU Architects, 2013) to exemplify some presented guidelines is the Brummen Town Hall designed by RAU Architects and Turntoo. Due to concerns over frequently shifting municipality borders, the municipality of Brummen commissioned a building for a service life of 20 years. Thus, the design approach applied by providers was to make it as a 'raw material depot' based on the possibility of retrieving all the building products after disassembly. In this sense, for example, the use of concrete has been minimized in favor of prefab timber components and different types of reversable joints allow to collect and reuse 90% of the building. Moreover, each component's data has been identified and registered, in order to allow producers to plan its destination after disassembly and arrange the logistics accordingly.

In this case, the main design guideline referred to the example is from Design for Disassembly, and in particular it focuses on *minimising and* *facilitate operations of disassembly and separation*. Indeed, as anticipated, the dismantling process is crucial to enable proper re-manufactuiring, since it deeply affects logistic processes and costs. As it was observed from the direct engagement of stakeholders, this is particularly important for outfitters, who play a specific role at the disassembly stage of the value chain, and it clarify how much their involvement in the design stage would be relevant to activate re-manufacturing. Secondary guidelines applied in the example are for sure *design of modular and replaceable components; engagement of reversible joining systems (in general).*

8.3.3 Desso-Tarkett Carpet tiles

The third example (Tarkett, 2015) comes from the company Desso Commercial Carpets by Tarkett, which is a global carpet and carpet tiles company that works for commercial customers from different sectors. Among their solutions, they provide the Carpet Leasing Service, which is based on turning carpet tiles into a service: Desso keeps the ownership of products and provide installation, cleaning, maintenance and eventually removal. Moreover, after the standard 7-years contract, a new carpet is provided by Desso and the old one is recycled and reintegrated into a new life cycle.

The key design choice that allows Desso to extend the overall flooring lifetime is a design oriented toward maintenance and repair, based on the use of tiles. Differently from rolls, tiles are designed to be modular and easily removable, since each tile is sticked through tape and can be punctually removed. This allow specific intervention in case of damages, avoiding a complete renovation of the flooring. Moreover, since Desso doesn't sell the tiles, the company provide services like maintenance and substitution, that contribute to extend the lifetime of products.

In this last example, the main design guideline represented is a combination of two: *arrange and facilitate disassembly and reattachment of easily damageable components; arrange and facilitate disassembly and reattachment of easily damageable components.* Indeed, although eased disassembly is a crucial feature of the product, it can be identified as peculiar for its implication in terms of maintenance and repair, which have been presented as complementary to re-manufacturing.

As noted also from stakeholders' feedbacks, the example shows that the design of an eco-efficient product could allow also a shift in the offer model, where economic interest is aligned with the pursuit of environmental benefits. This latter topic is treated in detail within Chapter 14, where Sustainable Product-Service Systems are introduced.

References

Amezquita T.R., Hammond and Bras B. (1995), *Characterizing the Re-manufacturability of Engineering Systems. ASME Advances in Design Automation Conference*, DE, vol. 82, Boston, Massachusetts, ASME, pp. 271-278.

Gehin A., Zwolinski P. and Brissaud D. (2008), "Imaging a Tool to Implement Sustainable End-of-Life Strategies in the Product Development Phase", *Journal of Cleaner Production*, *16*, 566-576. Available at: https://doi.org/10.1016/j.jclepro.2007.02.012.

Gispen (2022), *Circulaire Projectinrichter Voor Zorg, Onderwijs En kantoor-Gispen,* available at: www.gispen.com/en/, Accessed 10/06/2022.

Hatcher G.D., Ijomah W.L. and Windmill J.F.C. (2011), "Design for Re-manufacture: A literature Review and Future Research Needs", *Journal of Cleaner Production*, *19*(17), 2004-2014, available at: https://doi.org/10.1016/j.jclepro.2011.06.019.

Ijomah W.L., McMahon C.A., Hammon G.P. and Newman S.T. (2007), "Development of Fobust Design-for-Re-manufacturing Guidelines to Further the Aims of Sustainable Development", *International Journal of Production Research*, *45*(18-19), 4513-4536, available at: https://doi.org/10.1080/00207540701450138.

Keoleian G.A. and Menterey D. (1993), *Life Cycle Design Guidance Manual: Environmental Requirements and the Product System | Center for Sustainable Systems* (EPA/600/R-92/226), Risk Reduction Engineering Laboratory, Office of Research and Development, U.S. Environmental Protection Agency.

LeNS International. (2022), *LeNS International*, *a*vailable at: www.lens-international.org/. Accessed 10/06/2022.

Manzini E. and Vezzoli C. (1998), *Lo sviluppo di prodotti sostenibili. I requisiti ambientali dei prodotti industriali*, Maggioli.

Prendeville S., Peck D., Balkenende R., Cor E., Jansson K. and Karvonen I. (2016), *Map of Re-manufacturing Product Design Landscape* (p. 61).

RAU Architects. (2013). *Gemeentehuis Brummen,* RAU Architects, available at: www.rau.eu/portfolio/gemeentehuis-brummen/, accessed 10/06/2022.

Shahbazi S., Johansen K. and Sundin E. (2021), "Product Design for Automated Re-manufacturing – A Case Study of Electric and Electronic Equipment in Sweden", *Sustainability*, *13*(16), 9039. Available at: https://doi.org/10.3390/su13169039.

Tarkett (2015), *DESSO Carpet Rolls and Tiles – Tarkett | Tarkett*, *a*vailable at: http://professionals.tarkett.com/en_EU/node/desso-carpet-tile-and-roll-solutions-innovation-functionality-and-sustainability-5527, aaccessed 10/06/2022.

Vezzoli C. (2018), *Design for Environmental Sustainability: Life Cycle Design of Products* (2ª ed.). Springer-Verlag, available at: https://doi.org/10.1007/978-1-4471-7364-9.

Vezzoli C. and Sciama D. (2006), "Life Cycle Design: From General Methods to Product Type Specific Guidxelines and Checklists: a Method Adopted to Aevelop a Set of Guidelines/Checklist Handbook for the Eco-Efficient Design

of NECTA Vending Machines", *Journal of Cleaner Production – J CLEAN PROD*, *14*, 1319-1325, available at: https://doi.org/10.1016/j.jclepro.2005.11.011.
Yang S.S., Ong S.K. and Nee A. (2015), "Towards Implementation of DfRem into the Product Development Process", *Procedia CIRP*, *26*, 565-570, available at: https://doi.org/10.1016/j.procir.2014.07.026.

Cinzia Talamo, Architect, Ph.D., she is Full Professor of Technology of Architecture at the Department of Architecture, Built Environment and Construction Engineering (DABC) of Politecnico di Milano. Since 2019 she is a Member of the Academic Senate at Politecnico di Milano and she was Coordinator of the DABC Scientific Commission from 2016 to 2019. She participates as Principal Investigator in researches on a national and international scale concerning innovation in the field of management of the built environment. She develops her scientific activity on the Technology of Architecture discipline focusing on the role of technological innovation in architectural design and building management, deepening the following topics: strategies for the improvement of recycling and reuse processes of waste; cross-sectoral approaches for recycling, re-manufacturing and reuse of waste in a perspective of industrial symbiosis and circular economy; building maintenance, urban maintenance and Facility Management; information systems for Facility Management. On these topics, she is author of over 170 publications including books, essays, national and international conference proceedings and journal articles.

Carlo Vezzoli, Full Professor of Design at Politecnico di Milano. For nearly than 25 years he has been researching and teaching on design for sustainability. Nowadays, in the School of Design he holds the courses of product *Design for environmental Sustainability* and *System Design for Sustainability,* and he is the head of the research lab *LeNSlab Polimi* on *Design and system Innovation for Sustainability (DIS)*. He has delivered worldwide courses, lectures and speeches at international congresses in in *Africa* (Botswana, Kenya, South Africa and Uganda), *Asia* (China, India, Japan and Thailand), The *Americas* (Brazil, Colombia and Mexico), and *Europe* (Austria, Belgium, Denmark, Estonia, Finland, Ireland, France, Norway, The Netherlands and United Kingdom). Since 2007 he is founder of the *Learning Network on Sustainability* a worldwide multipolar network of nearly 150 design Universities, with the aim of diffusing design for sustainability with an open access ethos. He has written several books in English, Italian, Spanish, Portuguese and Chinese. He was awarded the title of PhD Honoris Causa by the Federal University of Parana.

Salvatore Viscuso, Architect, Ph.D., he is Assistant Professor in Architectural Technology at the Politecnico di Milano, Department of Architecture, Built Environment and Construction Engineering (DABC). In 2016, he earned his doctorate focusing on the design of innovative building components through computational design methods. Currently Dr. Viscuso is working on national funded research for implementing new circular models for the construction industry. As BIM manager, he collaborates with leading architecture offices and contractors for the modeling coordination of complex buildings at different project scales. He also participates as speaker in numerous international conferences and workshops (SITdA, IASS, Tensinet, Structural Membranes).