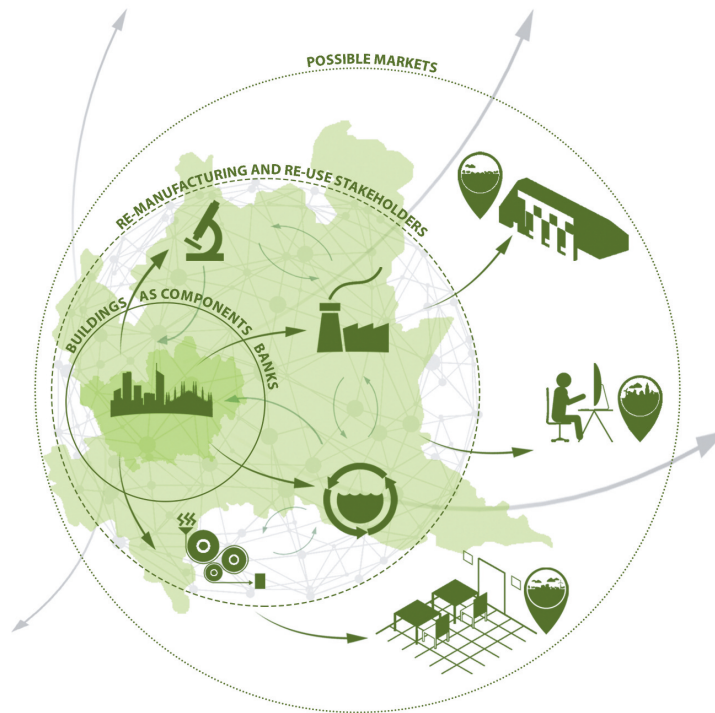


Re-manufacturing networks for tertiary architectures

Innovative organizational models
towards circularity

edited by Cinzia Maria Luisa Talamo



Ricerche di tecnologia dell'architettura

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The book presents the results of the project “*Re-NetTA (Re-manufacturing Networks for Tertiary Architectures). New organizational models and tools for re-manufacturing and re-using short life components coming from tertiary buildings renewal*”, developed at Politecnico di Milano (2018-2021) and supported by Fondazione Cariplo, grant n° 2018-0991 (Call “Circular Economy for a sustainable future 2018”).

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Introduction

This book deals with re-manufacturing, recondition, reuse and repurpose considered as winning strategies for boosting regenerative circular economy in the building sector.

The book presents many of the outcomes of the research “Re-NetTA (Re-manufacturing Networks for Tertiary Architectures). New organisational models and tools for re-manufacturing and re-using short life components coming from tertiary buildings renewal”. The research was funded in Italy by Fondazione Cariplo for the period 2019-2021 and developed by a multidisciplinary group composed of all the authors present in this publication.

The field of interest of the book is the building sector, focusing on various categories of tertiary buildings, characterized by short-term cycles of use.

The building sector is a fundamental lever for the activation of circular economy. European Commission identifies the construction sector as a “Priority area” involved in specific challenges in the context of circular economy: according to the Eurostat statistical data in EU-28 the main field that produces waste is construction sector, contributing to 33.5% of the total waste generated by all economic activities and households in 2014. Besides, the construction sector is an important driver for circular economy as it provides, according to European Commission data, 18 million direct jobs and contributes to about 9% of the EU GDP. The application of new circular economy strategies can create new jobs, social benefit, energy and resource efficiency and a sustainable environment.

Currently, the circular strategy more promoted in the built environment is recycling. Most of European Projects (e.g. HISER PROJECT, Resource Efficient Use of Mixed Waste, DEMOCLES, ENCORT) and particularly Life Project investigate on recycling (inter-sectoral or within the construc-

tion sector) of construction and demolition waste and deal with specific recycling topics (e.g. LIFE-PSLOOP Polystyrene Loop; CDW recycling Innovative solution for the separation of construction and demolition waste). Often recycling implies the downcycling and requests complex and energy-consuming processes. On the contrary, if well-organized, re-manufacturing and reuse require very simple and low-impacting processes, reduce the generation of waste and maintain over time the value of the resources embodied in manufactured products – once they are removed from the buildings – by extending their useful life and their usability with the lowest possible consumption of other materials and energy and with the maximum containment of emissions in the environment.

In the perspective of circular economy, the focus of this book on tertiary buildings derives from some considerations:

- cities all over the world are characterized by high quantities of tertiary buildings with various destinations (public and private offices, accommodation facilities, retail, exhibition facilities, temporary shops, etc.);
- there is an increasing stock of unused, often obsolete, tertiary buildings, especially after the pandemic;
- tertiary buildings are more and more characterized by quick cycles of renewal and reconfiguration of interior spaces following a series of phenomena that determine a fast functional obsolescence and frequent reshaping such as: recent approaches that shift attention to the use of buildings in terms of service (such as hoteling, leasing, co-working, smart working and various declinations of sharing) determining a high degree of temporary use; shortening of leases; transformations in the Real Estate market; transformations in the models of commerce;
- this kind of buildings generate significant quantities of disused elements and systems that become waste if not reused or remanufactured. These products (in particular interiors, services, equipment and furnishings) have usually a high degree of residual performances and are characterized by being dry assembled (therefore easy to disassemble), composed of high-value raw materials, generally equipped with manufacturer technical datasheets (therefore easily traceable) and, besides, by having a high added value.

This book investigates the most promising strategies and organisational models to maintain over time the value of the environmental and economic resources integrated into manufactured products, once they have been removed from buildings. Some novel concepts for the construction sector should be introduced:

- the integrated “re-actions” (re-manufacturing, re-condition, re-purpose, reuse, repair) as strategies for keeping building products and their embodied materials in use for longer time with significant decrease of waste, energy and water use and emissions through the reduction of manufacturing activities;
- the building as “components bank”. The building is no longer meant as the last destination of industrial products, but as a node within circular processes;
- “planned obsolescence” as a proactive strategy for addressing and optimizing the “re-actions”;
- decommissioned building products meant not as waste but as “bought and sell” items available for purchase from catalogues or other sources;
- “reverse supply chains” that is the delivery of goods (decommissioned elements) from the owners to the reuse or remanufacture operators.

These new concepts are connected with various possible approaches, innovative for the construction sector:

- from product to service, i.e. overcoming the purchase of building elements towards “pay per use” approaches which assume the presence of an operator who supplies products for defined periods and uses and who withdraws them and re-introduces them into the use network, possibly after re-manufacturing, repair, etc.;
- “disown ownership”, possibly with forms of peer to peer market, which assume the presence of networks that facilitate the sharing, renting or leasing and exchanging of products that can be remanufactured and repaired over time;
- lengthening of the life cycle of products through services, with low or zero consumption of materials and energy, based on the scheduled monitoring and updating (re-manufacturing, recondition, repair). These services may be integrated within FM (Facility Management) services related to space and maintenance management;
- assessing the reduction of impacts and the consumption of resources from the point of view of environmental (LCA), economic (LCC) and social (SLCA) sustainability in order to evaluate the effectiveness of circular economy strategies based on re-manufacturing and reuse processes.

By assuming these concepts and approaches the book introduces some challenges to the existing paradigms:

- from the design of products, meant as “black boxes”, to the design of systems that can be divided into items, identified for the different durations and for the possibility of being disassembled, remanufactured, traced and reused once isolated;
- from the sale of a product (the building element) to the supply of a service, enhancing the “extended producer responsibility” and “shared responsibility” along the supply chain through the introduction of new re-manufacturing operators;
- from the ownership of an asset to the delivery of a service (for example renting and leasing models).

Also thanks to the hints that emerged from the intense dialogues and many roundtables involving various categories of stakeholders, conducted during the *Re-NetTA* research, the book intends to identify and analyse the most important barriers to the development of effective re-manufacturing practices and the possible strategies to overcome them.

The book is articulated into three parts and 15 chapters.

Part I BACKGROUND introduces the current theoretical background and identifies key strategies about circular economy and re-manufacturing processes within the construction sector, focusing on tertiary architectures. It is divided into three chapters.

Chapter 1 deals with the relationships between circular economy and building sector, proposing tertiary architectures as promising testing ground for assessing circular strategies.

Chapter 2 introduces and discusses a hierarchy of the possible “re-actions” for circularity, each of one characterized by the return of a used product, trying to highlight the fundamentals and the basic conditions for propagating re-manufacturing, recondition, reuse and repurpose.

Chapter 3 provides an overview of the most existing consolidated practices of re-manufacturing within different industries and highlights possible strategies and approaches to transfer to the building sector.

Part II PROMISING MODELS outlines, according to a proposed framework (Ch. 4), a set of promising circular organizational models to facilitate re-manufacturing practices and their application to the different categories of the tertiary sector: exhibition, office and retail. This part also reports the results of active dialogues and round-tables with several categories of operators, adopting a stakeholder perspective. The chapters 5,6,7 describe each of the three models and share the same structure: the description of the organizational model, cases and views from the

perspective of some key stakeholders in the field-sectors, the enabling and hindering elements.

Chapter 4 proposes three promising circular organizational models and discusses some key features useful for deepening them: *rent contract as a support for re-manufacturing*; *all-inclusive solution to support re-manufacturing*; *alternative/secondary markets for re-manufactured products*.

Chapter 5 introduces the rent contract, focusing on value chain key factors that enable circular practices. Representative case studies for the tertiary sectors are discussed.

Chapter 6 presents the characteristics of an innovative organizational model proposed for the tertiary architecture based on the integration of all-inclusive services with the goal of promoting re-manufacturing practices. The investigation is developed considering the exhibition, office and retail sectors.

Chapter 7 The chapter presents the characteristics of an innovative organizational model aimed at promoting circular dynamics through the setting of a supply chain that identifies alternative/secondary markets as potential destinations for reused, re-manufactured and repurposed products.

Part III INSIGHTS provides some insights on the issue of re-manufacturing, analyzed from different perspectives with the aim of outlining a comprehensive overview of challenges and opportunities for the application of virtuous circular processes within building sector. In particular, Part III is organized in four key topics: A) Design for re-manufacturing; B) Digital Transformation; C) Environmental Sustainability; D) Stakeholder Management, regulations & policies.

Topic A “Design for Re-manufacturing” investigates the relevance of original product design in the specific context of re-manufacturing in tertiary architecture, with a focus on design strategies and guidelines.

Chapter 8 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.

Chapter 9 deepens the subject of design for re-manufacturing and circular processes applied to the field of textile architectures.

Topic B “Digital Transformation” explores the possibility to apply digital technologies to re-manufacturing practices, highlighting possible solutions to streamline current activities and to exploit the novel availability of real-time information and advanced data management capabilities offered by Information and Communication Technologies (ICTs).

Chapter 10 investigates how digital technologies can support the transition to circular economy of tertiary building through the digital simulation of the disassembly and remanufacturing stages.

Chapter 11 discusses how some barriers to the spreading of re-manufacturing practices may be handled more effectively by means of the Information and Communication Technologies (ICTs), especially Internet of Things (IoT), highlighting the key role of information platforms towards stakeholder collaboration and co-operation.

Topic C “Environmental Sustainability” focuses on the environmental benefit of re-manufacturing practices, emphasizing the application of life cycle tools to support the sustainability assessment of circular practices, encouraging the materials flow monitoring and information exchange among stakeholders.

Chapter 12 focuses on the assessment of the environmental sustainability of building products derived by re-manufacturing organizational models, in order to support eco-innovative approaches for the development of long-term value and green products. In this context, the material flows associated with re-manufacturing process are mapped and analyzed in depth, providing a framework for the application of LCA to re-manufacturing processes and re-manufactured products.

Chapter 13 deals with the traceability tools (e.g. materials passports, pre-demolition audit, etc.) useful to keep information related to building components in their entire life cycle (from material extraction to the disassembly after use and the end of life).

Topic D “Stakeholder Management, Regulations & Policies” deals with the definition of regulations supporting the relationships between the stakeholders and of approaches to the management of the re-manufacturing supply chain, providing also value chain insights to foster circular processes in the building industry.

Chapter 14 introduces the Sustainable Product-Service Systems (S.PSS) discussing to which extent they can enable value chain opportunities for re-manufacturing practices in the context of tertiary architectures and focusing on the application of product-service based models attached to re-manufacturing activities in the tertiary architectures context.

Chapter 15 aims to provide an overview of the main aspects on novelty introduced by reuse and remanufacturing practices assuming as a sample the Italian regulatory framework of the building sector, in particular focusing on aspects related to negotiation (sale, donation and leasing), safety, environmental and waste management.

6. Organizational models for re-manufacturing: all-inclusive services integrating partnered re-manufacturers

*by Sara Ratti, Nazly Atta, Anna Dalla Valle, Serena Giorgi,
Luca Macrì, Salvatore Viscuso*

6.1 All-inclusive services: from product-service logic towards new forms of partnerships for the extension of product useful life

The present chapter presents the characteristics of an innovative organizational model proposed for the tertiary architecture based on the integration of all-inclusive services with the goal of promoting re-manufacturing practices.

The organizational model presented in this chapter originates from the combination of two key elements: the offering of a product-service solution and a collaboration between two or more supply chain actors. Specifically, the organizational model based on all-inclusive services integrating partnered re-manufacturers implies the sale of the product to the customer, who will benefit from a set of services during the product use phase, aimed at extending the product useful life. The possible services might include cleaning, repair, maintenance, replacement and re-manufacturing. Relevant supply chain relationships are established between the provider, i.e. the product supplier and the re-manufacturer, i.e. the supplier of technical services associated to the product. The re-manufacturer will provide the required services oriented to protect and potentially extend the product life cycle during the use phase. He has a direct or indirect relationship with the user, offering his technical-operational skills and competences in the field of maintenance and re-manufacturing operations and he holds a business partnership with the product provider, who has commercial and distribution resources and competences to reach and engage the market users. The overview of the organizational model based on all-inclusive services and partnered re-manufacturers is presented in Fig. 6.1.

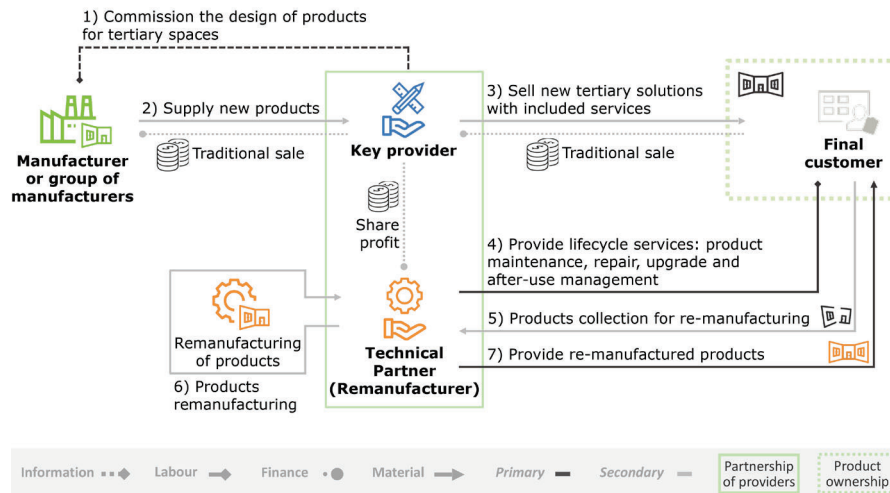


Fig. 6.1 – System map of the organizational model based on all-inclusive services and partnered re-manufacturers

While the model based on a rent contract, presented in Chapter 5, was oriented to facilitate a number of use-cycles of a given product distributed to a set of customers, the model presented in this chapter aims at extending the single product use cycle as long as possible, making the single customer, who also retains the product ownership benefit from these mechanisms in environmental and potentially economical terms. Indeed, by combining the use length and the product useful life (which turns into the minimization of the waste of residual performance), the proposed model promotes the generation of long-lasting win-win business relationships between the provider and the re-manufacturer and the customer (loyalty strategy).

Based on the key features, introduced in Chapter 4, the proposed model, based on all-inclusive services and partnered re-manufacturers, considers a specific combination of key options, summarized as follows:

- Original product design for re-manufacturing;
- Product procurement based on a service contract mechanism;
- Product collection through hybrid solutions;
- Presence of contracted re-manufacturers;
- Product re-designed for re-manufacturing;
- Product-service distribution performed with a partner intermediation;

- Product ownership retained in provider hands;
- Market destination same as the original product;
- Revenue configuration based on performance payments.

The following three sections are dedicated to the introduction of cases and views of stakeholders operating in the industries addressed in the study, which are specifically office buildings (Par. 6.2), exhibition (Par. 6.3) and retail (Par. 6.4) sectors.

6.2 All-inclusive services in the field of office buildings: cases and the view of the stakeholders

One of the potential application fields of the innovative organizational model based on all-inclusive services investigated in the research study was the office buildings. The activation of contacts in the field was conducted, considering the need and interest of the research to interact with an extended set of stakeholders operating along the supply chain. Indeed, the engaged stakeholders from previous interactions expressed the value of mutual understanding and collaboration with other value chain actors to enable business models. Hence business players from the upstream and downstream supply chain were engaged with the goal to gain a more comprehensive understanding of the sub-industry and to enrich the spectrum of perspectives on potential implementation of re-manufacturing opportunities. Consistently, the investigated cases and engaged stakeholders for the validation of the proposed business models were represented by a manufacturer, a general contractor and a trade association. The research project included the direct engagement of these selected stakeholders with the goal to gain multiple perspectives from field actors regarding the applicability of the proposed organizational model based on all-inclusive services. Specifically, the applicability of the proposed business model was investigated by focusing on possible existing specific re-manufacturer skills and competences among the office supply chain actors and focusing on the viability of the re-manufactured product, considering the existing sector regulations and market dynamics.

The involved stakeholder offered a comprehensive overview of the actor perspectives, representing concerns and views from the production, commercial and regulatory sides. In this sense, the main points raised by the office building sector representatives in relation with the business model based on all-inclusive services are associated to the shared

opinion of an existing supply chain network not sufficiently ready to offer the required technical competences and business skills to consider the re-manufactured product viable on the market and the reverse logistic network economically sustainable.

The stakeholders expressed the shared view on the lack of a re-manufacturing player and solid supply chain in the office buildings Italian industry. Indeed, the as-is supply chain network does not appear properly able to embrace circular practices in substitution of current large-scale practices for the office systems fit-out and office system building. The factors undermining the viability of circular practices by existing players are mainly associated to the economic convenience, to the lack of a solid logistics and production network that would guarantee the cost abatement of the closed-loop supply chain in substitution of the current linear one. Given this shared perspective on the existing supply chain, all stakeholders agreed that a new player role would be welcome within the supply chain with the aim to foster the activation of circular practices, not potentially promoted by existing commercial players (e.g. general contractors) and manufacturers, who do not own the specific know-how and competences in re-manufacturing processes. The new player should be able to introduce a competitive business proposition of circular solutions for the office system. Consistently, a robust and structured reverse supply chain should be put in place, in order to ensure the cost convenience and the diffusion of these practices at an industrial level. These result to be the critical absent elements in the as-is supply chain network.

Moreover, a further emerging issue is represented by the Italian regulatory framework. Existing regulatory frameworks associated to office building sector result relatively stringent, and they cover a fundamental importance in the market viability of office building components. For instance, safety-related aspects attached to the structural component characteristics are critical in assessing the quality of the products. The stringent regulatory system is also in a rapid evolution and this factor should be considered when developing a new business offer.

6.3 All-inclusive services in the field of exhibition fittings: cases and the view of the stakeholders

This chapter collects the reflections and suggestions gained through the interaction of representative stakeholders regarding the potential of an organizational model based on all-inclusive services oriented to promote re-manufacturing practices in the field of exhibition fittings.

Industrial cases from the Italian exhibition fittings sector have been identified and selected based on multiple criteria, considering the geographical location of activities, the experience and relevance within the specific market and potential sustainability-oriented approaches already in place in the existing business propositions.

Different stakeholders have been selected by means of preliminary documental analysis and direct interviews with managers.

The stakeholders involved in the direct engagement phase represented multiple roles within the exhibition fitting supply chain such as designers, manufacturers and outfitters, so to gather different perspectives in relation to the applicability of the proposed organizational models.

The research study included two separate subsequent interaction sessions with representative stakeholders from the exhibition fittings sector. This occurred with the purpose of a vertical investigation of potential application of certain proposed organizational archetypes that promote circular – re-manufacturing especially – practices. Hence, the research implied the opportunity to propose two versions of the organizational model based on all-inclusive services: the first version, presented in the following paragraph, originates from the preliminary application of a general business model to the exhibition market, while the second version is the result of the adjustment of the first version, in light of the key preliminary views and insights raised by the representative stakeholders engaged in the first interaction phase.

The organizational model proposing a product solution integrated with a set of all-inclusive services provided by an external re-manufacturer is proposed for the exhibition fittings reality, considering some different changes from the archetype described in 6.1. Specifically, a first archetype version proposed that the outfitter, by covering the key role of product provider, retains the ownership of the fitting solution, which is offered to the customer with an extended set of services oriented to extend useful life of the existing fitting solution. Hence, differently from the organizational archetype, the first version adjusted for exhibition fittings industry leverages the short duration and the high frequency of fitting components usage for the attempt of a product-service business solution, on which the outfitter can maintain the control and hence favour an environmental-friendly business management.

According to the model, different fitting products are supplied by producers to the outfitter, who integrates them in the final fitting solution. The fitting solution is delivered to the customer through an inclusive service contract agreement, which is meant to provide the customer with a set of activities as maintenance, repairing and adaptation of the fitting solution

together with a structured regeneration activity that aims at recovering the value of the product. The contract with the customer is based on an all-inclusive transaction: the single payment accounts for all the services provided among the fair-fitting lifecycle. After the use, the specific used product of the fitting solution is retrieved and brought to a contracted re-manufacturer that, in line with the supply agreement, provides the outfitter with a regenerated product to be integrated in next fitting solutions.

The specific organizational model based on all-inclusive services and partnered re-manufacturers proposed for exhibition fittings industry is displayed in detail in Fig. 6.2.

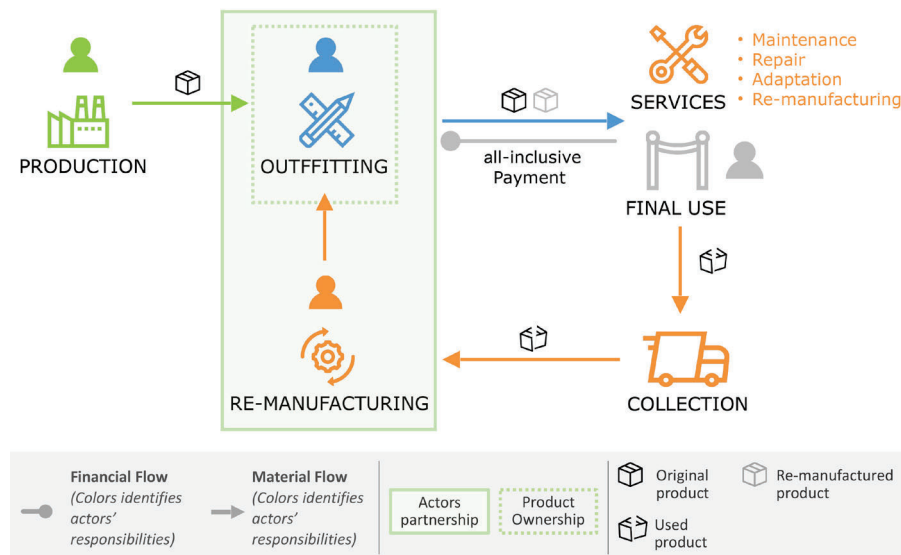


Fig. 6.2 – System map of the first version of organizational model based on all-inclusive services and partnered re-manufacturers proposed for exhibition fittings industry

A first interaction session with the representative stakeholders led to the collection and understanding of the actors perspectives regarding the proposed organizational model displayed in Fig. 6.2.

In general terms, the engaged stakeholders shared the position that key mechanisms proposed in the proposed model are already in place within the exhibition sector, although relevant considerations emerged.

- *Facilitation of customer retention.* The major strength of the model is that it allows the stand outfitter to make long-term plans with

customers, usually not proposed in practice by the same outfitter but resulting from an active input of customers. Indeed, many set-up companies are characterized by a little turnover of customers, as most of them remain consistent for several years. This setting opens the chance to develop and favour collaboration between exhibition outfitters and customers, providing the opportunity to enter into long-term contracts, also through the intermediation of architects, responsible for the design phase.

- *Product ownership retained by customers.* Concerning the ownership structure proposed in the model, the cases investigated in the field report different experiences associated to the ownership of exhibition stands and comprised products. Most of the engaged stakeholders sell the stand to customer, who becomes the owner. This setting works for two main reasons. On one hand, the customer is able to monitor the stock of products managed and stored by the appointed outfitter in a warehouse, making full use of them for most events and partial use for specific locations. On the other, through the partnership of stakeholders, the outfitter is involved in multiannual contracts, under the same conditions established for conventional agreements. This type of contract allows the exhibition outfitter to plan together with architects, the use of the available material, optimizing as much as possible reuse and re-manufacturing of the existing products. Differently, ownership is retained in the hands of provider when the market solution includes a rental activity, that implies that all the set-up products are multi-use from the outset and are re-manufactured to be used always by different customers.
- *Product modularity versus customization.* In this context, regardless of the different methods and customer targets that plainly determine the selection and application of the set-up materials, an open issue emerges especially when, as in the proposed model, the ownership of the stand products is retained by outfitter: modularity versus customization of products. When both structural and decorative products are created ad-hoc for a customer, resulting therefore highly personalized, it is hard to reuse them for other customers and therefore to extend their lifespan. This implies a great challenge also from a technical and design perspective, for ensuring that the created product is as modular as possible but at the same time as customizable as possible.
- *Multidisciplinary approach for design.* The involved stakeholders claimed to be able to handle the design of most products required by customers, having incorporated over time the necessary skills and competences. The few remaining cases are characterized by extravagant demands from customers, requiring the collaboration and expe-

rience of external experts in the development of specific products. Moreover, the dynamic and varied nature of customer demand lead outfitters to deal with suppliers to have a support in design and technical issues. A multidisciplinary approach in the re-design of the products emerges to be a relevant characteristic to consider in those supply-chain relationships promoting circular practices.

- *Outfitter in-house re-manufacturing activities.* Investigating the existing supply chain of exhibition fittings industry, possible re-manufacturing activities are generally performed in-house by the same exhibition outfitter and not provided by external suppliers as depicted by the presented model. In this way, the outfitter is in charge of the set-up, collection and re-manufacturing services, where basically everything that arrives at the exhibition site also returns to the warehouse to be re-manufactured and reused, by minimizing waste during the disassembly phase.
- *Interest for collaboration with external re-manufacturers.* The interviewed stakeholders showed interest in collaborating with specific partners to carry out re-manufacturing activities, when appropriate and useful for peculiar products. This is the case for instance of communication banners in PVC, since the international market calls for alternative materials. For this reason, some companies do not use anymore PVC banners for the layout graphics, as they are replaced with a completely recyclable eco-friendly textile with sublimation printing. This alternative solution costs more than PVC but embeds exceptional qualities for the textile lightness (particularly important factor for banners that reach hundreds of square meters and are handled by two people), for the quick-assembly and in terms of brilliance. Given that banners are hardly reused for several events, since it changes the language, the message to communicate, the location, etc., at the end of the event an external partner recovers and return them into the production process through a re-manufacturing process. Despite the higher price, the customer recognizes the qualities of the product, appreciating and valuing them.
- *New professional profile for re-manufacturing.* By recognizing the lack of technical skills, economic and physical resources in the existing supply chain players in order to perform re-manufacturing activities, actors from the exhibition fitting sector call for the emergence of a new professional profile.
- *Need of shared rules for re-manufacturing.* The challenge is to develop procedural and methodological guidelines in order to understand the real possibilities of re-manufacturing on the basis of what achieved at

the architectural scale, regardless the player who performs the re-manufacturing activity. Indeed, given that during re-manufacturing products may differ in terms of properties, shape, function and use, the definition of shared rules that allow to design and operate for ensuring continuity in the re-manufacturing processes would be extremely valuable.

- *Business potential of re-manufactured products.* With reference to re-manufacturing as part of the all-inclusive service contract offered by the exhibition outfitter to the customer, it is important to note that this solution implies additional costs compared to those incurred by standard services, with the risk of forcing out of the market. With the customer need to amortize the cost, a multi-annual amortisation plan is a common strategy. This mechanism implies that the outfitter, representing in this case the manufacturer, assumes responsibilities over the solution production, aiming at maintaining a high finishing level over a period of 5 years, selecting thus suitable materials for this durability. Also in some cases circular practices become conditions to participate and compete in certain tenders, since as anticipated requested by customers, or to be able to create some exhibition set-ups.
- *Product certification.* Concerning regulatory aspects and product certifications, outfitters consider fireproof issue as a significant constraint, because of fire resistance classes vary from country to country and the European classes are unclear and not generally recognized from individual countries. In this regard, they solicit the European Community to take decisive action in the management of the matter.
- *Time as crucial issue.* Barriers for the suitability of the proposed organizational model emerged in association with the exhibition context time factor. Indeed, outfitters must comply with fairs regulations and procedures that might provide for the demolition of stands, for time and cost reduction reasons, neglecting environmental issues. Beyond costs, an eco-sustainable disassembly takes time to be carry out and often trade fair calendars do not take this into account. In this perspective, event planners represent additional stakeholders that must be involved to put in practice reuse and re-manufacturing processes, providing thus the timing necessary for appropriate assembly, use and disassembly.
- *Covid-19 impacts in exhibition sector.* The issue of timing assumes further relevance in a post-Covid-19 reality. Indeed, the concentration of events, that were progressively postponed to the last quarter of 2020 year, led to an intensive work period for outfitters and to a revision of customers investment budget in fairs. In this context, companies set the priority to achieve an economically sustainable setting, necessarily leaving in the background the environmental goals.

- *Solutions for secondary market channels.* The set of products that after several use cycles are no longer considered reusable, can take different paths. Experiences shared by engaged stakeholders proved that secondary market channels (such as outlets) are used for medium- and high-end products from tables, chairs, decorations up to panelling and vertical partitions. This phenomenon is now growing as a result of e-commerce delivery, allowing also to foreign people to buy products.

In light of the insightful views regarding the first version of the organizational model based on all-inclusive service and partnered re-manufacturers, a revision of this brought to the adjusted version, characterized by two main revisited elements.

First, design is included as a key activity of the model: the outfitter is considered responsible for the design of the products used to build exhibition set-ups, arranging them for the re-manufacturing operations, performed as appropriate internally or in collaboration with one or more external partners. In this way, the outfitter plays a crucial role in launching the proposed organizational and business model, since design is placed upstream the system map. It is in charge of the design not only, as it usually happens, of the exhibition set-ups but also of the related products, being interested in the recovery and re-manufacturing activities.

Secondly, a revision of responsibilities over the services included in the product-service solution led to the partition of the services to the outfitter and to the re-manufacturer, according to the phase of the process. The set of services that occur before and during the event, such as maintenance, repair and storage, are provided by the outfitter, while the re-manufacturing activities are demanded to specific re-manufacturer. This change has been made because the survey of current practice points out that outfitters are often prepared and equipped in terms of machinery, expertise and skills for processing products.

Fig. 6.3 shows the details of the second version of the organizational model based on all-inclusive services and partnered re-manufacturers for exhibition sector.

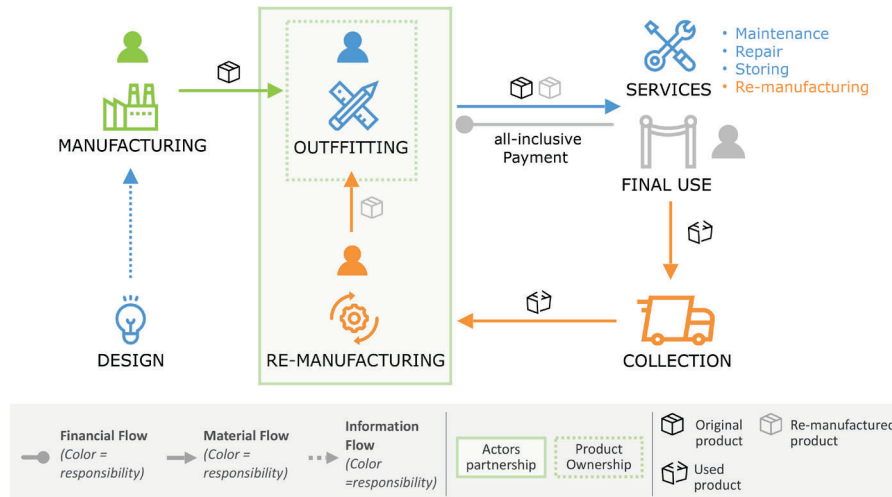


Fig. 6.3 – System map of the second version of organizational model based on all-inclusive services and partnered re-manufacturers proposed for exhibition fittings industry

6.4 All-inclusive services in the field of retail: cases and the view of the stakeholders

This paragraph presents the insights emerging from the research investigation regarding an organizational model based on all-inclusive services applied in the retail arena of tertiary architectures with the purpose to promote re-manufacturing practices.

The proposition of a re-manufacturing-oriented business model based on a product-service solution with all-inclusive services and partnerships with external re-manufacturers was accurately adjusted and re-framed for the building sector of retail spaces. Specifically, in the proposed organizational setting, the contractor (fit-out) sells retail systems including services for extending the useful life of the constituted elements and commissioning the re-manufacturing processes to external partners (Fig. 6.4).

Based on the lesson learnt from previous interaction with key stakeholders, the original proposed organizational model based on all-inclusive services was integrated with an upstream core activity: design phase. Indeed, design phase was introduced with the objective to facilitate circular processes, especially in a closed-loop product value chain, as proposed in this model, in which the single customer is the recipient of the physical component or product as “new” and as “re-manufactured”. In this mechanism, design for re-manufacturing could play a relevant enabler.

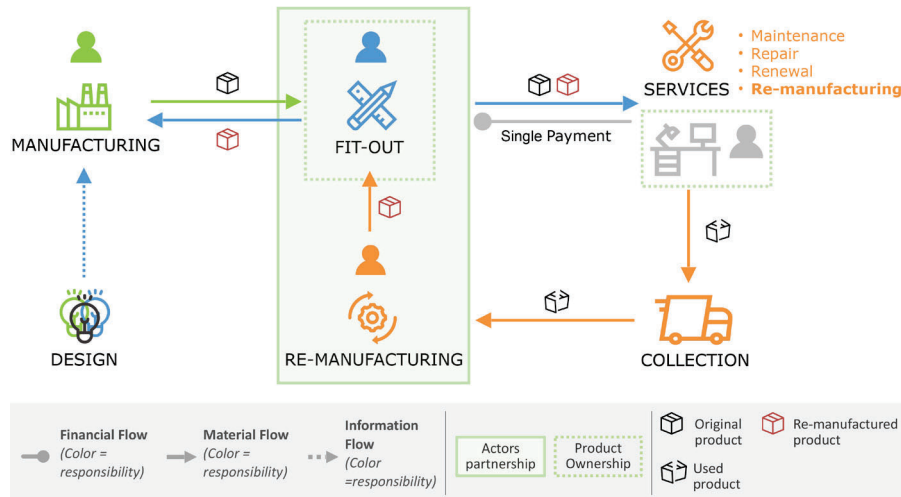


Fig. 6.4 - System map of the organizational model based on all-inclusive services and partnered re-manufacturers proposed for the building sector for retail spaces

Another focal aspect to mention is related to the ownership over the product. As in the original proposition of the model, the contractor sells the product coupled with a set of services and the customer acquires the ownership over the physical product.

The engaged stakeholders have been identified starting from the assumption that the third sector might cover a key role in developing and enhancing circular practices for the retail sector. Indeed, the design of corporate social responsibility strategies often implies the activation of collaboration agreement with non-profit organizations, that can ensure the experience and knowledge of third sector activities. To this end, stakeholders engaged in the research interaction phase have been selected involving both traditional actors from the retail sector and operators from the third sector. Specifically, the representative stakeholders were a major player acting as both designer, manufacturer and general contractors of its own retail stores; a general contractor serving franchising retail stores and two third-sector actors engaged in reverse logistics and manufacturing operations.

Stakeholders coming from the two environments – retail and third sector – have been invited to express their views regarding the different roles in the supply chain and different features (e.g. organization, size, interests, markets, core business, etc.) proposed in the organizational archetype based on all-inclusive services.

Field actors explained some industry and market-related elements that emerge as relevant issues to consider in relation to possible business proposition combining a product-service offer and re-manufacturing.

From a market point of view, product customization trend is confirmed to be a critical reality also in retail context of construction sector. Indeed, this dynamic might not facilitate customer demand to accept re-manufactured goods, rather than new solutions. On the other side, customization could be a primary barrier to activate a closed-loop value chain oriented to design products so that they can be subject easily to some processes in a post-consumer phase.

From a supply chain point view, the retail network results complex in terms of responsibilities upon products whose ownership and origin do not belong to the re-manufacturer player. In these cases, technical actors face barriers in terms of performance assessment and certification. This element, regarding the model proposing a closed-loop value chain, could be a potential trigger for experimenting this setting that relies on a design-for-re-manufacturing, a tight connection among the players (provider with designer and provider with the customer) and products on which information are more transparent and available. On the other side, the issue of product information availability opens to the need of monitoring the conditions of products during their useful life, that is a resource-consuming and poorly practiced activity, but necessary for tracking product information for new future uses.

6.5 The involved actors: roles, skills, relationships, new markets

This section aims at summarizing key concepts emerging from the research of the distinguished sector-specific experiences in association with the organizational model that is oriented to enable re-manufacturing activities through a product-service solution. In particular, the main aspects connected to the existing and new business actors within the organizational model will be presented distinguishing the roles, the skills, the relationships, and the market.

The research methodology was shared among each of the three investigated business environment, and this provided for the preliminary understanding of market players and supply chain mechanisms oriented to the identification of the involved actors, potentially covering a key role within the proposed organizational model. Key actors were selected mainly based on two factors: their relative positioning from the market, hence their ability to comprehend, capture and anticipate clients demand

and secondly their centrality in the supply chain network. Hence, in the context of tertiary architectures the players identified as pivot in an organizational model based on a product-service proposition were the general contractors for office and retail spaces and the outfitters of exhibition fitting solutions.

The producers, representing the upstream supply chain side, depending on the specific investigated sector, are separated actors from the “pivot” actor (e.g. office) or integrated in the “pivot” actor (e.g. exhibition). The difference between these cases is reflected in the multiple roles and responsibilities exerted by the actors within the organizational models properly adjusted for each business environment.

In the organizational model based on all-inclusive services, re-manufacturers are considered external partners of existing business actors. In the phases of search and selection of stakeholders from the fields, the presence of re-manufacturing capabilities and activities played a relevant criterion, however as this proposed organizational setting provides for, this was not a pre-requisite since re-manufacturers were considered as potentially external players from the existing ones. For instance, in the office reality, re-manufacturers were not identified as existing stakeholders, leaving space to the investigation of potential of new business roles entry for these purposes.

The organizational model includes different roles for the involved actors. The pivot actor, distinguishing general contractors for office and retail spaces and the outfitter in the exhibition business, is considered to be the main enabler of the circular organizational scheme, since it interacts with the customer, to capture the needs and define a proper solution that combines the economic and environmental sustainability. The role of establishing a solid and effective relationship with the customer is crucial in this setting, since the organizational model implies an agreement held by the provider and the customer that is based on the sale of a product integrated with the provision of specific services. This mechanism requires the building of a customer loyalty strategy, in order to allow that the client is retained and plays a key role in the activation of reverse loops of the products. Indeed, the organizational setting implies a close-loop flow of materials, hence a relevant role of the existing customer within the supply chain network. The customer is asked to be an active player in the support of procurement of post-consumer object and he is also bound to the business agreement with the provider to receive a re-manufactured solution.

The boundaries of roles covered by the producers, key providers and external re-manufacturers in the application of the presented organiza-

tional model are not strictly defined, yet they depend on the specific supply chain context. Indeed, the vertical integration of key providers is a significant variable that affects the types of activities run by each player in the value chain. In the exhibition fittings environment, existing outfitters are often prepared and equipped in terms of machinery, expertise and skills for processing products, hence the role of re-processing the object for the extension of its lifecycle could be shared with external technical operators. Differently, general contractors operating in the office fit-out activities do not have technical skills and resources to perform certain processing activities, hence the roles between them and a potential external re-manufacturer are clearly defined. The same logic applies to the producers roles: the exhibition sector demonstrates that outfitters work closely with architects that are often part of the internal staff for the solution design: in this context producers of components are pulled by a pivot actor that has design and technical capabilities.

The concept of roles is necessarily linked to the available and potential skills and resources that each actor may ensure within a multi-stakeholder network. Consequently, within the specific value chain setting the roles of each actor were assigned and re-defined during the research, based on the understanding of existing know-how and capabilities. The presented organizational model, beyond the necessary skills that has in common with the other two presented models, particularly focuses the attention mainly on three aspects that are the know-how of design for re-manufacturing, the ability to build a product-service solution with the customer, and the cross-sectoral knowledge for the operation management of the closed-loop product flow. In general, these skills emerging as necessary and significant in the viability of this value chain model reflect the importance of multiple sides: the design phase, the marketing management, and the logistics management.

The product design oriented to facilitate re-processing activities resulted crucial in the definition of a circular product-service solution, lowering the physical, technical, and functional barriers for extending the lifecycle of post-consumer goods. This phase plays a crucial role also considering the closed-loop relationship built between the provider and the customer that implies a customized solution, hence a designed solution for the specific purpose and customer need.

Secondly, the nature of a closed network implies that the provider builds a sufficiently solid customer relationship, hence demonstrating proper marketing capabilities for building the premises of a long-term agreement that combines the sale and the provision of re-processing services. Third, the sustainability of a closed-loop supply chain depends on

the resources and skills that can ensure the reverse logistics management at operational level. Indeed, the role of a collector, responsible for the reverse procurement, transportation, storage e re-allocation of post-consumer products, is considered crucial for the activation of circular supply chains. Consistently, also in this application the presence of these resources and capabilities emerges as key enablers of the circular mechanism.

Studying the interactions among the multiple stakeholders, the presented organizational model leverages on two main significant relationships: a market-oriented relationship, as anticipated in the introduction of actor roles, and a supply-chain relationship.

The customer relationship results pivotal for the acceptance of a product-service solution, hence as a business viability enabler, and also for the sustainability of a closed-loop value chain management. This financial relationship is built on a performance-based payment, such as pay-per-period contract between the solution provider and the end-user (e.g. outfitter and corporate client in the exhibition fitting business).

The key relationship within supply chain actors stands between the “pivot” actor or key provider and the external re-manufacturer built with the goal to provide a re-manufactured product in a product-service solution proposed to the market. The definition of business partnership structure is crucial, since the actors share the responsibilities over the integrated solution sold to the customer: the physical product and the performance of specific services.

6.6 Perspectives, leverages and barriers

Consistently with the key insights emerged from the interactions with stakeholders regarding the applicability of an organizational archetype based on all-inclusive services in their fields, this section aims at summarizing main leverages and barriers associated to the supply chain and market environments and drawing brief general conclusions.

6.6.1 Leverages

The key leverages emerging from the structured interaction with the representative stakeholders from office, exhibition and retail sectors of tertiary architectures associated to the organizational model based on all-inclusive services are described, distinguishing leverages characterising supply chain mechanisms, and the ones characterising the market.

The exhibition fitting sector results having an existing supply chain with key elements that turn into leverages for the proposition of the organizational model. Indeed, two main supply chain factors might represent possible enablers of innovative mechanisms in a circular perspective. First, the current relationships the outfitter establishes with the client are characterised by a multi-period duration, favouring long-lasting business partnerships, increasing customer loyalty and hence virtuous circular practices such as the series of use cycles of a given product and the activation of a reverse supply chain between the customer and the outfitter or the partnered re-manufacturers. Second, the concept of product ownership assumes a significant role in the viability of an organizational model based on all-inclusive services and in the exhibition sector the existing reality gave evidence that often the ownership is retained in the hands of the provider, so that he can exert a high-level control on the product and material flows in a closed-loop supply chain system.

Further leverages have been identified discussing the market dynamics and trends of the investigated business fields.

Specifically, the future trends within these markets might play a role in revealing the potential of circular and innovative business propositions. For instance, the office building sector is experiencing a revision of space layout in light of the pandemic-related situation that pushed organizations to rethink the way of office working. This market dynamic could represent the chance to discuss also the environmental footprint of physical spaces employed by organizations, which consider environmental performances more and more as a priority in their strategies. Also, the cost-driven logic that dominates the existing office building business might be questioned in the future market, favouring environmental performances of projects at the same priority level of economic sustainability.

The rising role played by the environmental footprint in the market behaviours is reflected also in the exhibition fitting industry, in which fair tenders progressively integrate environmentally friendly practices within the requirements of outfitter activities. These elements might represent new market entry barriers, hence new competition drivers that trigger outfitter strategies in exploring circular business propositions.

Re-purposing strategies are seen positive and in an increasing trend as corporate social responsibility practices in the retail sector of tertiary architectures. Projects oriented to generate new destinations for products that have a low residual economic value associated to the existing market are gaining relevance in different large-scale organizations that may be interested in reporting sustainability-related activities attached to their core businesses and that have availability of resources to devote.

6.6.2 Barriers

In a specular way to leverages, the interaction with different actors from the fields allowed to understand and recognize the current environment barriers potentially preventing the applicability of an innovative organizational setting that combines a product-service solution with a partnership with external re-manufacturers. Indeed, the organizational model hardly fits with specific elements mainly associated to the studied markets.

All business realities shared the increasing trend of product customization: market demands more and more highly differentiated goods and with the rising competition organizations are pushed more and more to meet clients requests. This dynamic does not match with a sustainability-oriented philosophy and especially with the proposed market mechanism of a long-term relationship with the customer and the achievement in multiplying the use cycles of a given physical component. Outfitters, general contractors for retail and office spaces experience the need to respond to a market that is oriented to more and more customized requests.

Another main element seen as a limit for the viability of re-manufacturing practices that imply the re-utilization and re-processing of components for the market is represented by the existing regulatory frameworks and the presence of certifications. For instance, safety aspects and environmental aspects play a relevant role in the office ecosystem for building and furniture components and the regulations are very stringent in determining that a re-manufactured or re-used object is sufficiently safe to be viable in the market.

In the exhibition fitting industry, certifications for fireproof and structural resistance of products, differ frequently from country to country, representing an obstacle for re-re-manufactured products to be compliant with certain standards. Given the intensive use of wood-based products in this field, the non-compliance with fireproof requirements might represent a relevant barrier for the viability of re-manufactured goods.

Further hindering elements emerged from the experiences of specific sectors. For instance, the market arena of office building solutions is dominated by a cost-driven logic: clients demand for low-cost solutions, and this factor pulls industry players that strive to compete on costs. In the as-is setting there is no room for exploring alternative solutions that result less economically convenient than the current ones.

Differently, in exhibition sector the tight timetable imposed by event organization that does not allow a proper disassembly and recovery of products, hence discouraging the introduction of circular activities that are based also on an accurate disassembly phase of the fitting solution.

The investigation of experiences from the building sector for retail spaces identified an issue in the volume of material flows coming from maintenance, renewal or demolition processes of tertiary buildings. In many cases, the volume is not sufficiently high to justify new industrial processes, also due to the unstable demand, which is often difficult to predict in terms of quantities and product typology. Nonetheless, even in the case of significant demand volumes it is necessary to demonstrate the economic advantage in adopting a re-manufactured product, since if it results with equal or lower quality but more expensive than the new one, it will be hardly reinstated into the market.

6.6.3 General perspectives

Based on the overview of possible leverages and barriers associated to the application of an all-inclusive-service organizational model for circularity in the building sector of offices, exhibitions and retail spaces, some general concluding observations are summarized.

The studied tertiary architectures in the Italian context result sharing some key needs for their readiness to embrace re-manufacturing practices both at supply chain and at market level.

First of all, a general need, already acknowledged within literature and professional practices, is represented by the design and proposition of solutions, thought as trade-off between product modularity and customization. Indeed, it is widely recognized that modularity and standardization of technical elements facilitate assembling and disassembling processes, product retrieval in the market, as well as maintenance and replacement operations. The providers of exhibition fittings solutions, general contractors for office and retail spaces do recognize the need to propose attractive solutions, designed in a way that circular activities are facilitated.

In this sense, eco-design and design for re-manufacturing emerged to be crucial activities for the activation of a business model oriented to include a set of services for the extension of product life cycle and for the replication of customers use cycles. New professional figures are called to fill the gap of adequate cross-sectoral skills, including know-how on sustainability, circular economy and eco-design, as well as competence on technical and operational aspects linked to the building process along the whole product life cycle.

From a supply chain perspective, the operations management of reverse material cycles emerged to be an uncovered responsibility by existing players, since they do not own sufficient resources, or they are not incen-

tivized by the market requests in a proper way. For instance, as exhibition tenders have integrated some environmental requirements, outfitters are called to explore circular solutions in their businesses, hence facing and managing reverse logistics for circular practices. Similar incentives coming from the market would trigger these uncovered supply chain activities also in the building sector for retail spaces.

Concerning policy and regulatory aspects, an emerging need of tertiary architecture actors is represented by the support of both procedure and methodological guidelines, needed to understand the real possibilities of product re-manufacturing. Besides, the introduction and harmonization of regulatory frameworks aimed at defining new procedures and new bodies for re-manufactured product certifications would support new businesses based on circular approaches.

This book deals with re-manufacturing, recondition, reuse and repurpose considered as winning strategies for boosting regenerative circular economy in the building sector. It presents many of the outcomes of the research *Re-NetTA (Re-manufacturing Networks for Tertiary Architectures)*. *New organisational models and tools for re-manufacturing and re-using short life components coming from tertiary buildings renewal*, funded in Italy by Fondazione Cariplo for the period 2019-2021.

The field of interest of the book is the building sector, focusing on various categories of tertiary buildings, characterized by short-term cycles of use.

The book investigates the most promising strategies and organizational models to maintain over time the value of the environmental and economic resources integrated into manufactured products, once they have been removed from buildings, by extending their useful life and their usability with the lower possible consumption of other materials and energy and with the maximum containment of emissions into the environment.

The text is articulated into three sections.

Part I BACKGROUND introduces the current theoretical background and identifies key strategies about circular economy and re-manufacturing processes within the building sector, focusing on tertiary architectures. It is divided into three chapters.

Part II PROMISING MODELS outlines, according to a proposed framework, a set of promising circular organizational models to facilitate re-manufacturing practices and their application to the different categories of the tertiary sectors: exhibition, office and retail. This part also reports the results of active dialogues and roundtables with several categories of operators, adopting a stakeholder perspective.

Part III INSIGHTS provides some insights on the issue of re-manufacturing, analyzed from different perspectives with the aim of outlining a comprehensive overview of challenges and opportunities for the application of virtuous circular processes within building sector. Part III is organized in four key topics: A) Design for Re-manufacturing; B) Digital Transformation; C) Environmental Sustainability; D) Stakeholder Management, Regulations & Policies.



FrancoAngeli
La passione per le conoscenze