Sustainable built cultural heritage conservation with Cradle to Cradle

L. Cazacova

***Abstract*—**Built cultural heritage is represented by the tangible resources that reflect past lived experiences and diversity of communities. These precious resources belong not only to past and present generations but also to the future ones. Such resources cannot be replenished, therefore should be protected and conserved. Moreover, since they should be handed over to the future generations, the conservation process should also address sustainability concerns. Therefore, besides taking care of built physical conditions of cultural heritage and its maintenance the conservation process should satisfy environmental, economical and social sustainability. This research aims to suggest a built cultural heritage conservation method by integrating Cradle to Cradle concept into ICOMOS requirements, wherein ICOMOS legislations promote vernacular architecture and built cultural heritage conservation, while Cradle to Cradle concept takes care of the sustainability aspects of the conservation process. Let by the given aim, significance of sustainable conservation is studied, ICOMOS legislations and Cradle to Cradle concepts are highlighted, an integrated sustainable built cultural heritage conservation method is suggested and the guidelines for sustainable conservation are designed.

***Keywords*—**Sustainability, Cradle to Cradle, built cultural heritage, heritage sustainable conservation, integrated ICOMOS + C2C approach.

I. Introduction

BUILT cultural heritage enriches modern community, connecting it with both the past lived experiences and the nature. These are tangible historical records that express communities' identities and diversities. They are irreplaceable and precious, hence must be protected and conserved for present and future generations [1]. Beside conservation of built cultural heritage, physical conditions and its maintenance, the process should also be looked at from environmental, economic and social sustainability point of view. Currently, vernacular buildings do not meet modern building standards, hence they posses many sustainable features. The buildings already exist; they don't require new land to be built, raw materials to be extracted, new construction materials to be produced, energy to be spent for materials extraction, fabrication and transportation [2].

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Vernacular architecture could be considered as an excellent example of sustainability, where Cradle to Cradle design, methods and principles were incorporated. The concept of building from organic materials available on site, material reuse and construction for disassembly is not new, and has been practiced since prehistoric times when the earliest shelters were being built. The buildings were directly connected with nature and constructed of natural materials, using local skills and traditional techniques. Such buildings were not only functional, but also sustainable [3]. Man-made feature employed in construction utilized local materials which made the building easily integrated into the biological cycle at the end of its life, directly benefiting local society, economy and environment [4].

This research discusses a new integrated ICOMOS + Cradle to Cradle approach as sustainable method of built cultural heritage conservation, wherein ICOMOS legislations facilitate and promote vernacular architecture and built cultural heritage protection, while Cradle to Cradle concept takes care of integrating the built environment into planet's biological cycle.

The research questions that aim to introduce an innovative approach for sustainable built cultural heritage conservation are follows:

- Does built cultural heritage conservation contribute to the environmental, economical and social sustainability?
- Could built heritage conservation be enhanced with Cradle to Cradle?

The research is composed of foreword chapter and three main parts – Present Facilitator, Current situation and Future facilitator, wherein ICOMOS legislations for built cultural heritage conservation and Cradle to Cradle concepts for built environment enhancement are considered as the Present Facilitator, Current situation states the research problem, and Future facilitator is ICOMOS + Cradle to Cradle approach for built cultural heritage protection.

Foreword discusses the importance of sustainable conservation and its contribution to the environment, economy and society. The chapter Present Facilitator highlights ICOMOS' requirements and definitions such as conservation, adaptation, restoration, reconstruction as well as the procedures of conservation practice and Cradle to Cradle concept wherein recycling and reusing are defined and the principle criteria and tools for built environment developing are clarified. The Current Situation compares ICOMOS and Cradle to Cradle requirements and identifies the problems and the areas of built cultural heritage conservation needing enhancement. Future Facilitator suggests an integrated -

ICOMOS + Cradle to Cradle approach - for built cultural heritage conservation, explains its reasons and designs the sustainable conservations process guidelines to be followed.

II. Foreword - Sustainability and Cultural Heritage

What does sustainability have to do with the cultural and built heritage? Does built cultural heritage conservation contribute to the environmental, economical and social sustainability? This chapter defines sustainability, built heritage, and builds a bridge between the two.

A. Sustainability

Sustainability is defined as the society's ability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. To achieve sustainable development all its three pillars - environmental, economic and social - have to be balanced [5].

B. Cultural and built heritage

Cultural heritage is distinct by an entirety of either artistic or symbolic material signs which makes each particular place recognizable by its distinct features. It is a storehouse of human experience handed on by the past to each culture and, therefore, to the whole of humankind. Thus, cultural heritage preservation is a corner-stone policy of contemporary civilizations [6].

C. Linking built cultural heritage with sustainability concept

Built cultural heritage conservation and sustainable development both aim to consume the planet's resources in a way that to not compromise the needs of future generations. Built cultural heritage is a resource of humankind experiences inherited from past cultures, thus conserving them contributes to the balance of environmental, social and economical sustainable development.

According to Bergman [7] buildings are responsible for 40% of raw materials use and 30% of the waste output. Therefore, the buildings that do not have to be built, and already exist can be considered as the most sustainable ones [8]. Conservation, rehabilitation and compatible reuse of built cultural heritage correspond to the sustainable principles of natural and human-made resources use.

Built cultural heritage conservation contribution to the environmental sustainability:

Reusing the buildings – conserving them – results in contribution to the environmental sustainability. Building construction and manufacturing industry constantly requires new land for its structures, extraction of raw materials and energy for building. Moreover, it increases globally amounts of carbon dioxide and green gas emissions.

Therefore, built cultural heritage conservation via reusing the buildings instead of demolishing them and rising new ones results in minimizing:

- Land use and built areas expansion;
- Raw materials mining/extraction for construction materials fabrication;
- Energy consumption for materials manufacturing, transportation and construction;
- Construction waste generation;
- Carbon dioxide and green gas emissions.

Built cultural heritage conservation contribution to the economical sustainability:

Re-using of old buildings has economical value – each built structure is storage of materials and comprises a large amount of embodied energy (including physical). Raising a new building on new land requires larger investment than reusing, renovating, reconstructing an existing one. Reusing an old building instead of building new one will result in minimizing:

- Expenses for construction materials;
- Expenses for manpower;
- Embodied energy for construction and materials transportation.

Built cultural heritage conservation contribution to the social sustainability:

Built cultural heritage diversity exists in time and space, and demands respect for other cultures and all aspects of their belief systems. Conservation of built cultural heritage contributes to the sustainable social development by supporting cultural diversity.

D. Sustainability and Cradle to Cradle

Conservation of built cultural heritage without doubt contribute to the sustainable development process, on the other hand sustainability concepts can also enhance the conservation process.

Cradle to Cradle (C2C) is one of the sustainability concepts popularized by McDonough and Braungart [9] and it states that everything we have and will ever have, is in one form or another, on the planet now. The resources of our materials as well as air and water which are life necessities, do not get replenished from elsewhere. Therefore, to be sustainable we must never use up resources faster than the Earth's own ecosystems can replenish them (Fig. 1).

C2C teaches how products, buildings, and systems that are beneficial (less harmful) for the planet and its populations, and the economy can be designed. To achieve eco-effectiveness in design three C2C principles listed below have to be respected:

- Waste equals Food; Everything is a Nutrient for Something Else.

In nature, where the cycles work continuously, concept of waste doesn't exist. In the ideal human word, the resources should be treated the same way as in nature where every product cycles through different systems and waste of one system is food for another. This is possible only by seeing all materials as either biological (products/materials that are compostable and can be returned back as nutritious resource for plants and animals to the nature) or technical nutrients (products/materials that can be returned back into the industrial system by being continuously reused for new products manufacturing).

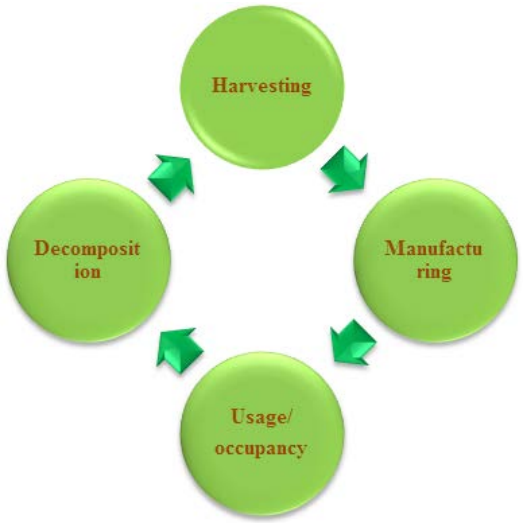

Fig. 1 Cradle to cradle conceptual diagram

- Usage of Sun; Renewable Energy Consumption Only

If the consumption of non-renewable sources of energy such as gas, coal and oil which are limited is not well maintained they will one day be wiped out. Renewable sources of energy such as sun, wind, water, geothermal energy, waste heat that is released as source of energy are unlimited, therefore are better preferred.

- Enjoyment of diversity; Species, Cultural and Innovative Diversity

Without diversity the ecosystem of the planet becomes unstable. Among the aspects of diversities are biodiversity, materials and energy diversity, cultural, social, ecological, economic forces and innovations.

The three C2C principles and the dual cycle approach, suggest the criteria for the design of products, objects and processes that should be fulfilled. The C2C ten main criteria are the following:

- All products, objects and processes should be designed in such a way that all materials can later on be entirely reused in a biological or technological cycle. Application of hybrid materials that is difficult to separate should be avoided, and materials' life cycle usage path should be defined.
- Harmful or toxic emissions must be avoided during the production and usage process of a product/object.
- Production and usage process of a product/object should create an added value to its stakeholders.
- Design based on Triple E approach - Economy, Ecology and Equity is to be employed.
- Renewable sources of energy should be used for product/object fabrication and application/usage/maintenance.
- Design based on respect of diversities: culture, location, species, innovation, etc. should be preferred.
- Design of product/object should be oriented toward water resources quality and quantity protection.
- Production process of the products/objects should be carried out with social responsibilities (no child forced labor, unhealthy workplaces, and discrimination).
- Application of local approach in the production process.
- Design intentions should be transparent and have measurable targets.

III. Present Facilitator – ICOMOS and Cradle to Cradle

The International Council on Monuments and Sites (ICOMOS) is a professional, non-governmental association dedicated to the conservation and protection of cultural heritage places around the world and Cradle to Cradle design (C2C) is a biometric approach to the design of products and systems that models human industry on nature's processes viewing materials as nutrients circulating in healthy, safe metabolisms.

A. ICOMOS for built cultural heritage's protection through conservation, adaptation/reuse

Built cultural heritage's or a place's value means possessing historical, archaeological, architectural, technological, aesthetic, scientific, spiritual, social, traditional or other special cultural significance, associated with human activity [10].

Places of cultural heritage have lasting values and can be appreciated in their own right. They teach us about the past and the culture of our predecessors, provide the context for community identity whereby people relate to the land and to those who have gone before. Built cultural heritage provides variety and contrast in the modern world, a measure against which the achievements of today can be compared and serve a visible evidence of the continuity between past, present and future [10]. These places are historical records that reflect the diversity of our societies forming the countries' identities, therefore are valuable and inimitable, and must be identified and protected [1]. Demolition of significant fabric of a place is generally not acceptable as declared in Article 15 of Burra Chapter [1].

Conservation is defined as a process of caring for a place so as to safeguard its cultural heritage value [10]. The intention of conservation is not only to care for places, but their structures, materials and cultural meaning. Article 4 [1] states that conservation should make use of all the knowledge, skills and disciplines which can contribute to the study and care for the place wherein traditional techniques and materials are preferred for the fabric safeguarding. While Article 5 [1] requires that conservation of a place should identify and take into consideration all aspects of cultural and natural significance without unwarranted emphasis on any single value at the expense of others. Conservation process involves three parts - Understanding significance, Developing conservation policy and Manage conservation process, which are defined by figure 2.

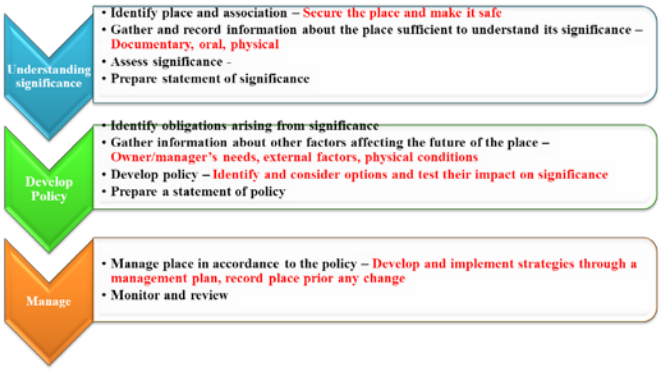

Fig. 2 Conservation process' structure of investigations, decisions and actions

One of the prospective methods of cultural heritage conservation is adaptation, which means modifying a place to suit the current use or a proposed use, involving the least possible loss of cultural heritage value and described by Article 7 [1]. The new use should involve minimal change to the original fabric and use, and should respect associations and meanings [11].

Table I Steps to be followed in conservation projects

Step	Required procedures
Definition of the cultural heritage value of the place	-Prior research of any documentary, oral history Detailed examination of the place Recording of its physical condition
Community consultation	-Continuing throughout a project
Preparation of a plan	-To meet the conservation principles
Implementation of the plan	
Documentation of any research	-Recording and conservation work as it proceeds

Adaptation might be executed by two means, restoration or reconstruction, depending on the physical condition of the place. Article 1 [1] defines restoration as returning the existing fabric of a place to a state known earlier without the introduction of new material and reconstruction as returning a place to a state known earlier through introduction of new recycled and salvaged material from other places, into the fabric. In some cases, when is beneficial for conservation, modern techniques and materials could be introduced. Therefore, conservation projects should follow the steps listed in table I.

B. Cradle to Cradle concept for built environment

This chapter enlightens the application of C2C principles for the built environment.

C2C approach to the built environment is in which biological and technical cycles are closed and have no negative impact on environment. All construction materials are turned into 'nutrients' for the next cycle (Fig. 3). This approach introduces the concept of sustainable development of the building industry without harmful effects on the environment [8].

All materials employed in construction and the waste generated might be divided into two primary categories: biological nutrients (that can be safely returned to the Earth and become a part of a new cycle) and technical nutrients (that are not easily degradable and need to be kept in cycle of usage, have to be recycled) [7] [9] (Fig. 3).

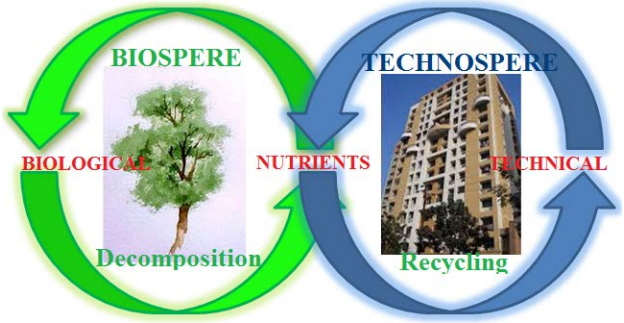

Fig. 3 All waste materials return to either biological or technical nutrient cycles, or are reincorporated into later steps in the life cycle.

A Cradle to Cradle building can be defined as a building which contains measurable elements that add value and celebrates innovation and enjoyment by significantly enhancing the quality of materials, biodiversity, air, and water; using current solar income; being de-constructible and recyclable, and performing diverse practical and life-enhancing functions for its stakeholders [12] [13]. In the other words it can be said that a building has an excellent chance of achieving C2C if it fulfills the three basic C2C principles [12]:

- 1st principle - Everything is Nutrient for Something Else:

-Define materials and their intended use pathways: Use only materials with defined biological and technical pathways and have positive impacts on health and environment.

-Integrate biological nutrients: Suggest measurable recyclable biological nutrients and water by integrating biomass production into buildings, landscaping and special plans to generate more biomass, soil and clean water than before developing on the site [12].

-Enhance air and climate quality: Suggest measurable means for improving indoor air quality for biological metabolism, thus the indoor air quality is better than before entering the building and provides indoor comfort for occupants; Suggest means for improving outdoor air quality that is healthier for biological metabolisms that before it enters the building [12].

-Enhance water quality: Suggest means for quantifiable water quality improvement so the water is healthier for biological metabolisms than before it entered the building [12].

- 2nd principle - Use the Sun; Use Renewable Energy Only:

-Suggest renewable energy systems that generate more energy than required for building and site use [12].

- 3rd principle - Enjoy diversity; Species, Cultural and Innovative Diversity:

-Suggest measurable means for supporting diversities, so the building/area supports more diversity than before development;
-Actively support biodiversity;
-Celebrate conceptual diversity with innovation;
-Add value and enhance quality for stakeholders, Enhance stakeholder well-being and enjoyment [12].

The principle criteria for developing a C2C building:
The principle criteria for developing of a C2C building are listed in table II and can be interpreted as a) Set the goal and objectives (develop a plan), b) Implementation (Inventory/record of the exciting resources), and c) Integration (Integrating systems, companies, innovations, occupants, stakeholders and developing policies).

Prior to a building being developed or renovated, an inventory should be executed to determine what C2C features already exist. The stakeholders decide what to preserve, therefore their involvement is required [12].

Buildings are ordinarily designed for their current functional use, and not for their reuse or deconstruction, thus building elements selection is not optimal from the beginning. Therefore, the use of natural local materials, consideration of local climate and energy effectiveness are important criteria to be considered [14]. These criteria were applied by vernacular architecture.

Another important criterion to be considered is the recycled content. Recycling can be defined as a process of manufacturing new products from products that have already served their original purpose and were broken down into raw materials which are used to make new ones, while reusing is simple to use an item again (for the same function or for a different one) after it has been used [15].

For a product to meet minimum requirements in the Cradle to Cradle Certified program it has to follow the guidelines: must not contain chloroprene, PVC or other related chemicals at any concentration; all materials and chemicals must be assessed in order to have a non-existent toxicity level to human and environment; a strategy must be developed to optimize all remaining toxic chemicals; all compounds must be defined as technical nutrients that can be recycled and biological nutrients that can be composted [15][16].

Table II Principle criteria for developing a C2C building

Steps	**Requirements/ suggestions**
State your intentions	-Is the building going to contribute to air and water cleaning? -Is it going to be deconstructable? -Is the building demonstrating defined and safe ingredients?
Implementation Integration	-Do an inventory -Integrate Innovative Finance -Integrate Innovation Partnerships -Integrate Diverse C2C-Experienced Contractors -Integrate Systems and Application Tools -Integrate Diverse Uses with Features that Apply C2C Criteria -Integrate Natural Light with Innovative Artificial Light -Integrate Renewably Powered, Healthy Mobility -Protect Occupants from Environmental Hazards -Consider Aesthetic Opinions of Stakeholders

Therefore, the strategy for building materials application is to:

- Use materials, quality and contents of which are measurably defined in technical or biological pathways from manufacturing through use and recovery.
- Use materials whose impacts are measurably beneficial for human health and the environment [12].

The tools for first C2C principle application in buildings are [12]:

- Actively beneficial qualities of the materials;
- Defined product recycling;
- Defined use pathways;
- Design for assembly, disassembly, and reverse logistics;
- Materials pooling;
- Preferred ingredients lists.

When the C2C principles are incorporated into design, the buildings and other infrastructure elements are created in a way when anything that would otherwise have resulted in waste is conceived as a nutrient for other technical or biological process. Hence, buildings are created to enable disassembly and recycling/upcycling of technical and biological nutrients. Built environment's features are also integrated into designs to support cultural and conceptual diversity as well as biodiversity providing habitat for flora and fauna [17].

To determine whether a building complies with the Cradle to Cradle principles is just a first step. Further on the implementation of the aspects into practice is a second important step. Subsequently a strategy will be developed and tested to integrate and implement the aspects and desired results in the design and building process [18].

Unfortunately, C2C buildings or developments are slow to be implemented. Instead there are C2C Inspired Elements in buildings and developments that will depend on geographical location and climate. Since the building is qualified as C2C depending on the quantity of incorporated Inspired Elements,

these can be considered as steps on the way to Cradle to Cradle buildings [19].

IV. Current Situation

As seen from figure 4 the principles of C2C are attuned to the ICOMOS legislation. The first step in built cultural heritage protection according to ICOMOS is to define the value of the cultural heritage, and according to C2C is to define the value to be added. The next step is to do an inventory (C2C), record current physical conditions (ICOMOS) and both of which require involvement of the community.

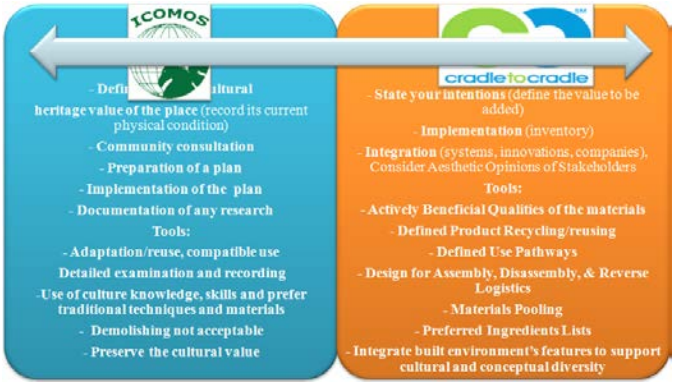

Fig. 4 ICOMOS and C2C concept compatibility

Basically, the goals and strategies needs to be set, a plan based on available resources is to be designed and the plan has to implemented through a holistic approach. The tools also show connections – reuse instead of demolishing, preference of local materials and techniques, preserve and/or support cultural value/diversity.

Vernacular architecture employs natural local materials and techniques, thus the problem arises only when a built cultural heritage is conserved by reconstruction and modern techniques and materials are introduced [20]. Therefore, with the integrated ICOMOS + C2C cultural heritage conservation approach a building, fabric or built environment will be considered as a product consisting of materials and attributes with their ingredients. This will facilitate more detailed documentation of the physical condition of the built environment, its materials and pathways, and selection of the new materials and techniques to be introduced.

V. Research Methodology

The research methodology shown in figure 5 is designed on a linear process, and includes three parts – Present facilitator ICOMOS & C2C, Current situation analyses, and Future facilitator (ICOMOS + C2C).

The first part describes ICOMOS and Cradle to Cradle concepts, wherein the definitions and requirements for built cultural heritage conservation are brought forward and the C2C criteria for built environment are defined.

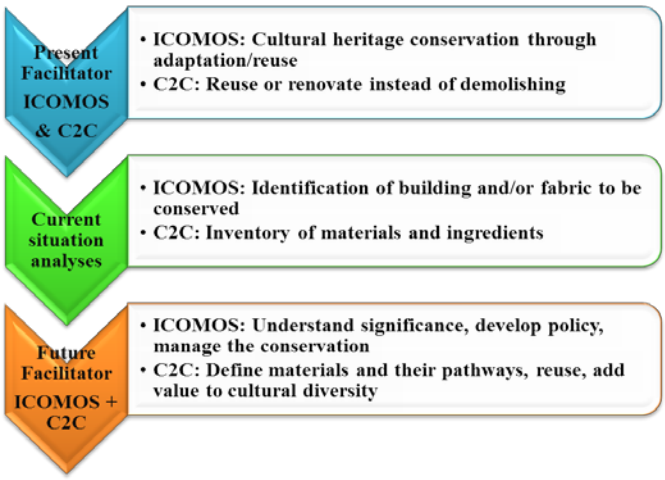

Fig. 5 Research methodology

The second part of the research – Current situation – compares ICOMOS and Cradle to Cradle requirements, formulates the problem and suggests a solution for built cultural heritage conservation enhancement.

In the third part, Future Facilitator, the integrated ICOMOS + C2C approach is described and the guidelines for cultural built heritage conservations are developed.

VI. Future Facilitator – Sustainable Conservation

This chapter introduces a new integrated approach to build cultural heritage conservation – ICOMOS + C2C.

As seen in figure 6 according to the Cradle to Cradle principles a built product should form a full cycle starting from materials harvesting/extraction through manufacturing/building and usage/occupancy, and finishing the cycle by materials decomposition [22]. Therefore, the suggested integrated approach assumes that built cultural heritage is considered as a product consisting of materials and attributes containing diverse ingredients.

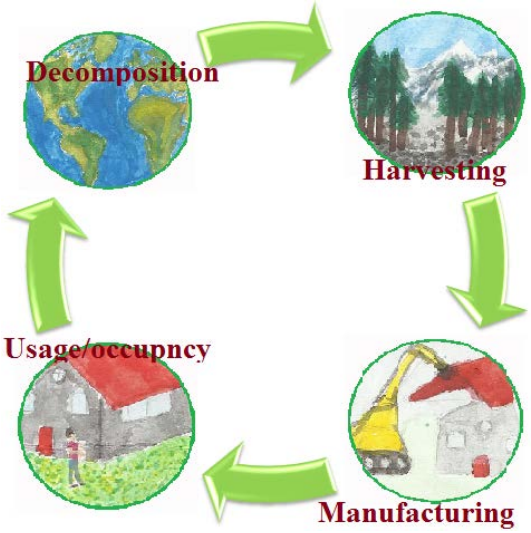

Fig. 6 C2C concepts for built environment

A. *ICOMOS + C2C for built cultural heritage protection*

As previously mentioned, vernacular architecture employs local techniques and natural materials in construction. Materials may vary depending on locality and could be listed as: a) timber, stone, mud bricks, etc. for foundations and walls; b) compacted earth, pebbles and timber for floors; c) timber or multi-layered structures (timber, branches, mud plaster, etc) for roofs; d) lime stone or mud plaster for wall/floors/ceiling finishes; e) wood, palm fronds, rattan, bamboo and home woven textile for furnishings and accessories. The indoor thermal comfort was facilitated by passive design (optimum insulation, use the building mass within the insulated shell, fresh air is introduced and stale air exhausted by a ventilation system, orientation to the south, carefully planned internal zoning, integrated design) [21]. All construction materials comply with C2C concepts and they are either biodegradable, either reusable or recyclable.

With the integrated ICOMOS + C2C approach to a built cultural heritage conservation the building (product) is not demolished or recycled, but reused. A careful attention is paid to the product materials and features ingredients, materials pathways (Fig.7).

When restoration is required for conservation, product attributes materials and constructing techniques inventory, is implemented. Materials' pathways are traced and materials ingredients are listed, and C2C inspired elements are identified. For product and its attributes renovation only C2C materials and finishes (plaster, dies, lacquers, polishers, sealants, etc.) are selected.

When for built cultural heritage conservation purpose a reconstruction with the introduction of new materials and attributes is suggested, recycled salvaged from other places attributes within the same locality are used. In case when new modern attributes and materials are introduced, it should be done using the same as or similar to original ingredients which will also comply only with C2C concepts.

Fig. 7 C2C concepts integration into built cultural heritage protection

The introduced materials must not contain chloroprene, PVC or other related chemicals at any concentration. In order to ensure a non-existent toxicity level to human and environment, the assessment of all materials and chemicals is required. Only compounds which can be defined as technical nutrients that can be recycled and biological nutrients that can be composted can be introduced [16].

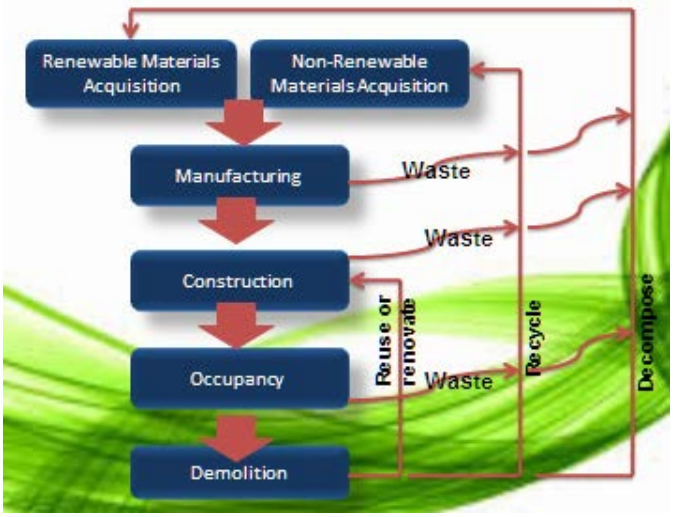

Fig.8 Pathways of renewable and non-renewable materials applied in buildings reconstruction

This will ensure the full cycle of the conserved product from Cradle to Cradle and will enhance the built cultural heritage value (Fig.8).

B. *Guidelines for Integrated approach on built cultural heritage conservation*

Step 1 - The first step in integrated conservation approach is - understanding building significance and identification of C2C inspired elements – where the built cultural heritage is preliminarily identified, and then the documentary, oral and physical information sufficient to understand its significance is gathered. And finally the cultural heritage is assesses and a statement of its significance is prepared.

For example a building is recognized to be vernacular and of cultural significance by a) a manner of building shared with the community; b) a recognizable local or regional character responsive to the environment; c) coherence of style, form and appearance, or the use of traditionally established building types; d) traditional expertise in design and construction which is transmitted informally; e) an effective response to functional, social and environmental constraints; f) the effective application of traditional construction systems and crafts [20]. Building assessment is then executed, and a statement of building cultural significance is prepared.

The integration of C2C in this step: Since vernacular architecture usually employs local natural materials and construction techniques, here are preliminary identified building's C2C Inspired Elements (materials and pathways, materials ingredients, and features and construction techniques).

Step 2 - The second step is - developing cultural significance policy and stating the intentions – while considering owner/management needs the decision is made to conserve the building by adaptation/reuse.

For example, residential building can remain as a residence or can be given another compatible use. External factors that might affect building significance and its physical conditions are identified. The plan of its conservation is prepared, where the goals, objectives and strategies are stated. Thus the goal is to conserve by adaptation, the objectives:

- To reuse or compatible use.

Strategies: a) Collaborate with building's owner, community and local authority; b) Consider local, regional and country legislations; c) Reflect the association of the place.

- To assess residence physical condition. Strategies: a) Involve experts in built cultural heritage assessment; b) Invite local traditional builders; c) Consult local craftsmen.
- To minimize the impact on building significance. Strategies: a) Decide Restoration or Reconstruction; b) If Reconstruction – with or without the introduction of new materials; c) If Reconstruction with or without the introduction of modern materials or techniques.
- To execute detailed inventory of attributes and materials.

Strategies: a) List all attributes; b) List each attribute material; c) Identify materials pathways; d) Identify and list each material ingredients.

- To develop a conservation policy.

Strategies: a) Identify obligations arising from significance; b) Involve local community – citizens, authorities, industry, funders [23].

- To identify options and test their impact on significance.

Strategies: a) In case of reconstruction with the introduction of new materials make sure there are similar and the same value salvaged components, attributes or materials; b) In case of reconstruction with the introduction of modern materials and techniques select materials with the ingredients similar to the original one and that comply with C2C requirements; c) Select a technique than will not diminish built cultural heritage significance; d) Ensure the modern selected materials are locally available; e) Ensure the new techniques can executed by the local builders.

- To prepare a statement of conservation policy: Strategies: a) communicate the conservation policy to the stakeholders.

The integration of C2C in second step is crucial and will ensure that selected materials not only match the original but are also recyclable or decomposable and long lasting. C2C also integrates innovative partnership, funders, and stakeholders' opinion into conservation process.

Step 3 – Managing the conservation plan. At this step the conservation process is managed in accordance to the conservation policy prepared during the second step, starting with building restoration or reconstruction and finishing with its future maintenance. During this stage a conservation manager and project supervisor are nominated; the role of local community is identified; local builders, craftsmen and materials' suppliers are selected; in case of reconstruction experienced consultants and executers with the experience in reconstruction with modern materials introduction are engaged. The whole conservation process is monitored, and recorded prior to any changes being executed.

C2C principles introduce the integration of innovative experienced contractors, and stakeholders' partnership to the third step of the conservation process.

VII. Conclusion

Built cultural heritage is a totality of intangible and tangible symbols that exists in time and space and makes each place recognizable by its distinct features contributing to the diversity of the societies. These precious resources of past human experiences and cultures belong to the whole humankind and have to be passed on to the future generations. Thus, cultural heritage protection is a corner-stone policy of contemporary generation [6]. Appreciation and successful protection of the vernacular heritage depends on community's involvement and support, and continuous use and maintenance [11]. Furthermore, the conservation process should be carried out considering environmental, economic and social sustainability.

Both built cultural heritage conservation and sustainable development aim to consume the planet's resources without compromising the needs of the future generations. Since built cultural heritage is a resource inherited from past cultures, its conservation contribute to the balance of environmental, social and economical sustainable development.

This research aimed to suggest a sustainable method of built cultural heritage conservation through answering the research questions: Does built cultural heritage conservation contribute to the environmental, economical and social sustainable development? Could built heritage conservation be enhanced with Cradle to Cradle?

The results of this research show that built cultural heritage conservation by adaptation (reuse) contributes to the environmental sustainability through minimizing expansion of buildable areas, extraction of raw materials for new construction materials' fabrication, energy consumption for manufacturing, transportation and construction of materials/buildings, construction waste generation, carbon dioxide and green gas emissions. The reduction of expenses related to extraction/creation of new materials, manpower and energy for construction contribute to the economical sustainability. Conservation of built cultural heritage also contributes to the sustainable social development by supporting plant's cultural diversity.

Undoubtedly conservation of built cultural heritage contributes to the sustainable development process. Nevertheless, sustainability concepts can also enhance the conservation process. The inclusion of Cradle to Cradle concept into conservation process, which aims to achieve eco-effectiveness in buildings' design in order to make them less harmful for the planet and its occupants, makes it sustainable.

With integrated ICOMOS + C2C approach to built cultural heritage conservation the building which is considered as a product, is not demolished or recycled, but reused. This could be done by assigning a new compatible use and restoration/reconstruction with/without the introduction of new

or modern materials and technologies. The guidelines for the integrated conservation method require attention to be paid to the selected for built cultural heritage conservation materials and features ingredients, and materials pathways. All construction materials and methods should comply with C2C concepts and be biodegradable, reusable, or recyclable. In other words, only compounds which can be defined as technical nutrients that can be recycled and biological nutrients that can be composted can be introduced [16].

Vernacular buildings were constructed of locally available natural materials and with the employment of local construction techniques, which required minimal amount of embodied energy. The incorporation of C2C concept with ICOMOS legislations for built cultural conservation ensures that the building is reused and not demolished. Furthermore, such sustainable method of conservation involves no loss of heritage value and ensures the return of the building to its known earlier state only through employment of identical to the original features - materials and their ingredients, and with application of identical to the original construction techniques. Therefore, integrated method ICOMOS + C2C contributes to the environmental, economic and social sustainable development and enhance the conservation process.

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