SUSTAINABLE MODEL FOR ARCHITECTURE AND RETAILING ENVIRONMENTS BASED ON THE CIRCULAR ECONOMY CONCEPT

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ABSTRACT

A recent sustainability-based economic model, the Circular Economy, is examined as a catalyst for a potential new retail model focused on an integrated sustainable system providing residential building and renovation products sales. The premise of the Circular Economy is the argument of utilizing resources continuously by extracting the maximum value from them, then recovering and regenerating products and materials at the end of each service life. The research presents a qualitative study of the Circular Economy concept as an innovation outgrowth for the built environment and retailing facilities. The work proves the Circular Economy theory's necessity as applied to the retail industry, providing a new programmatic retail-based concept with a practical development as an architectural design demonstration project. This project demonstrates how through new retail programmatic synergies, the Circular Economy would be the basis for a new retail model. The application is shown through an urban redevelopment proposal of a former industrial building in a declining North American city that demonstrates Circular Economy issues in the site selection and building design.

Keywords: waste, circular economy, collect, fix, sell, residential, retail, regulations.

1 INTRODUCTION

By the end of the second decade of the 21st century, sustainability and green building materials have become the leading criteria for the architecture practice in North America. Despite the vast expansion of green building materials in the U.S., their availability to consumers in the residential home improvement and renovation arena is minimal, even though Americans spend more than $400 billion a year on residential renovations and repairs [1].

More than 60% of consumers want more sustainable product choices [2]. However, with limited green building retail material stores, premium prices, and a lack of awareness of the benefits of green products, sustainability is facing a major deficit in the field of residential home improvement. The current home improvement retail models are operating on a linear economy aspect of "take, make, and waste" [3]. The absence of sustainable home improvement stores from the reach of the American society while the linear economy retail models are monopolizing the residential market leads to overusing natural resources and producing more landfill waste.

Waste is one of the most significant challenges to civilization. More than 2.1 billion tons of waste are produced every year, and only 16% of them are being recycled [4] – the rest go to landfills. According to the Verisk Maplecroft report, the U.S. represents 4% of the world's population, but it produces 12% of global waste [5]. Americans are considered the originators of the concept "throwaway society", as described by the sociologist Vance Packard, due to their acquiring habit that is attributed to cultural hegemony of consumption and the unlimited regenerative styles of a variety of commodities that change with fads or fashion. As a result, U.S. consumers replace their older items with newer ones frequently, and they produce unsustainable amounts of waste. Products in the home improvement arena fall within this condition. In fact, construction remodeling materials account for 22% of that waste according to the U.S. EPA [6].

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The closed-loop regenerative approach of the Circular Economy concept, which centers on "take, make, and reuse" instead of "take, make, and waste", is a promising solution for the issue of waste and the lack of sustainable products. It also limits the extraction of the primary resources while supporting economic growth and generating new green collar jobs through upcycling and recycling [7].

This study examined the application of the Circular Economy theory in an architectural, programmatic design proposal. The research includes a qualitative study with inductive and deductive methodologies examining the Circular Economy innovation outgrowth for the built environment and retailing facilities. The first part of this research explores the problem, the available solutions and the pros and cons of the results and concludes that the Circular Economy concept is the solution to the dilemma facing the current retail model, and that it is necessary for architects to change the design of the current model of retailing facilities. The second part presents a specialized theoretical concept and proposes a demonstration project that uses Circular Economy principles to create a hybrid of current retail models and interactive social spaces in one facility. The new model gives consumers access to sustainable building products in an attractive, safe, and communal environment and includes repurposed and recycled goods.

2 THE IMPACT OF CONSUMERISM ON WASTE

The Industrial Revolution fostered mass consumption and production while extracting natural resources extravagantly [8]. This, combined with marketing strategies, serves to booster the American dream; regardless of their purchasing power, consumers acquire more items than they need. "With less than 5 percent of the world's population, the U.S. uses one-third of the world's paper, a quarter of the world's oil, 23 percent of the coal, 27 percent of the aluminum, and 19 percent of the copper". People in the U.S. waste more than the environment can afford to process [9], and they throw away tons of items that have not lost their full life cycle, items that can be recovered, reused or resold [10].

Consumerism also played an essential role in the architecture of retail facilities in the U.S., affecting the production of buildings' form developing a consumerist type of architecture like shopping malls, department stores, chain food restaurants, and many other. In the last decade, the U.S. has added more than 0.9 billion square feet of vacant retail spaces [11]. Many of those vacant structures are on the demolishing list [12], generating more waste that goes to landfill.

It is very disturbing to see the quantities of valuable products that have been sent to waste without consideration of its residual value. However, that is because there haven't been any serious economic attempts to guide the fate of inadequate items or to urge the economy toward generating new resources out of waste.

3 THE CIRCULAR ECONOMY SOLUTIONS

Experts predict that the Circular Economy will drive the fourth economic revolution [13]. Many countries have already adopted the Circular Economy measures into their economic system. The British Standards Institution (BSI), for example, developed and launched its first Circular Economy standard, and the European Commission approved an action plan to boost Europe's transition to Circular Economy.

The concept of circularity can be applied to many industries. In fact, major worldwide companies have already adopted the Circular Economy concept into their products in industries like high tech, automotive, textile, agriculture, food, furniture, biochemical, architecture and construction, business, materials, development institutions and others [14].

3.1 Circular Economy overview

Circular Economy is a systematic approach to economic development designed to benefit businesses, society, and the environment. A Circular Economy is regenerative by design and aims to decouple growth from the consumption of finite resources gradually [15]. It also utilizes closed-loop systems to divert materials from landfills – recovering or restoring products, components, and materials by reusing, repairing, remanufacturing, or recycling. Closed-loop recycling can increase the lifespan of a product and optimally become infinitely regenerative [16]. The Circular Economy "model of production represents an unprecedented opportunity to reduce costs, embodied carbon, and strain on natural resources and ecosystems" [17].

The Ellen MacArthur Foundation illustrates the Circular Economy concept in a "butterfly" diagram. The right side illustrates the technical cycle and closing the loops of resources by circularity strategies such as reuse, refurbishment, and recycling. The left side of the diagram shows the biological cycle and the loops and cascades assuring the sustainable management of biological resources and creating renewable flows and stocks. The aim of this model is to minimize the extraction of raw materials and waste generation [18] (Fig. 1).

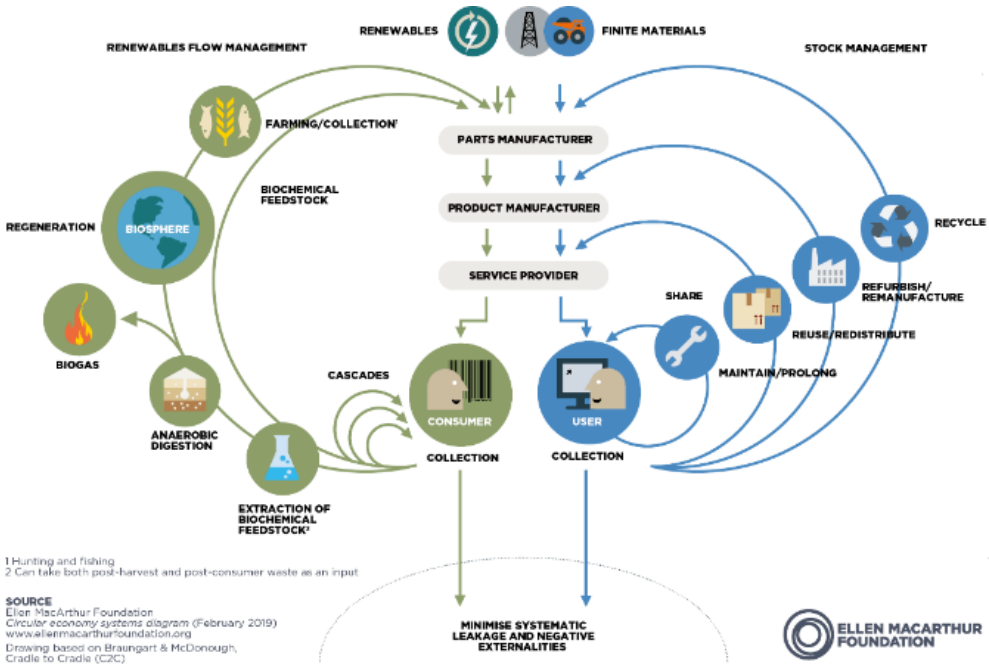

Figure 1: The butterfly diagram – Visualizing the Circular Economy.

3.2 Circular Economy in the built environment

The largest part of our daily experiences is integrated with the built environment. The quality of the building that surrounds us influences our emotions and actions. Beyond the force of emotions that the built environment provides, there are technical aspects, such as deconstruction, which are becoming a deep interest for the architecture community [19].

The Ellen MacArthur Foundation diagram is highly relevant to the built environment. The right side guides the construction process and enforces the disassemble design principles, and the left side handles the after-use materials and factors them into the repurposing and recycling processes that generate new resources out of waste.

Architects and designers can help reduce waste by applying Circular Economy characteristics to buildings and design buildings to be more adjustable, more extensive, and service multiple users, reducing the demand for new buildings. In addition, architects can close the loop for a building's construction and performance by adopting refurbished materials into designs, utilizing restored and recycled goods from the previous program, and designing new products with the intent of prolonged uses [20] (Fig. 2).

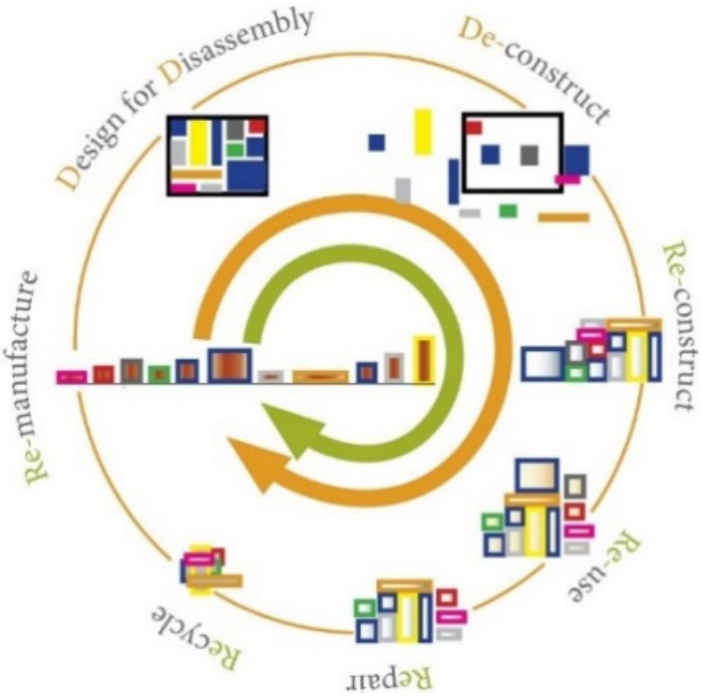

Figure 2: Circular Economy building principles

There are two different approaches for the Circular Economy in the built environment; one involves an existing building, and the second is for new buildings. Existing building principles emphasize extending the life cycle of the building; minimizing resource input, waste, emissions, water, and energy leakage while slowing, closing, and narrowing energy and material loops; and avoiding disposal and loss of economic and ecological value. New building principles emphasize robust and flexible design, as well as guidelines for disassembly, reuse possibilities, repair diagrams, and setups to remanufacture materials or recycle them [21].

The Circular Economy building principles direct architects and designers to approach the built environment on a case-by-case basis to minimize consumption and reduce construction waste by continually reusing materials. The built environment practitioners should reconcile this alternative economic system with their designs, processes, and business models [22].

3.3 Circular Economy business model

In the process of applying the Circular Economy to architecture design and construction, it became clear that is tremendously difficult to close the loop on sustainable building – especially for homeowners – because of a lack of access to sustainable products in the retail home improvement arena [23]. Most of the home improvement stores in the U.S. don't widely practice the Circular Economy business model yet; this movement toward circularity is still in its infancy.

The theoretical concept of the Circular Economy vigorously emphasizes the idea of re-use. A business model based on the re-use theory already exists in businesses like thrift stores, second-hand stores, flea markets, antique shops, pawn shops, consignment stores, record stores, etc. Although re-use businesses make up a small percentage of retail businesses, the demand for reused products is growing, and re-use stores exist all over North America. According to IBIS World, the re-commerce industry is growing at a rate of 2.3% [24], but this at this rate the transformation to the Circular Economy is too far on the horizon.

In addition, re-commerce businesses are mostly independent and localized, and their inventories are in bulks and not specialized into standard products. Most importantly, the managing system capitalizes on the Collect/Sell-As-Is business strategy. Some items sold in the re-use shopping arena are not ready for immediate use due to wear and tear or defects. In many cases, neither the re-commerce shopping arenas nor the customers are willing to fix them. There are guidelines that control the collection and distribution of re-used goods or government rules that support environmental concerns and minimize excessive waste.

In contrast, current home improvement retail stores under the Linear Economy business model are well organized, specialized, and accessible to many homeowners. In fact, the 6.3% growth rate in this industry in the U.S. shows that there is a demand for home improvement products [25].

There is no established chain of green building materials stores around the U.S. that is dedicated to homeowners. Therefore, there is a need for a new retail business model in the home improvement industry that is chaperoned by the Circular Economy guidelines.

4 CIRCULAR ECONOMY RETAIL BUSINESS MODEL

The theory of Circular Economy should change the way architects design retailing facilities. Architects and designers need to add the layer of circularity into their plan so that the design acknowledges and allows the operation of the space under the Circular Economy concept. Combining the Circular Economy architecture characteristics with the Circular Economy business characteristics in the residential home improvement arena creates a new approach: the Circular Economy retail business model [26], which utilizes reused and recycled material all in one place while minimizing waste. Unlike the current re-commerce stores that operate in a one-way system of "Collect-Sell", the new model operates on a closed loop strategy of "Collect-Fix-Sell" (Fig. 3).

4.1 New synergies in retailing

The resulting demonstration project operates the Collect-Fix-Sell system in a single facility as an alternative to or hybrid of current retail models [27]. In this innovative design, consumers will have access to multiple services that revolve into one continuous loop of generating new sources, making profits, and sustaining an environmentally friendly attitude. Buyers and sellers will have access to collection storage facilities, workshops, retail sales,

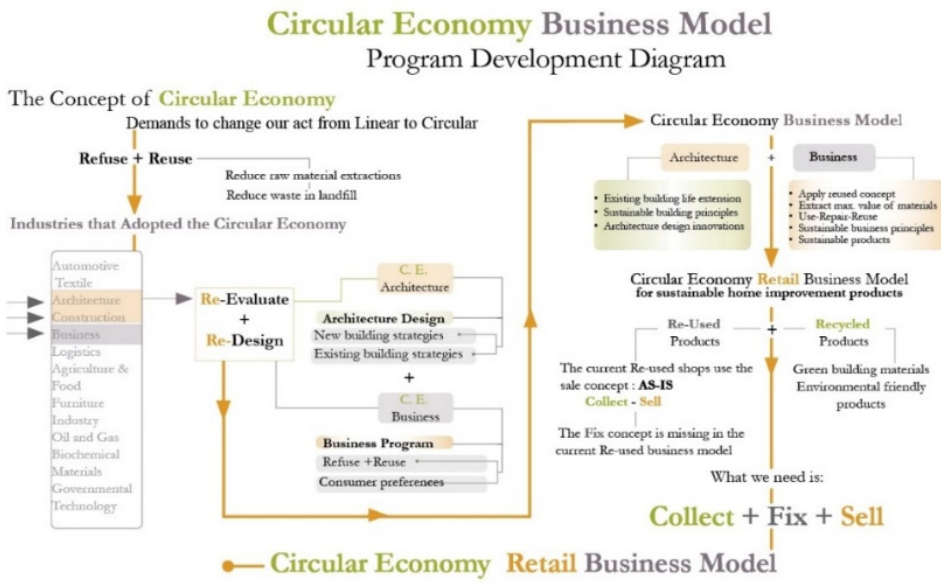

Figure 3: Circular Economy business model program development diagram.

and interactive social spaces. Users will be able to buy, fix and sell sustainable home improvement goods in an attractive, safe, communal, and comfortable environment (Fig. 4).

A functional facility that combines storage, light industrial work and a market will promote the concept of up-cycling and recycling products and raise the discourse of sustainable awareness, solidarity, and responsibility among the public.

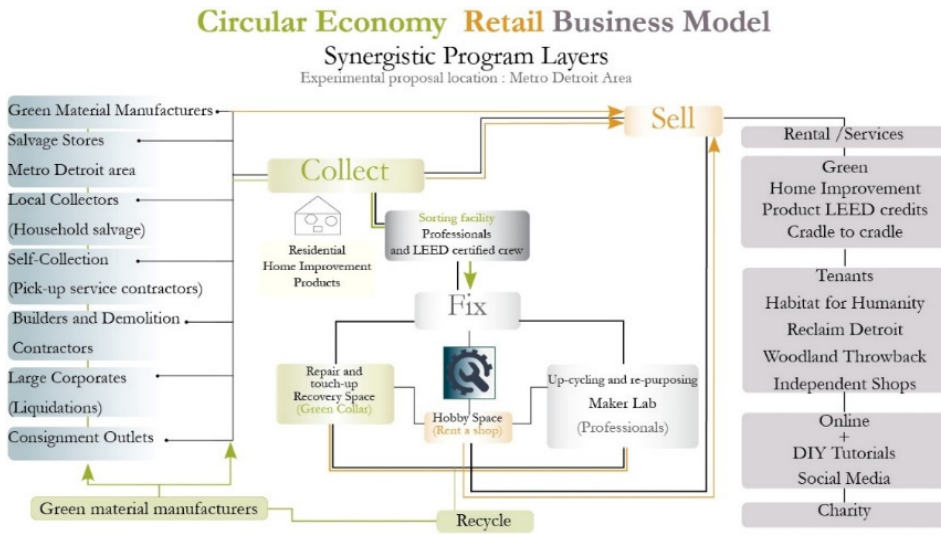

Figure 4: Circular Economy retail business model flowchart diagram.

4.2 The Circular Economy retail business model program layers

The proposed business model distribution plan starts in the collection facility "Collect". This department is responsible for compiling all salvage architecture items and green building materials. The collected items are assessed and sorted by professionals to determine their eligibility for immediate sale or repair before they reach the public. Example of items collected include reclaimed lumber, building materials, and other architecture details. The collection space will require a loading dock, sorting facility and storage.

Items from the "Collect" area will be send to one of the three "Fix" facility departments: Recovery, Maker Lab or Hobby Space. These specialized departments assess the items and extend their life span through repairing, upcycling, or repurposing instead of throwing them away. The "Sell" facility is the retail area, where public can access a wide variety of recycled and upcycled green home improvement items and materials.

4.3 The Circular Economy retail business model application

Demonstrating the Circular Economy theory in a practical retail business model required a suitable building and a site with a supportive urban fabric. The process of qualifying a site for the new retail business model began with an analysis of the causes of the retail apocalypse in North America [28], the changes in consumer spending habits [29], the availability of products that could be reused, and existing abandoned buildings [30] capable of accommodating the programmatic elements for the new retail store. (Fig. 5).

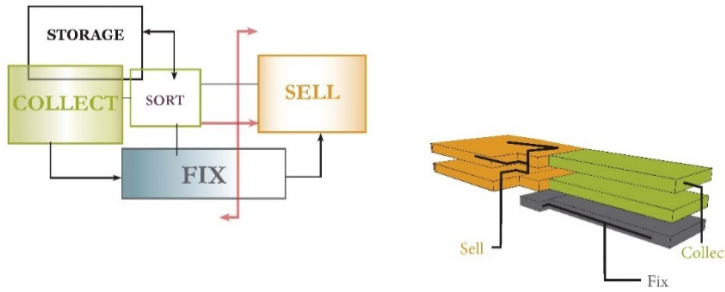

Figure 5: Program major spaces flowchart diagram.

4.3.1 Existing building selection

There are many abandoned and vacant buildings in North America due to the retail apocalypse [30]. This research tested three different building sites with structures that allowed flexibility in their plan for a multi-purpose program and their ability to attract foot traffic, capitalize on interest in re-commerce products, support urban revival, and improve commercial zones.

The best option for the application of Circular Economy principles was the old Apple Thorn Valley Slaughterhouse property located in northeast Detroit, Michigan (Fig. 6). It was built in 1937 near the Eastern Market, which is a vibrant site sponsored by the revitalization plan of the city of Detroit. The building has been vacant for nearly two decades [31]. In addition to the historical value of the building, the structure has had changes to its program and form throughout the years, making its floor plan flexible.

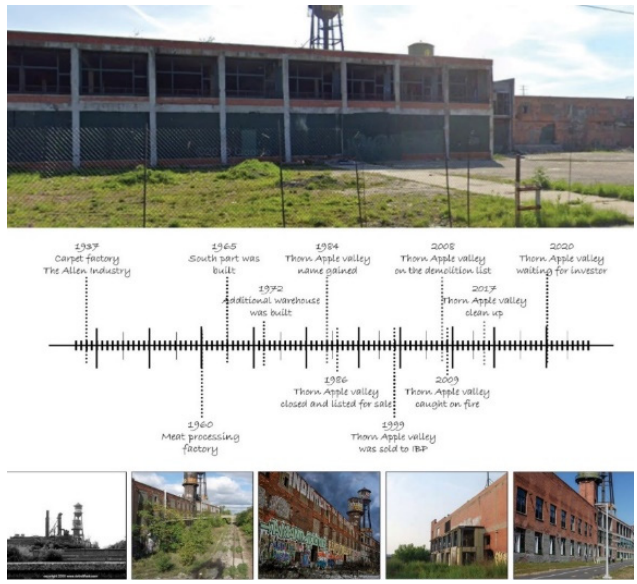

Figure 6: Building site with historical timeline.

4.3.2 Market analysis

This building is in the center of an emerging plan for the City of Detroit, which aims to enhance the business growth in the area and attract high foot traffic to the nearby market and a variety of attractions [32]. The vibrant location capitalizes on the demographic changes and the interest in Gen Z who show a wide embracement to the re-use philosophy, and they are willing to pay more for sustainable products (73%) compared to Millennials (68%) [33].

4.3.3 Building analysis

The building is a two-story structure with an additional walkout lower level that is located in an industrial zone and features a 2.13-acre lot with 1100 parking spots on site and near the building. The top two floors provide an approximate 115,000 square feet; the lower level provides approximately 28,000 square feet that features a 471 linear feet access to Dequindre Cut, a public green walkway with variety of attractions [34]. A potential opening on the southwest wall could be utilized as a corridor connection to drive the foot traffic through the building from the market on the southwest corner to Dequindre Cut in the northeast. In addition, the building across from the subject property is also vacant and could potentially serve the expansion program in the future [35].

Preliminary bioclimatic studies suggest minor changes to the exterior shell to preserve more energy and enhance the natural ventilation system and day lighting performance [36]. Based on the building analysis, the property is highly suitable for the proposed model (Fig. 7).

A closer look at the interior architecture and the program function of the building found an incredible opportunity to enhance the circulation and the flow for the proposed business plan [37]. The plan enhances the form and the function of the exterior facades and the interior flow of the building while maximizing the advantages of the building's orientation, location, circulation, and bioclimatic design strategies (Fig. 8).

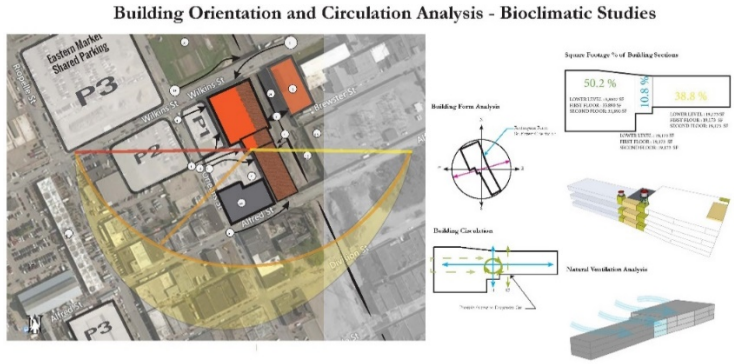

Figure 7: Building site circulation and bioclimatic analysis.

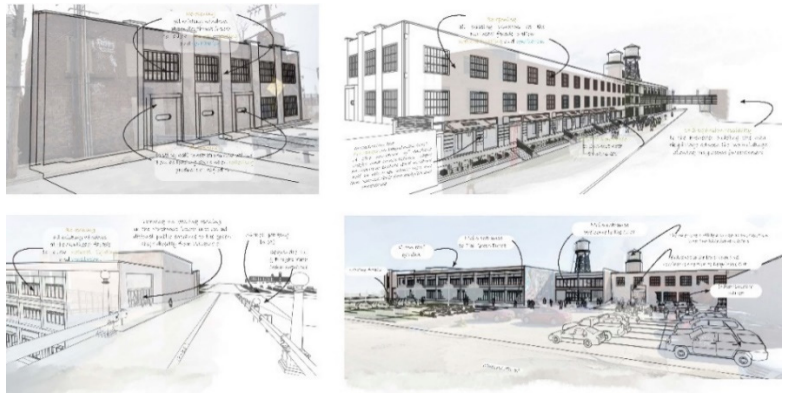

Figure 8: Building design analysis proposal.

Figure 9: Circular Economy retail business rendering.

The former Thorn Apple Valley Slaughterhouse building will be transformed from an abandoned site into a vibrant destination with retail shops, food venues, exhibitions, storage, workshop spaces, and a market for sustainable home improvement building products. The

project preserves the energy of the original building while adapting it into an energy-conserving building and revitalizing a Detroit landmark. The retail business capitalizes on the existing high foot traffic levels and consumers that come to the Eastern Market for locally made products (Fig. 9).

In conclusion, this research addressed the issue of excessive waste in the U.S. and the lack of sustainable product choices in the residential home improvement arena despite the rise of sustainability movement and consumer preferences for reused products. This paper described the effects of mass production, consumerism, consumer behavior and retail closures that led to negative impacts on the environment due to massive extraction of natural resources and excessive waste generation from throw-away products and construction residue. This study also examined the concept of the Circular Economy as a promising solution to the issue of waste and sustainable products in the retail market and determined its validity.

Based on this conclusion, this work proposed a theoretical, programmatic concept for a retail business model based on the Circular Economy precepts and presented an architectural design demonstration project; both the architecture and the business framing systems combined were able to prove and present a new guideline for a retail business model for home improvement products that promote recycling and upcycling and presents innovative synergistic shopping relationships. The proposed design and site demonstrate the sustainable practices espoused to customers with storage, workspace, and market areas that emphasize the Circular Economy concept. This example is a guide for developers and designers to invest in and create profitable home improvement retail chain stores.

The U.S. transition to circularity is in its adolescence [38]. It is a problem but also a major opportunity to test solutions to accelerate the process, as this research did by proposing a guideline to transform a linear retail model into a circular one.

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