BUS GoCircular

Shaping a Circular Sustainable Future

Module 2

Implementing Circular Practice in the Design, Build and Deconstruction Phase of Construction

Circular Economy in the Construction Industry

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Summary

The trainee must gain a good understanding of what opportunities for circular economy are available to them in all phases of the construction process such as reuse, adaptability, modular design and implementation. They must also be able to clearly see the benefits to their work and how this can improve the quality of buildings. They should also gain a good understanding of how this can then be implemented in Multi-functional Green Roofs Facades and Interiors Elements.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Objectives/Learning Outcomes

- 27 - Design products so they use as little material, water, energy, etc. as possible during use phase
- 28 - Design modular structures for multifunctional green roofs, façades, and interior elements, so that the components can be disassembled and reused after end of service life
- 29 - Design multifunctional green roofs, façades, and interior elements to enable reuse and recycling
- 54 - Integrate multi-functionality into buildings by making use of roofs and façades
- 60 - Assemble modular structures for multifunctional green roofs, façades, and interior elements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Objectives/Learning Outcomes

- 65 - Disassemble modular structures from multifunctional green roofs, façades, and interior elements for reuse
- 61 - Conduct a feasibility study to, if applicable, prioritise renovation, minimise used surface, and minimise the total mass of materials to be used
- 76 - Operate multifunctional roofs in a clever manner that suits the current situation best, looking further than solely the original design to optimise sustainability and circularity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Module Content

- Modular and Adaptable Design and Construction
- Design For Disassembly (DfD)
- Product-as-a-service (Paas)
- Design and build Multi-functional Green Roofs Facades and Exterior Elements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Modular and Adaptable Design and Construction

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Adaptable Design

Adaptive as the name suggests means CHANGING.

Changing according to the needs of surrounding architecture and external factors is the essence of adaptive architecture. Adaptive architecture is a framework which allows a building to changes its structure, behaviour or resources according to request and need.

It can be a multi-disciplinary approach concerned with buildings that are totally driven by internal data and also building that are designed to adapt to their environments, their inhabitants and objects.

In simple terms adaptive design is the ability of design to change based on need.

Source- https://sovereignarchitects.com/2015/05/16/adaptive-architecture/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Benefits of Adaptable Design

- An adaptable home will allow people to remain in their homes throughout aging, injury, or illness, while also providing accessibility for unexpected disabilities that might occur later in life.
- An adaptably designed home that allows you to stay in your home for a longer period of time will let homeowners enjoy the savings that often come with sustainable and energy-efficient upgrades and investments. For example, a solar PV system might take about a decade to pay off through your monthly energy bill savings. Since solar systems can easily last for over 25 years, staying in your home for a longer period can enable you to enjoy extended economic benefits.
- Flexible home design can also allow homeowners to generate income later in life through rental or subletting.

Source- https://www.buildwithrise.com/stories/adaptable-design-how-to-build-a-home-for-a-lifetime

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Modular Construction

- Modular construction is a way of building through the use of modular parts that are constructed in a factory and assembled on-site.
- Modular units can be used for any type of application, from entire houses to apartments to mobile site units, and more recently, home offices.

LEAN-
a way to do
“more and more, with less and less”.

Source: https://gupp-class.eu/

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

What is modular construction

Modular construction is a process in which a building is constructed off-site, under controlled plant conditions, using the same materials and designing to the same codes and standards as conventionally built facilities – but in about half the time. Buildings are produced in “modules” that when put together on site, reflect the identical design intent and specifications of the most sophisticated site-built facility – without compromise.

Source-https://www.chapmantaylor.com/insights/what-is-modular-construction-and-why-has-chapman-taylor-embraced-it

Source- https://www.modular.org/what-is-modular-construction/

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Advantages of modular constructions

Source- https://www.koma-modular.cz/en/modularity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Advantages of modular constructions

LINE QUALITY

Most production is carried out under constant climatic conditions in a production hall. Fully digitized production enables line quality to be achieved thanks to the control system.

Source- https://www.koma-modular.cz/en/modularity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Advantages of modular constructions

FIXED PRICE

The economic benefits are not only based on the speed of modular construction. Line production also means control over the price of a product. As a result, the price you agree to when awarding the contract is the price you actually pay for the construction.

Source- https://www.koma-modular.cz/en/modularity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Advantages of modular constructions

SPEED

Thanks to the preparation of modules, including the equipment in the production hall, the building will be erected on site in a matter of hours and is effectively ready for use.

Source- https://www.koma-modular.cz/en/modularity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Advantages of modular constructions

DISASSEMBILITY

A modular object can later be disassembled into individual modules and re-implemented to meet the needs of another object.

Source- https://www.koma-modular.cz/en/modularity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Advantages of modular constructions

FLEXIBILITY

Modular buildings can respond to the current needs of the owner and can be expanded. For example two additional floors could be added.

Source- https://www.koma-modular.cz/en/modularity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Advantages of modular constructions

ENVIRONMENTAL PROTECTION

One equally important feature follows from above; a modular structure is extremely environmentally friendly. Inhabitants of surrounding living spaces are not disturbed by an enduring construction process.

Source- https://www.koma-modular.cz/en/modularity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Greener

- **Greater Flexibility and Reuse:** Modular buildings can be disassembled and the modules relocated or refurbished for new use, reducing the demand for raw materials and minimizing the amount of energy expended to create a building to meet the new need.
- **Less Material Waste:** When building in a factory, waste is eliminated by recycling materials, controlling inventory and protecting building materials.
- **Improved Air Quality:** Because the modular structure is substantially completed in a factory-controlled setting using dry materials, the potential for high levels of moisture being trapped in the new construction is eliminated.

Source- https://www.modular.org/what-is-modular-construction/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Faster

- **Reduced Construction Schedule:** Because construction of modular buildings can occur simultaneously with the site and foundation work, projects can be completed 30% to 50% sooner than traditional construction.
- **Elimination of Weather Delays:** 60 - 90% of the construction is completed inside a factory, which mitigates the risk of weather delays. Buildings are occupied sooner, creating a faster return on investment.
- **Built to Code with Quality Materials:** Modular buildings are built to meet or exceed the same building codes and standards as site-built structures, and the same architect-specified materials used in conventionally constructed buildings are used in modular construction projects – wood, concrete and steel.

Source- https://www.modular.org/what-is-modular-construction/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Stronger

- **Safer Construction:** The indoor construction environment reduces the risks of accidents and related liabilities for workers.
- **Better Engineered Building & BIM:** PMC relies on advanced BIM for visualization to assess the energy performance and identify the most cost-effective efficiency measures. PMC is ideal for the use of this technology where the construction process is already a collaboration of systems, materials and people—much like the software itself.
- **Limitless Design Opportunities:** Modular units may be designed to fit in with external aesthetics of any existing building and modular units, once assembled, are virtually indistinguishable from their site-built counterparts.

Source- https://www.modular.org/what-is-modular-construction/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Temporary Community Centre for Refugees in Roztyly, Czech Republic

Modular community centre for refugees implemented in less than 1 month.

The assembly of the 26-module building started in March 2022 when the first half of the modules were delivered. The rest of the modules were delivered and assembled the next day. This was followed by finishing work, preparation of the modules and equipping the building. The building is scheduled to be operational less than a month after the start of assembly.

*Source-*https://i.ytimg.com/vi/WcyhM5QqJFQ/maxresdefault.jpg

Source-https://www.koma-modular.cz/en/references/docasne-komunitni-centrum-pro-uprchliky-v-roztylech

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

The Development and Innovation Centre of Modularity

The new building on the KOMA company premises breaks the stereotypes of modular construction. Thanks to cooperation with the architectural duo, Michal Krištof and Ondřej Chybík, it was possible to create a unique space with an area of 170 m2 using only 6 modules with a trapezoidal ground plan.

You can construct a building from a variety of materials – bricks, panels or whole modules. This concept is taken a step further by using and filling the space between the modules. This project also implements green roof structures.

Source-https://i.ytimg.com/vi/WcyhM5QqJFQ/maxresdefault.jpg

https://www.youtube.com/watch?time_continue=22&v=obP7sh3PNCM&feature=emb_logo

Video available (not English)

Source-https://www.koma-modular.cz/en/references

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

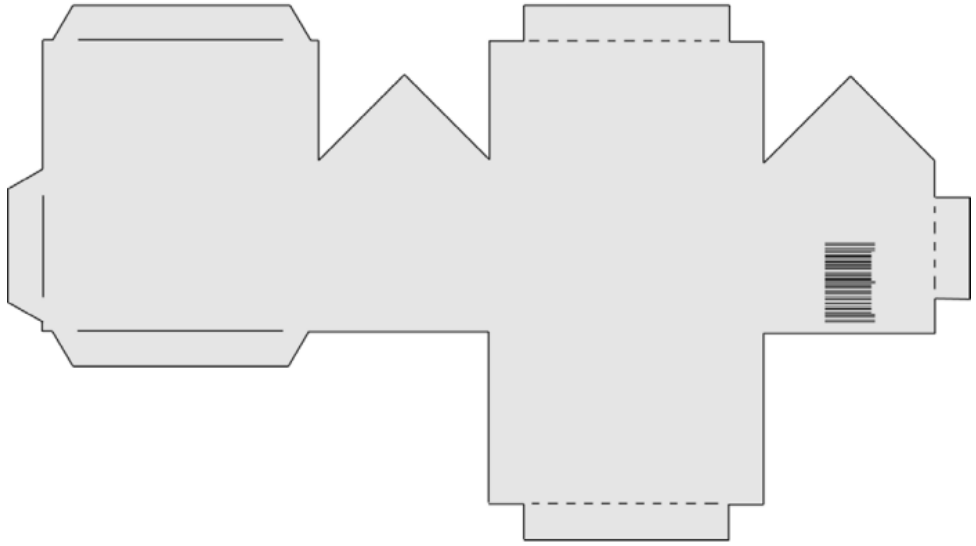
Design For Disassembly (DfD)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Design For Disassembly (DfD)

By definition, Design for Disassembly (DfD) is the design of buildings to facilitate future changes and dismantlement (in part or whole) for recovery of systems, components and materials, thus ensuring the building can be recycled as efficiently as possible at the end of its lifespan.

The strategy builds on an increasing acknowledgment of the fact that the majority of the built environment has a limited lifespan and that every building represents a depository of resources, which, rather than ending up in a landfill, should find their way back into the "reduce, reuse, recycle" loop.



Source-https://i.ytimg.com/vi/WcyhM5QqJFQ/maxresdefault.jpg

Source- https://www.archdaily.com/943366/a-guide-to-design-for-disassembly

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Ten Key Principles for DfD

- Document materials and methods for deconstruction. To efficient disassembly and deconstruction.
- Select materials using the precautionary principle. Consideration for future impacts and high quality materials will retain value and/or be more feasible for reuse and recycling.
- Design connections that are accessible. Accessible connections will increase efficiency.
- Minimize or eliminate chemical connections. Reduce use of binders, sealers and glues on, or in materials, make them difficult to separate and recycle.
- Use bolted, screwed and nailed connections.
- Separate mechanical, electrical and plumbing systems. It is easier to separate components and materials for repair, replacement, reuse and recycling.

Source- https://www.lifecyclebuilding.org/docs/DfDseattle.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Ten Key Principles for DfD

- Design to the worker and labor of separation. Human-scale components or conversely attuning to ease of removal by standard mechanical equipment will decrease labor intensity and increase the ability to incorporate a variety of skill levels.
- Simplicity of structure and form. Allow for ease of construction and deconstruction in increments.
- Interchangeability. Modularity, independence and standardization will facilitate reuse.
- Safe deconstruction. Allowing for movement and safety of workers, equipment and site access, and ease of materials flow will make renovation and disassembly more economical and reduce risk.

Source- https://www.lifecyclebuilding.org/docs/DfDseattle.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Opportunities and Challenges

The construction industry is the world's largest consumer of raw materials, and most of them never return to the material loop. Incorporating the DfD strategy into the architectural process would reduce the embodied energy and carbon emissions of the construction sector, as it would significantly curtail the consumption of first-use materials.

Nonetheless, the DfD process is not without its challenges. The lack of regulation regarding recycled materials and the uncertainty around the quality and quantity of used materials are still disincentives to the DfD method. Another significant challenge, for the time being, is the cost and speed of the process, as demolition is considered cheaper and faster than taking a construction apart piece by piece.

However, research by EPA (Environmental Protection Agency) demonstrated that deconstruction could be cost-competitive with demolition if there are sufficient recoverable materials with a good market value to offset the higher labour costs.

Source- https://www.archdaily.com/943366/a-guide-to-design-for-disassembly

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Material Requirements and Deconstruction

Design for Disassembly requires extensive research into construction materials for selecting the ones that are non-toxic, of high quality (to withstand assembly and disassembly) and have good recycling potential.

DfD requires generating a detailed deconstruction plan, including instructions for the disassembly of elements, as well as a review of the building components and materials and how they should be reused, recycled, or reclaimed.

Source-https://images.adsttc.com/media/images/5f06/3c89/b357/655d/4600/029d/slideshow/R_Hjortshoj-Wasteland_855.jpg?1594244228

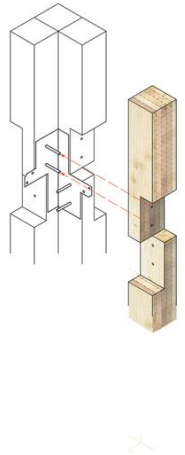
Source- https://www.archdaily.com/943366/a-guide-to-design-for-disassembly

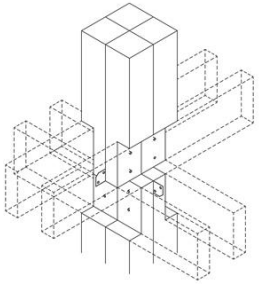
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Connections

One fundamental principle of DfD is creating accessible connections and choosing the appropriate joinery in order to ease dismantlement and avoid the use of heavy equipment, or too many tools.

The focus should be on mechanical joinery, using bolted, screwed or nailed connections, as opposed to non-removable, chemical ones such as binders, sealers, glues or welding, which would make the material difficult to separate and recycle.





Source-https://images.adsttc.com/media/images/5f06/aa99/b357/655d/4600/032b/slideshow/kfi.jpg?1594272401

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Design for DfD Further Information

https://www.lifecyclebuilding.org/docs/DfDseattle.pdf

Design for Disassembly in the built environment: DfD a guide to closed-loop design and building

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Product-as-a-Service (Design and building life)

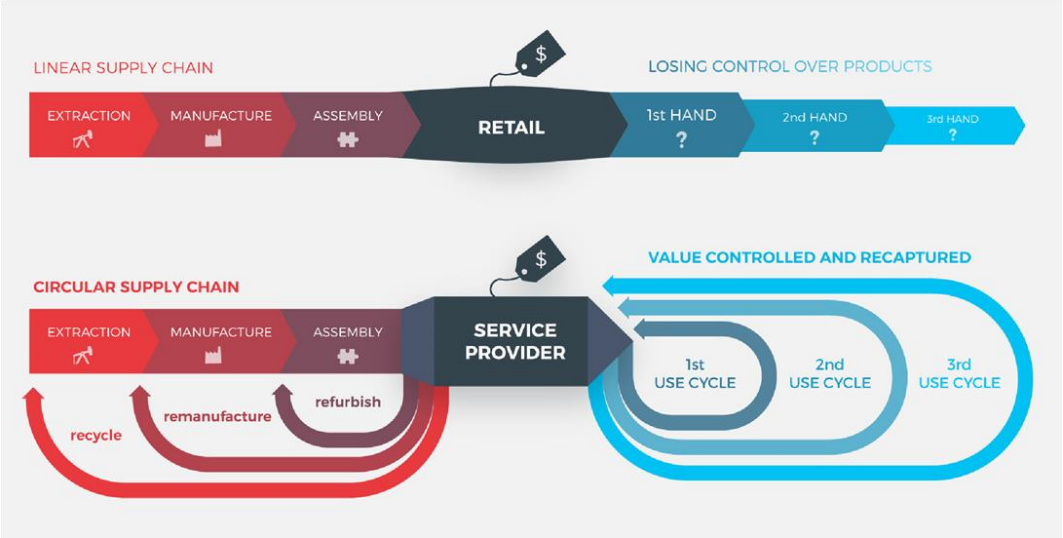
Presentation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Product as a Service (PaaS)

In Product-as-a-Service (PaaS) business models, the provider retains ownership or control of the product throughout the use-phase.

As such, these businesses have a much stronger incentive to maximise product utilisation. It's also in their interests to reduce the total number of products required and their lifecycle cost (LCC).



Source- https://assets.website-files.com/5d26d80e8836af2d12ed1269/5e4d0b66eb0887cb4ffa5e7c_PaaS-Question-Kit.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Product as a service (PaaS) Strengths

Product Lifespan

- As accountability for the product is shifted from the customer to the service provider, the incentive for the service provider is to increase resource and asset productivity and to prolong the lifetime of the product.

Customer Retention

- Maintenance, repair, recycling and other services can lead to an increase in customer retention. Stable, long-term revenue, compared to traditional sales business model which it is more difficult to establish long term relationships with customers.

Sourcing

- Less exposure to pricy or material scarcity.

Source- https://assets.website-files.com/5d26d80e8836af2d12ed1269/5e4d0b66eb0887cb4ffa5e7c_PaaS-Question-Kit.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Product as a service (PaaS) Strengths

User Data

- Predictive maintenance and other measures such as environmental impact.

Environmental Impact

- Positive impact on the environment

The Cash Flow

- In contrast to a linear business model, the incoming cash flow of the PaaS service provider is delayed as the customer pays a small service fee on a recurring basis instead of a one-off payment when buying the product.

The Customer

- The financial or creditworthiness of the customer is crucial for the robustness of the cashflow.

Source- https://assets.website-files.com/5d26d80e8836af2d12ed1269/5e4d0b66eb0887cb4ffa5e7c_PaaS-Question-Kit.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Product as a service (PaaS) Challenges

The Service Contract

- The relationship between Client and service provider is captured in the service contract which becomes very important

The Assets

- Assets becomes less adequate as collateral

The Circular Supply Chain

- Risks to supply chain have more options to fail in comparison to one source

Source- https://assets.website-files.com/5d26d80e8836af2d12ed1269/5e4d0b66eb0887cb4ffa5e7c_PaaS-Question-Kit.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

PaaS Example Outside Construction Headphones-as-a-service

- The modular design allows 85% of components to be reused.
- Products use durable, standardised designs, meaning fewer virgin materials are used to create new headphones.
- The subscription model allows Gerrard Street to recover and recycle headphones at the end of their life.

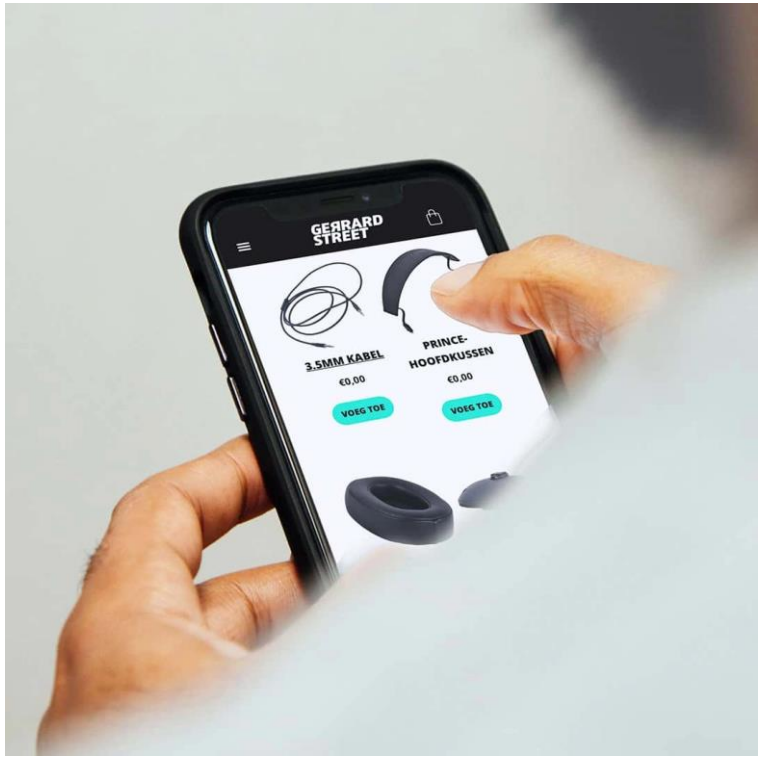
Source- https://ellenmacarthurfoundation.org/circular-examples/gerrard-street

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

PaaS Example Outside Construction Headphones-as-a-service

How it works

- After subscribing and placing an order, Gerrard Street customers receive their headphones in a building kit box.
- If headphones become damaged in any way, Gerrard Street will immediately send out a replacement part to the customer. Customers can also return the headphones for an upgrade or complete replacement.
- New models are sent with return stickers to make the swapping process as easy as possible. This gives flexible access to people who want a high quality listening experience without a costly initial outlay.



Source-https://repeat.audio/

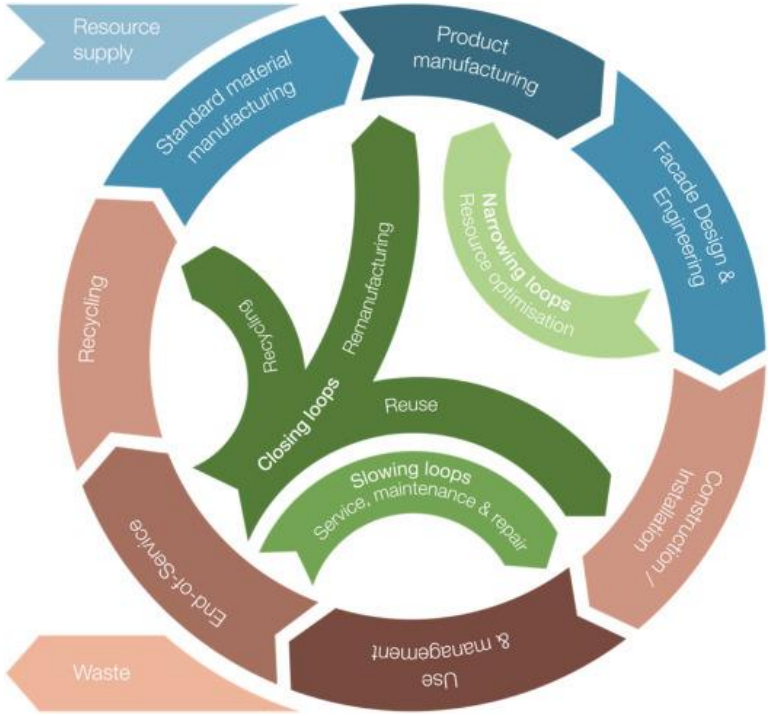
Source- https://ellenmacarthurfoundation.org/circular-examples/gerrard-street

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

PaaS Example In Construction Facades-as-a-service

Instead of transferring ownership of the facade in a traditional manner, the Facade Service Company remains the owner of- and responsible for the facade, its proper functioning and the agreed quality of services.

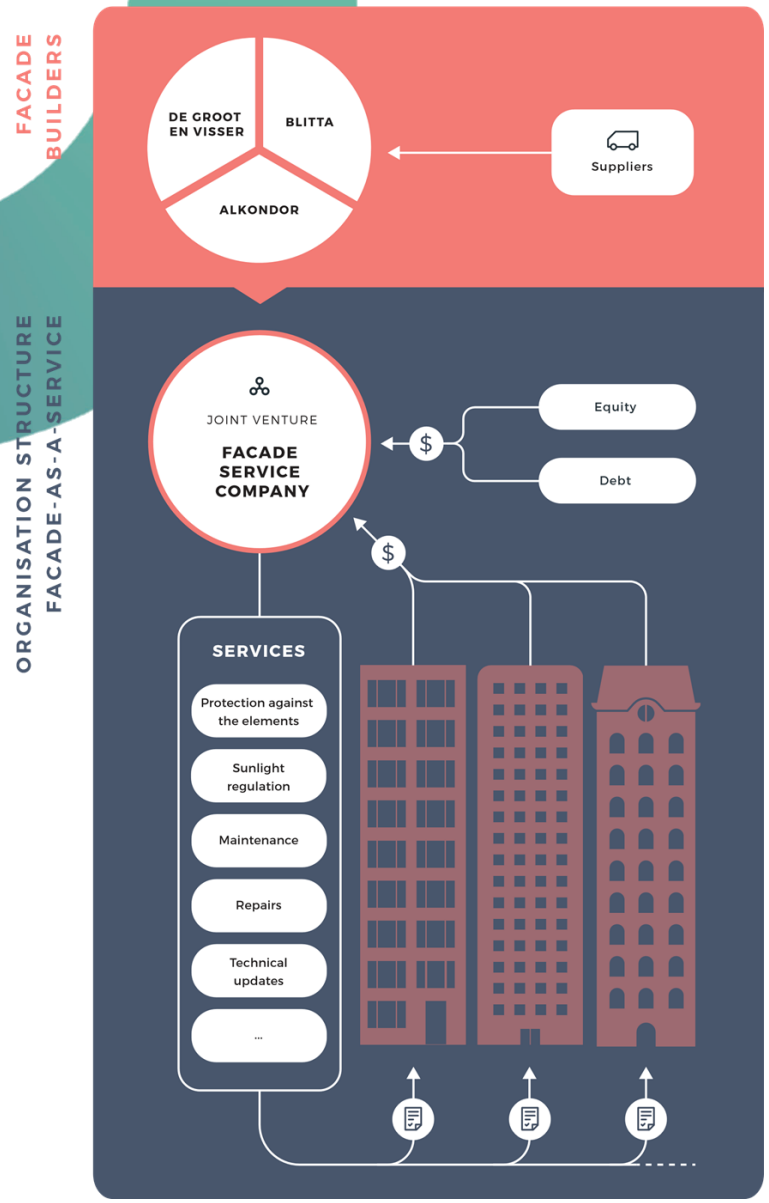
This service model stimulates the provider to develop a sustainable, future-proof facade and incentivises taking into account technological innovation and adaptability in the design phase.



Source- https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.sciencedirect.com%2Fscience%2Farticle%2Fpii%2FB9780128224779000005X&psig=AOvVaw2xsNYttvxlCqbaxsTOTR4K&ust=1673009990874000&source=images&cd=vfe&ved=0CBAQjRxqFwoTCKit1Zu-sPwCFQAAAAAdAAAAABAJ

Source- https://www.circle-economy.com/resources/facade-as-a-service#:~:text=The%20Facades%2Das%2Da%2D,all%20adjustable%20by%20remote%20control.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740



- In return for paying a fixed periodic fee the customer receives the services and is unburdened: the Facade Service Company takes care of maintenance, repair and technical updates. This reinforces the 'trust' factor for the customer.
- Incentivise sustainable energy consumption. There may be a possibility for a discount on the monthly service fee when maintenance costs are lower thanks to careful use of the facade.
- Financially, this proposition is attractive if the total cost of usage of the facade does not exceed the total cost of ownership.

Source- https://www.circle-economy.com/resources/facade-as-a-service#:~:text=The%20Facades%2Das%2Da%2D,all%20adjustable%20by%20remote%20control.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Design and Build for Multi-functional Green Roofs Facades and Exterior Elements

Presentation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Multi-functional Green Roofs Facades and Exterior Elements

- Case Study
- Modular and Adaptable Design
- Green Roofs Facades and Interior Elements-as-a-Service (Green roofs-as-a-Service (GraaS))

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Elementary & Middle School - Paris, France - Djuric Tardio Architectes

Djuric Tardio Architectes has completed the project for the removable and rebuildable wooden nursery in the Luxembourg Gardens, one of the most popular places in Paris for both Parisians and tourists.

The construction of the nursery is temporary since the building will be dismantled and reassembled in another part of Paris, but in another configuration that remains free thanks to interchangeable and identical modules. The site where the modular building is currently located will be restored after two years.

*Source:*https://www.metalocus.es/en/news/modular-and-nomadic-building-paris-wooden-nursery-luxembourg-gardens-djuric-tardio-architectes

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Elementary & Middle School - Paris, France - Djuric Tardio Architectes

Architectural approach. The Jardin du Luxembourg is an exceptional site. Therefore, the building had to take into account the constraint of a short-term existence and the requirement of a harmonious insertion. This high-performing and bio-sourced building was designed with the principle of reversibility. It can be entirely reconfigured to be utilized for this program or others (emergency housing, offices, etc.), in order to serve new needs and future uses. The Luxembourg site will be identically returned to its original state in two years and the building will be erected elsewhere.

*Source:*https://www.archdaily.com/943366/a-guide-to-design-for-disassembly

*Source:*https://www.archdaily.com/935476/wooden-nursery-djuric-tardio-architectes

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Case Study - Noah's Ark Children's Hospice

A green roof will soon be gracing the new building at Noah's Ark Children's Hospice in Barnet, London. And it will be a green roof with a difference. With solar panels and native wildflower vegetation, this biosolar roof will bring both energy and life to the project. Bridgman & Bridgman in partnership with Bauder Ltd started construction in October 2018. We were fortunate to being able to time-lapse the construction and shall continue to film the roof as it changes over time. By spring the roof will be a flourishing wildflower meadow in the sky, helping to support native wildlife. At the same time the solar panels will be producing renewable energy.

Source- https://livingroofs.org/noahs-ark-childrens-hospice-green-roof-start/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Press play on video or go to - https://youtu.be/B0W_PVmiWjA

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

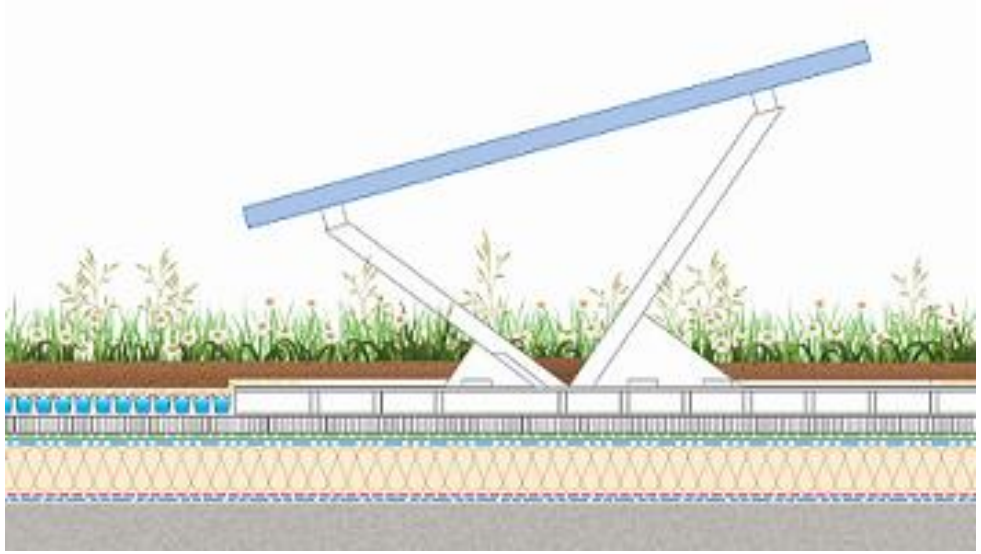
Modular and Adaptable Construction as Referenced to Case Study

Possibilities for implementing Modular Design

- Repeatable modules for reuse and easy additions
- Pre-planted modular trays

Possibilities for implementing Adaptable Design

- Easy access to services and symptoms
- Adaptable design symptoms allowing for addition of elements such as further solar panels



Source-https://www.bauder.co.uk/case-studies/noah%E2%80%99s-ark-children%E2%80%99s-hospice

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

DfD and its Application to Case Study

Utilising Design for Disassembly and Modular design for green roofs, facades and interior elements means that elements of a building can easily be designed and built and reused following the end of life of the building. Allowing elements to be reused in the future.

Source-http://www.greenroofs.com/projects/pa-dept-of-environmental-protection-southeast-regional-headquarters/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

GRaaS - Opportunities

Similarly to Facades-as-a-Service, Green Roofs-as-a-Service (GRaaS) will -

- Extend Product Lifespan
- Insure Longer Customer Retention
- Make Sourcing More Sustainable
- Utilise User Data for Maintenance and Repairs
- Environmental Impact Reduction

Source-https://www.bauder.co.uk/case-studies/noah%E2%80%99s-ark-children%E2%80%99s-hospice

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

QUIZ/ASSIGNMENT/ACTIVITY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

EXTRA READING/STUDY

Activity

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

EXTRA READING/STUDY

For Further Case Studies and Training Material Please Follow the Link Below

https://docs.google.com/spreadsheets/d/1DTte4Ph8pQ4lKzYGFt2_S-d1Z_Rmd9-i/edit?usp=sharing&ouid=112148808974461842163&rtpof=true&sd=true

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

EXTRA READING/STUDY

Green Construction: A Growing Global Trend

https://a.storyblok.com/f/64835/x/7ddfdf5224/emea-green-construction-v1.pdf

BIMzeED

https://bimzeed.eu/

Product-as-a-Service in the circular economy

https://www.stenarecycling.com/what-we-offer/stena-circular-consulting/product-as-a-service/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

https://busgocircular.eu/

Follow us

https://twitter.com/BusGoCircular

https://www.linkedin.com/company/busgocircular

https://www.youtube.com/channel/UCXu4Rjs5WDXBE-yqda5kt5A

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Colophon

BUS GoCircular

Partners

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740