Module 8

Lean and modular construction

Circular Economy in Construction

24 partners

12 countries

Date of Event

*Author/ **Institute***

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Lean and modular construction | Summary

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To provide the basic knowledge to understand lean and modular construction and how these methods impact on the circular economy

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Lean and modular construction | Objectives

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1. Outline the definition and **principles** for Lean construction
2. Outline how Lean Construction can **reduce waste** and use of natural resources.
3. Outline the process of **managing** the Lean Construction capabilities for each stage of construction
4. Outline the definition and **principles** for modular construction/lean production.
5. Outline how modular construction can **reduce waste** and the use of natural resources.

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Lean and modular construction | Content

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Topic 1 – Lean construction

Topic 2 – Modular construction

Image source: kore-system.com

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1. Lean construction

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Origins of Lean

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- Lean can be traced to Toyota in 1950s in Japan. Toyota's goal was to produce cars of the **best quality, at the lowest cost and with the shortest lead time through the elimination of waste.**

- Lean production uses:
  - ❑ less of everything compared with mass production,
  - ❑ requires keeping far less inventory,
  - ❑ results in fewer defects,
  - ❑ produces a greater and growing variety of products.

LEAN-
"maximising value, while minimising waste".

Image source: Toyota-Europe.com

Lean in construction

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- The lean methodology is a modern approach to managing construction in a way that **delivers successful projects in the most time-efficient and cost-effective manner.**
- The lean approach emphasis is on maximising customer value while minimising waste.
- **This makes perfect sense in the construction industry where timeframe, cost and safety are crucial.**

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

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Lean in construction

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- Lean management enables the construction team to "**identify areas of improvement and act upon them in time, to see tangible results**".

- When used in conjunction with traditional project management techniques, Lean Construction helps everyone to understand "**how information, manpower and materials can be used more efficiently, to deliver desired results on time, without exceeding the budget".**

Image source: industryEurope.com

Lean principles

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The basic principles of Lean Construction include:

1. **Planning carefully** to reduce waste,

2. **Improving communication** between team members as well as the construction company and the customer

3. **Using data** to create a predictable process.

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Why Lean?

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- The implementation of lean construction has been gaining traction over the last several years as **more and more firms realise the benefits of applying lean thinking to construction.**

- The concept is simple –

  “maximise value for the client while at the same time minimising waste”

Image source: bulderspace.com

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Lean methods

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- **There is no set method or process to achieve lean.**
- There are a number of tools, methods, and systems that have been developed in an attempt to translate lean thinking to construction.
- Whatever method is used, **cutting costs, reducing construction times, increasing productivity, and efficiently and effectively managing projects can all be achieved through successful implementation of lean principles.**

Image source: eccgroup.ae

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Lean principles: **types of waste**

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- **Lean construction is accomplished by cutting out waste.** The eight major types of waste in construction are easy to remember because they result in **DOWNTIME.**

Defects

Anything not done correctly the first time which results in rework. This wastes time in having to make the repairs and materials needed to correct the work.

Overproduction

When a task is completed faster than scheduled or before the next task in the sequence is ready to start.

Lean principles: types of waste

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Waiting

This wasted time where workers are waiting for materials to be delivered or for preceding work to be completed. This disrupts the workflow and results in workers waiting for work.

Not utilising talent

You wouldn't hire an electrician to fill a construction labourer position. It would be a complete waste of their talents, skills, and knowledge.

Transport

The transportation of equipment, materials, and workers to a jobsite before they are needed. It can also refer to the transmission of information with no added value.

Lean principles: types of waste

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Inventory

In lean construction, you want to move toward “just in time” inventory as opposed to “just in case” inventory.

Motion

Any unnecessary movement that can be eliminated, such as having to make multiple trips across the jobsite to get more tools or materials.

Excess Processing

Double-checking or adding extra processes to try and eliminate other areas of waste will involuntarily lead to more waste from over processing.

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There are a number of principles of Lean construction.

1. Identify value for the client

- **Identifying client values should begin early in the conceptual planning phase of a project and be carried on through construction.**
- It's important to understand what your client wants, and why, so the project team can manage expectations and best advise the client.
- A deep level of trust must be established between all stakeholders in order to successfully deliver lean practices.
- **In lean construction, all stakeholders are involved: owner, architect, engineers, general contractor, subcontractors, and suppliers.**

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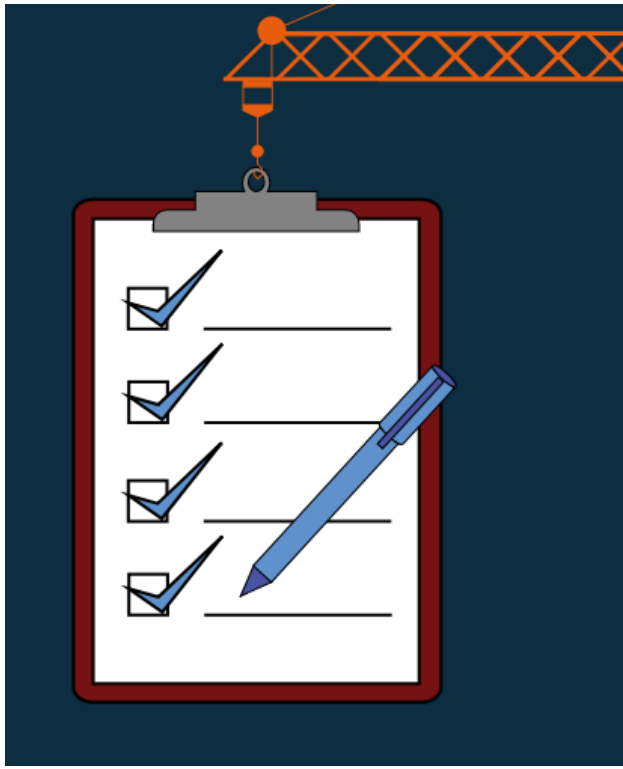
2. Identify processes that deliver the value stream

- Once value is identified from a client's perspective, the processes needed to deliver the value stream are identified.
- The value stream is simply what the client values.
- **All steps in the process should be carefully mapped out to determine what activities are involved**. This includes labour, information, materials, and equipment needed for each activity.
- **Any steps in a process that don't add value for the client should be eliminated.**



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3. Achieving flow of work processes

- The goal in lean construction is to achieve a **continuous workflow that is reliable and predictable.** Each stage of production is done in sequence.
- For example, you wouldn't start drywalling until all of the electrical and plumbing was first fixed. In order achieve flow **all parties have to communicate and work together to avoid interruptions**.
- If one stage of production gets behind or ahead of schedule, it's important to **communicate and make adjustments** to avoid the workers waiting for work or being delayed.

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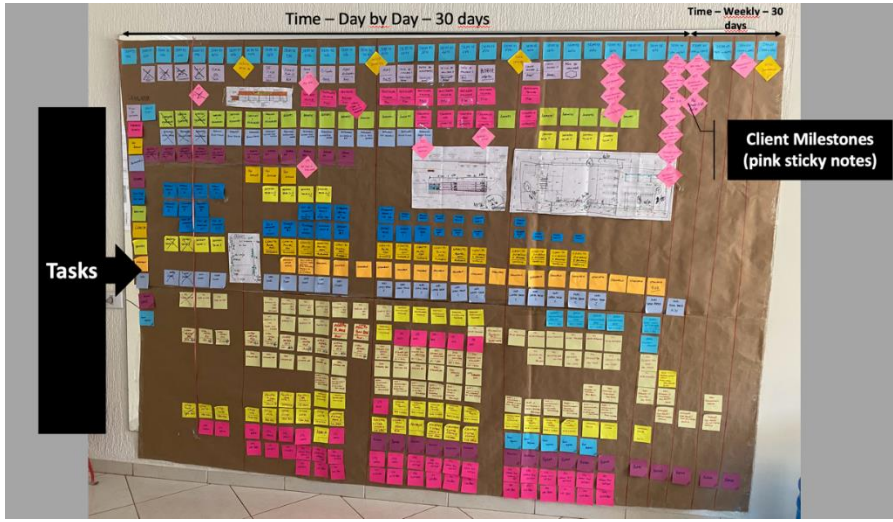
4. Using pull planning and scheduling

- When using **pull planning,** the work is released based on downstream demand in order to create reliable workflows.
- Because work is done sequentially and the completion of one task releases work onto the next task- **starting from a specific milestone and working backwards to schedule work when it can be performed** is required.
- **In lean construction pull planning is done by those performing the work**, typically the subcontractors, through communication and collaboration with each other, to dictate the schedule of tasks.
- They can work with the next subcontractor, or customer, downstream to coordinate schedules and handoffs.



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5. Continuous improvement

- Continually making improvements to further eliminate waste and add value, is critical, to perfect your lean construction processes.

- Not only should adjustments be made throughout the individual project to identify and reduce waste, but **taking what is learned from project to project will allow continuous innovation of new ways to add value and eliminate waste.**

Example of lean construction management

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https://www.youtube.com/watch?v=FeQht25ry2g&t=177s

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Introducing BIM

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- **BIM is a collaborative method of working, involving the efficient design, management and sharing of information, between various parties, using digital methods and processes.** Therefore, it is the key part, of the current Digital Construction movement.

- The BIM process considers the full life-cycle of a building, from initial conception to project completion, and also operations and maintenance stages.

- **At the centre of the BIM Process is a digital Building Information Model**. This is a digital 3D model, which is a data rich/ embedded 3D model that holds up to date information and acts as a digital description of every aspect of the built asset.

Collaboration with BIM

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- The BIM model contains both graphical (objects, shapes) and non-graphical (documents, quantities etc) information. This information is shared and stored within a Common Data Environment **(CDE),** a digital shared storage facility **(the Cloud).**

- **During the construction or execution phase, the use of the BIM model provides a very powerful interpretation tool for everyone involved in the project.**

- BIM is embraced in the industry as a driver of greater collaboration, efficiency, innovation and value across the sector.

To learn more about BIM click here

https://youtu.be/gsm15cawHbY

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Traditional Vs. BIM

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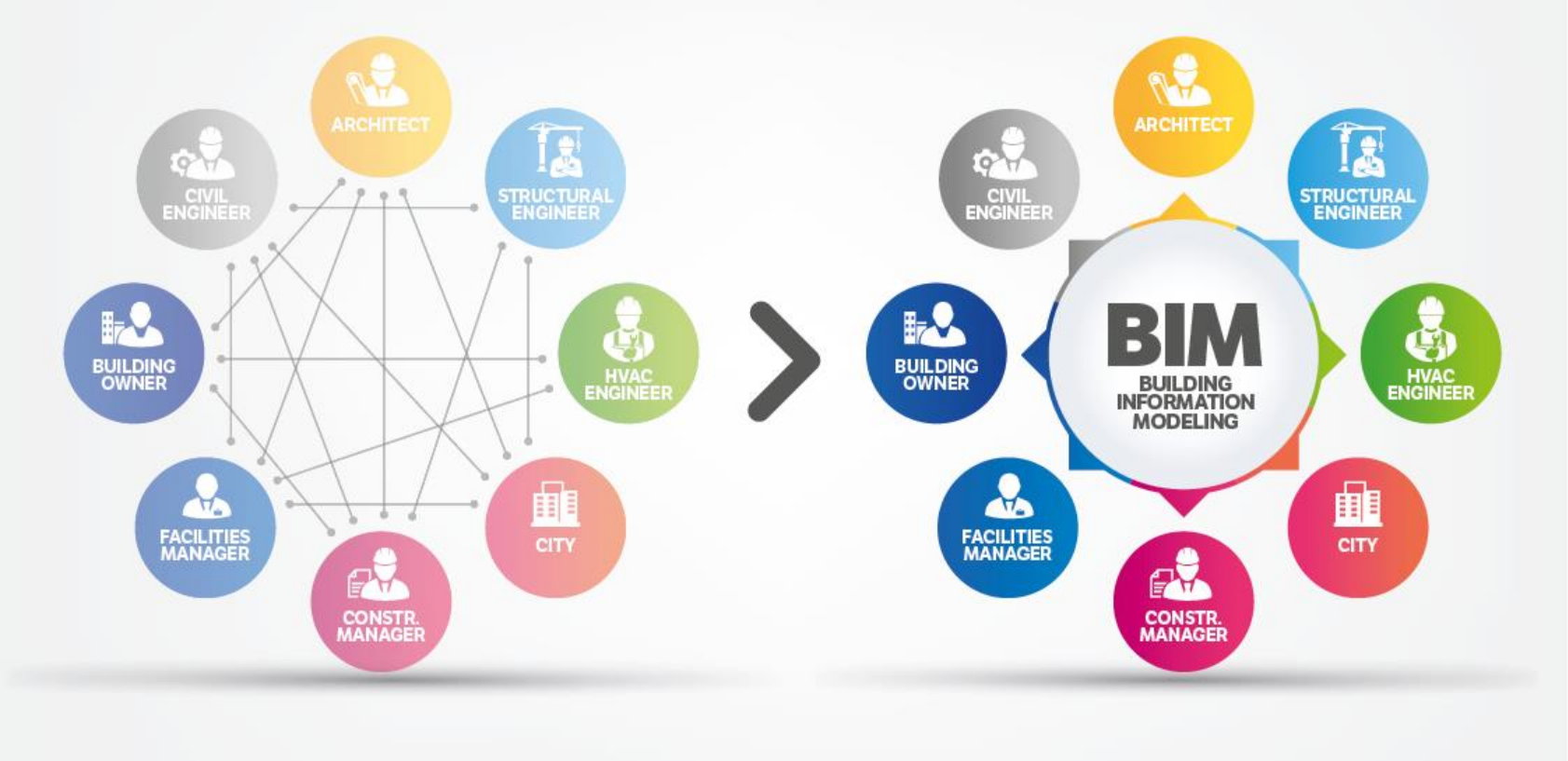

Traditional vs. BIM project management

Lean and Building Information Modelling (BIM)

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https://youtu.be/94lAPHuqxvA

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2. Modular construction

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Introduction to modular construction

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- The prefabricated modular trend is just that: the standardisation of the construction process, carried out off-site in factory conditions.

- Prefabricated construction is used across all sectors, and with the cost of traditional construction methods rising, more developers are exploring prefabrication as an alternative.

Image source: aprao.com

Is modular construction the future?

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https://youtu.be/ItCToQSSdhQ

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Introduction to modular construction

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- 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.

Image source: constructionnetworkireland.com

Introduction to modular construction

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- Historically, construction has been a manual and fragmented process with multiple trades co-operating over a period of time to bring a build together - but when that process doesn't go according to plan, there are development projects that fall behind schedule and over budget.

- But in a controlled environment, the process can be completed in half the time of traditional construction methods.

Image source: chapmantaylor.com

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Introduction to modular construction

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- With most modular construction is carried out indoors, there are less delays, and therefore a greater appeal when working to tight deadlines.
- Coupled with low labour productivity levels and skills shortages due to an ageing workforce, there is a compelling argument to be made for embracing modular construction.

Image source: modular.org

Benefits of modular construction

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1. Quicker Project Completion Times

- Projects can be completed in half the time as compared to traditional construction. **Less time is needed onsite** as the bulk of the building elements have already been pre-made in the factory, leading to faster installation.

- Since most of the manufacturing happens inside a controlled environment like a factory, it also **eliminates the risk of delays due to adverse weather**

- Consequently, buildings are occupied sooner, yielding a faster return on investment. This time-saving aspect of modular construction **keeps the project on schedule and speeds up the build process time** while remaining efficient.

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Benefits of modular construction

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2. Fewer Site Disturbances

- With a large proportion of the build and fit-out completed in the factory, there will not be a convoy of trucks and other heavy machinery carrying workers and materials to and from the construction site, reducing the logistics nightmare.

Image source: 123rf.com

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3. Reduced Environmental Impact

- There is a **significantly lower impact of construction activities on-site** such as: reduced carbon emissions from workers and deliveries and noise pollution.
- There are **minimal vehicles and machinery** pumping pollutants into the air, leading to fewer greenhouse gas emissions.
- Off-site construction generates **less solid material waste that ends up in landfill sites.**
- Materials can be **ordered more accurately based on calculated requirements in a factory environment, and it is easier to handle and recycle the waste in a controlled manufacturing facility.**

Image source: istockphoto.com

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Benefits of modular construction

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4. Greater Safety and Working Conditions

- Moving some of the construction work from a site to a factory, offers safer working conditions, as it significantly diminishes the risk of dangerous onsite construction hazards such as:
  - ❑ poor weather and visibility,
  - ❑ slips and falls,
  - ❑ falling from a height,
  - ❑ equipment-error related accidents.

Image source: 123rf.com

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5. Better Manufacturing Precision and Quality

- It can be easier to precisely meet design specifications in a factory environment, which means that the design does not have to allow the margin for error necessary for onsite construction.

- Off-site construction also leads to improved indoor air quality. Due to adverse weather conditions on-site, high levels of moisture can get trapped into the building materials, The structure created inside a factory uses dry quality materials, which helps prevent mould, dust mites, and other organisms that exist with it.

Image source: istockphoto.com

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Benefits of modular construction

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6. Cost-Effective

- With less waste, faster production, and fewer mistakes in a factory, offsite construction can often be less expensive, than traditional onsite construction.

- Off-site construction helps save on skilled labour costs, as the prefabricated pieces are designed to fit together easily without needing certain specialised expertise.

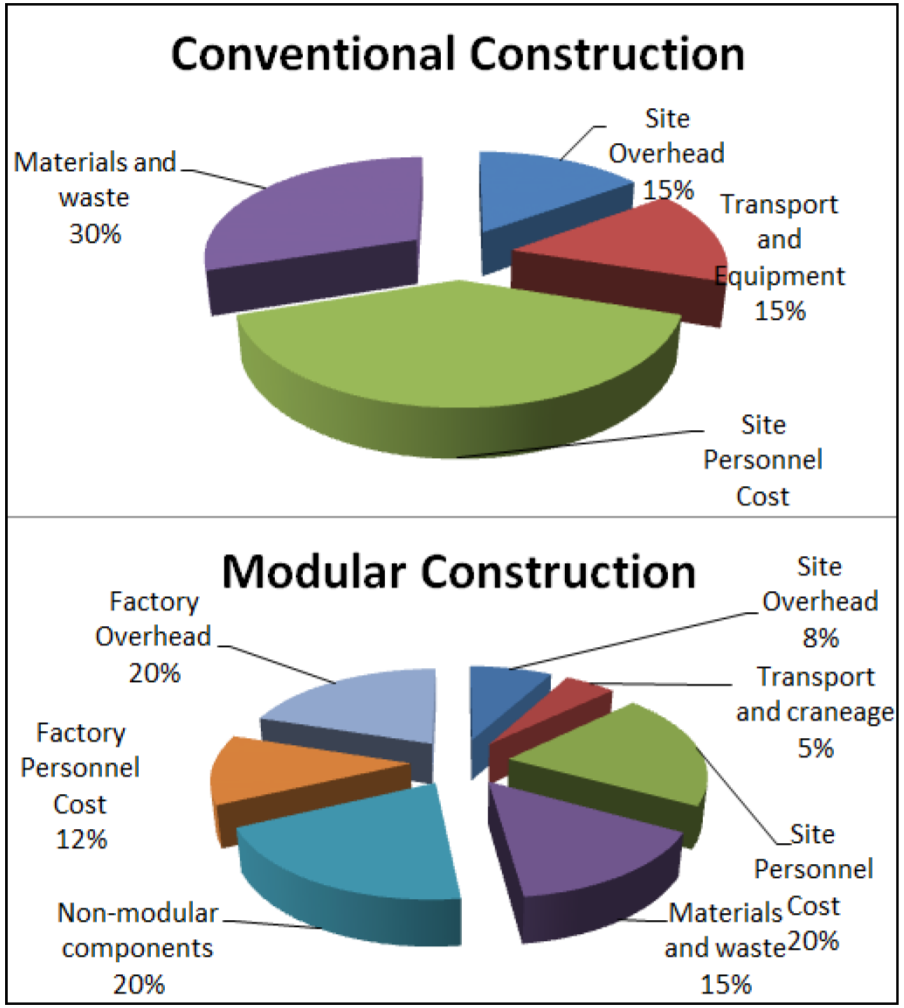

Image source: mdpio.com

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7. Flexibility of Use

- Modular buildings can easily be transported from one site to another, which serves as a real advantage for construction companies needing site offices.
- Modular buildings can easily be located on a site, to enable the fast development of building units to assist with housing need.

Image source: mdpi.com

Conclusion

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Modular construction is increasing in popularity due to factors such as:

- ❑ increased environmental awareness,
- ❑ soaring demand for housing,
- ❑ a desire for efficiency,
- ❑ speed of construction
- ❑ the technological advancements that enable all these elements to come together.

Image source: blog.stacksource.com

Assessment

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Thank You

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