

The role of digital in Facilitating the Offsite Process

Background

The Irish Construction Industry finds itself in uncertain times as Covid 19 continues to bring the sector to a halt. A recent survey from the Construction Industry Federation found that there are deep concerns regarding a return to productivity with the industry facing cash flow issues, legal disputes, and productivity challenges [1]. This may result in organisations having to explore modern methods of construction (MMC) such as Building Information Modelling (BIM) and Offsite Construction (OSC), which are both gaining significant traction within the sector.

OSC and BIM both serve as valuable solutions in terms of improving the performance of the construction industry. The offsite technologies are improving the speed and quality of construction delivery, and using BIM with these technologies will increase the scale of facilities that can be modelled while decreasing the modelling time and enhancing the quality [2]. BIM can facilitate offsite manufacturing as it enables greater precision in specifying material requirements, which can then reduce over-ordering and thus decrease construction site waste. Also, BIM can assist fabricators and contractors by providing a 3D model of element positions [3].

The next CitA Digital Transformation Series to be held on June 10th, 2020, will provide a focus on the synergies between digital and OSC. This will be accomplished through five keynote speakers from RKD Architects, Kennedy Smith Architects, Vision Built, Construction Innovation Hub, and Manufacton.

RKD Architects

RKD is an international firm driven by design thinking. Their skilled team of experienced

professionals collaborate to deliver projects which range in terms of type and complexity informed by design principles relating to simplicity, sustainability, efficiency, aesthetics, and innovation. RKD is also a Tier 1 Lead Designer for the Design & Construction of BIM Level 2 projects as certified by the British Standards Institute. Through the application of BIM, they can communicate with all disciplines in real-time, which enables them to better manage and track design development on selected projects.

RKD has embraced both BIM and offsite construction in recent years, as seen through the Kerry Global Technology & Innovation Centre [3]. The BIM model was developed by Arup and RKD and used for design visualisation, cost estimating, trade co-ordination, offsite fabrication, and constructability reviews. The end goal was to produce a final 'as-built' model, which would be used to support an integrated facility life cycle process. Innovative prefabrication of specific work elements was a strategy used to compress the schedule and accelerate the construction process. Offsite fabrication was utilised for large sections of pipework and multi-service arrangements. The most substantial of which was a series of 4 storey vertical pipework riser modules which were constructed offsite in one piece. These modules were delivered to site fully completed, insulated, cleaned, and pressure tested and craned in to place over the space of several hours.

Smith + Kennedy Architects

Smith Kennedy Architects are a long-established architectural practice based in Dublin who are dedicated to the provision of Architectural services with an emphasis on high-quality, contemporary design and professional service. The firm is fully computerized using AutoCAD as the primary drawing software and are now beginning a move to BIM.

Some of their recent projects that have used offsite construction include Castle Park School in Dalkey. The school applied a system called Eurozone, which is a prefabricated shuttering and insulation two-dimensional system that originates from Italy. The system was versatile and worker-friendly, but issues were found when aligning it from Italian to Irish standards. Smith Kennedy Architects have constructed several housing projects with prefabricated timber frame construction. They have also completed a large house using a German prefabricated concrete wall and floor system. Figure 1 illustrates the erection onsite of the modular elements.



Figure 1: onsite installation

Vision Built

Vision Built is a specialised offsite manufacturing company, providing full frame load-bearing structural systems from cold-formed steel in a factory in Galway, for supply to its customer base in both Ireland and the UK. Established in 2012, Vision Built has 38 employees in its factory in Oranmore, County Galway. The company's London office is in St Albans, which has overseen the completion of many notable projects. Over the years, the company has delivered a range of projects in Ireland and across the UK in many sectors, including residential, commercial, health care, industrial, and pharmaceutical. Some examples of previous projects include the Travelodge Hotel in London, Premier Inn in Great Yarmouth, Travellodg in Elwock Place,

Comfort Inn in Solihull, HIX Hotel in Lambeth, and Dublin City Council Rapid Housing.

Vision Built provides in house design, manufacture, and installation, supplying a full structural insulated frame certified up to 10 stories. The business is accredited by ISO 9000, 14000, Irish Agement certification, and the Steel Construction Institute. The business continues to serve its existing and new customer base within Ireland and the UK partnering with main contractors and developers

Vision Built offers a range of pre-assembled load-bearing panels with insulation if required for full structure or infill. These panels can be assembled onsite to provide a full structural solution to a project via the incorporation if required of hot rolled steel, which is also supplied by Vision Built; this significantly increases the speed of construction of all projects. The pre-insulated panels eliminate cold bridging, and with Vision Built, accredited junction details, can bring ψ Value to as low as 0.04.

For structural infill systems, Vision Built offers a full design and supply of cold-formed steel infills with swaged ends, which allow for a full flush system. This allows for the infill of reinforced concrete or hot rolled steel structures. This forms the inner leaf of the external structure and can be designed to support most types of cladding and external leafs.

Vision Built's framing system is a cold-formed steel panelised product. Various types of 2D panelised systems are manufactured to allow efficient installation by ease of assembly onsite. With specialised equipment at the Oranmore factory, the company is capable of high-precision work to a very high level of quality. The designs from framing models are sent to the machines on the floor, and the process is automated to achieve the best results.

Design for Manufacture and Assembly (DFMA) is a common term in offsite construction and is at the core of what Vision Built does. This process involves a combination of experience and expertise in buildability, manufacturing, and design to ensure ease of

assembly onsite. Vision Built uses the most up to date design software and offers BIM level 2 to all customers.

Vision Built also manufacture a range of lattice joists that can be assembled to form a floor structure, roof structure, and to act as a beam. Further to this, they also supply and install a composite deck solution, which is commonly used as part of a composite floor slab, where the decking acts as both permanent formwork and tensile reinforcement (sagging) at the bottom of the slab. Other products include welfare pods, garden office pods, and other ranges of volumetric modular units to enhance offsite construction. Figure 2 illustrates the erection onsite of the 2D smart modular elements



Figure 2: erection of 2D Smart Modular Elements

Construction Innovation Hub

The Construction Innovation Hub brings together world class expertise from BRE, the Manufacturing Technology Centre (MTC) and the Centre for Digital Built Britain (CDBB). Working around the four core themes of Value, Manufacturing, Assurance, and Digital, it aims to change the way buildings and infrastructure is designed, manufactured, integrated, and connected within our built environment.

The Hub will support collaboration across sectors and with businesses of all sizes, governmental organisations, universities, technology partners and RTOs, to develop, commercialise, and promote digital and manufacturing technologies for the construction sector. The Construction Innovation Hub will start by developing, demonstrating, and

validating product family architectures, standardised platforms, and components for schools, prisons, hospitals, and other standard buildings procured by the government. It will develop the next stage of BIM processes, tools, and standards for the whole lifecycle of an asset to ensure the UK remains a leader in digital construction. To this effect, CDBB has published *"The Building Information Modelling (BIM) Interoperability Report"* for consultation. It forms part of the Construction Innovation Hub's work to grow the digital economy for the construction and infrastructure sector and to develop and promote digital ways of working as enablers of greater whole-life-value in the built environment.

The Hub will also develop new digital approaches to quality control, testing and validation, and regulatory compliance. Underlying this will be an academic programme to create the information management frameworks and rules which will underpin digital twins and the future digital built environments. The Construction Innovation Hub aims to enable buildings to be built faster, more sustainably, and more economically. These buildings will go on to perform better in terms of ongoing running costs as well as social and environmental outcomes.

The Construction Innovation Hub is now inviting clients and businesses to input into the first of a series of new digital processes that it hopes can spark a game-change in the sector's approach to quality planning. The Hub's Construction Quality Planning (CQP) process is inspired by Advanced Product Quality Planning (APQP), which is already used widely across leading manufacturing sectors like aerospace and automotive. CQP defines an approach for firms that supply the construction sector with new products and assemblies that will form part of tomorrow's offsite manufactured buildings. The CQP process will also play a vital role in guiding the Hub's flagship Platform Design Programme.

Manufacture

Manufacture helps the construction industry leverage the power of prefabrication, with a solution that

provides the management across the entire offsite/prefab process. Manufacton's PreFab and Modular Execution system is an enterprise platform that allows all users across the supply chain to track and manage offsite and onsite deliverables across planning, design (BIM), fabrication, logistics, and installation phases of construction. Trade contractors leverage Manufacton to coordinate materials, and track progress, all from a single integrated view across the entire construction supply chain.

Their software enables you to visualise real-time status across all trades by connecting supply chains to coordinated BIM models. This allows one to better coordinate projects with agile planning to stay on schedule, reduce labour waste, and identify issues earlier in the process. This results in less time preparing for general meetings as you can easily track workflows and generate timely project insights. The automate colour coding of BIM models provides real-time tracking of subcontractor work, which can be visualised in the model by schedule, location, company, and status. The model can be filtered to show what has been installed in the past month and what is scheduled to be delivered in the future. This results in visual reports during meetings with the main contractor, trade contractors, owners, etc. to answer questions on completed and upcoming work.

In regards to trades, the software can boost productivity through real-time, always-on tracking, analytics, scheduling, and inventory tools. The team can measure shop output, create more prefab, with step-by-step monitoring and analytics and integrated workflows. This is achieved through efficient communication between field, shop, and operations teams. The BIM models and templates are used to inform materials and inventory requirements. In regards to modular, the software tracks all material, panels, and modules using integrated QR codes to make sure the right items are delivered to the job site at the right time. Reports can also be generated on earned value based on actual work, as well as providing proof of work completed to validate deliverables for invoicing customers.

Conclusion

Organisations are now exploring modern methods of construction that include the partnership between BIM and OSC, so as to establish an advantage within an already competitive sector. Companies are beginning to innovate in order to align with Covid 19 measures with software companies introducing products, such as wearables and AI sensors, to detect when workers do not maintain social distancing practices or to limit a workspace to only a handful of workers [6]. Moving forward, MMC will need to become a fundamental part of the Irish construction sector if a return to productivity is to be realised.

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