

Savings from going digital

Digital fabrication enables precise component manufacture, resulting in improved on site productivity. While it is early days, a potential upside is reduced labour costs and more affordable housing.

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Figure 1: EDFAB digital fabrication sleepout.

MANY FACTORS CONTRIBUTE to the affordability of a building or home. The cost of construction, market rates, profit margins, and supply and demand all play a part.

Digital fabrication using computer-controlled equipment, automation and robotics has the potential to change the construction industry dramatically, and

affordability is one of the likely benefits. Others will include higher quality and more streamlined design to production.

Construction still labour intensive

Construction cost can be broken down into three broad categories - material, labour and approval costs.

Labour costs are substantial at 30-50% of construction costs on average. When compared with the car or manufacturing sectors, construction is very labour intensive.

This is with good reason. Early prefabricated projects were fraught with difficulty. A notable example is Ronan Point in the UK, which partially collapsed. The collapse was attributed to a combination of more complex joints and a new expectation for much tighter tolerances.

Change in accuracy needed

With traditional building elements, installation to within 10 mm accuracy was sufficient. Prefabricated elements, however, need to be fitted to millimetre accuracy.

This has been a significant shift for the industry, complicated further by new complex jointing techniques that are too difficult to achieve on building sites exposed to dust, dirt and the weather.

The industry is starting to have a much better appreciation of new technologies and

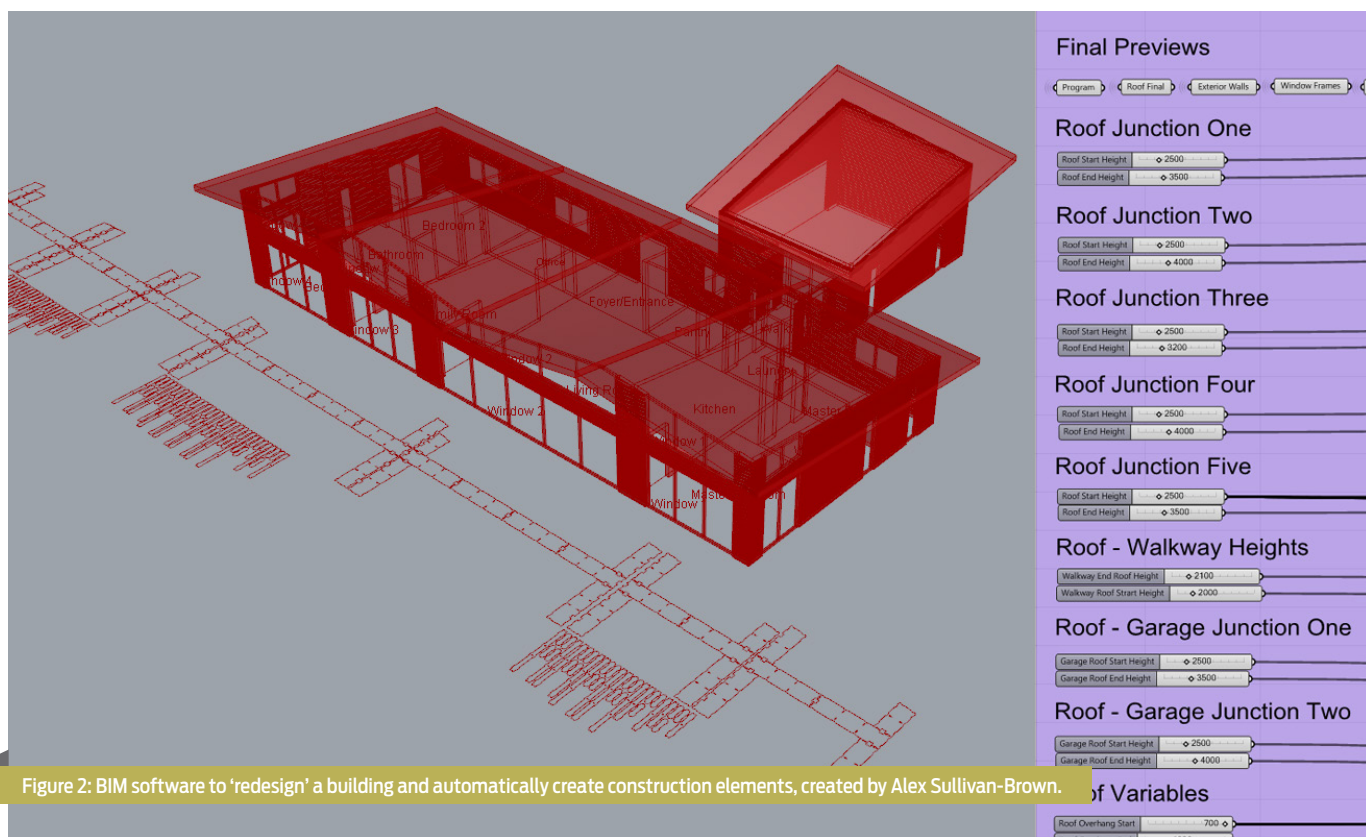


IMAGE - ALEX SULLIVAN-BROWN © 2015 CC-BY-SA

how they might require changes in organisation, skill or construction processes.

Increase in productivity

Research carried out at the University of Auckland shows digital fabrication does not necessarily remove the need for skilled people or construction knowledge. However, it can enable a labour force to be more productive, which increases affordability.

Digital fabrication also creates very precise components that fit together accurately and quickly. Where other specialists are also using digital fabrication on a project, components have more consistency. Fitting during construction becomes faster and more efficient, and the construction process has fewer delays, but what it is being fitted to, for example, foundations, need to be equally accurate.

Significant potential time savings

The EDFAB research group at the University of Auckland digitally fabricated a sleepout

using an innovative plywood system (see Figure 1). Components were pre-cut and pre-assembled in the digital workshop, then transferred to site for quick assembly.

This small-scale simple standardised project demonstrated significant time savings. The potential benefits on a large-scale project for increasing productivity and reducing construction time are significant.

Increased quality another bonus

The research also suggests quality increases dramatically with digital fabrication, meaning more consistency, ease and safety when assembling a building.

Increased quality may also mean healthier, warmer homes that are more affordable to heat when well ventilated. Choice also increases. Currently, researchers are prototyping design software where a customer can change the size of rooms and orientation of a potential house for their site (see Figure 2).

The software keeps the changes within current building regulations and

automatically creates all digital files for the digital fabrication of the structural parts and building envelope.

Research is also being carried out into automatically changing window sizes in a building information model (BIM) to maximise winter solar gain and limit summer overheating, irrespective of how a house is oriented on site.

WikiHouse and digital fabrication

Further, digital fabrication offers another answer to affordability. Space Craft Systems, a New Zealand-based social enterprise, is creating high-quality buildings utilising the WikiHouse open-source building platform. This enables assisted self-delivery, an alternative to purchasing through a commercial property developer or national building company.

The construction system is specifically designed to be assembled safely by people with little or no specialist knowledge. Space Craft is demonstrating how it is possible ➤



Figure 3: WikiHouse created by Space Craft Systems, a community led building system.

for a community of people, mostly with no specialist building skills, to build high-quality buildings (see Figure 3).

This model of community-driven development engages directly with end users and utilises a community's own social capital as labour. This means enterprises can still make a healthy profit, while at the same time a building becomes much more affordable and better meets the users' needs.

Digital workflow benefits other sectors

These innovations are only the beginning, and in other sectors, early adopters of digital innovations have seen additional benefits. Organisations such as Amazon and Apple's iTunes have made music and books more affordable but also increased choices.

They continue to increase their labour force and have been able to improve the efficiencies of delivering their products through a digital workflow.

The building industry mostly remains an analogue workflow, and there is considerable room to implement both near and long-term changes to improve business. As Amazon and Apple iTunes show, this does not necessarily mean reducing profits or a company's workforce.

Change needed to drive implementation

All these small innovations are possible with a digital workflow and fabrication. When combined, they have the potential to improve both building affordability and quality.

However, to fully embrace these innovations requires legislative change, including:

- changing the building approval process
- reviewing how construction progress is monitored both on and off site
- better ways to measure building envelope performance and energy and ventilation performance requirements.

It also requires resources to help organisations access and share technological developments as well as to upskill their labour force. One such innovation is a digital innovation think-tank that has been funded by BRANZ - AECFutures (see aecfutures.org).

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