A CONSTRUCTION PRODUCTIVITY MAGAZINE

We shape a safe, high quality, sustainable and friendly built environment

Building and Construction Authority

JUN 2016

The Winning Formula: Innovative and Collaborative BIM

Building up BIM Collaboration Capabilities

Reaching New Milestones with Design for Manufacturing and Assembly

Straits Construction’s Productivity and Innovation Week 2016
CEO’S MESSAGE

Dear Readers,

When BCA first introduced the Construction Productivity Roadmap in 2010, “productivity” became the buzzword of the built environment sector. BCA has continued to champion the productivity movement in the industry, keep the industry informed of new productive technologies as well as support productivity related workforce development, technology adoption and capability building through the various funds and schemes under the Construction Productivity and Capability Fund (CPCF). Today, productivity is still, if not even more, important to the built environment sector. Increasingly, companies big and small have adopted productive technologies to varying degrees.

Earlier this year, Deputy Prime Minister Tharman Shanmugaratnum visited the first high-rise residential Prefabricated Pre-finished Volumetric Construction (PPVC) project at Nanyang Technological University (NTU). Separately, Minister of National Development Lawrence Wong visited the Crowne Plaza Extension project, the first private commercial PPVC project in Singapore. The support of both the public and private sectors in the adoption of productive technologies for local construction projects is heartening and I am very happy that NTU and OUE have taken the lead with the hostel and hotel projects respectively. This is also testament to the fact that PPVC is not restricted to housing projects and has immense potential waiting to be unveiled. I am sure that in time to come, and with the public sector taking the lead, PPVC will soon be widely adopted in more construction projects in Singapore.

The industry is now familiar with Building Information Modelling (BIM) and has begun to innovatively utilise BIM to raise construction productivity. BIM is integral to the Virtual Design and Construction (VDC) process as it provides invaluable information during the planning stage. Potential problems can be detected ahead of the actual construction, which helps project teams make well-informed decisions and even fosters greater collaboration and understanding between team members. Three projects (CapitaGreen, Mapletree Business City II and Yishun Community Hospital) have done exceptionally well in leveraging BIM innovatively and have in the process achieved cost savings and projects of higher quality. These three outstanding projects have been awarded the Platinum Award under the project category at the BCA BIM Awards last year.

Touted as one of the key technologies to improve productivity and integration across the value chain, there is good potential that BIM will be increasingly adopted by the industry.

Let us continue to join hands and actively participate in building a future-ready built environment for Singapore.

Dr John Keung
Chief Executive Officer
The innovative method of PPVC saves up to 40% in manpower and up to 20% in construction time. Compared to conventional construction methods, which take 14 to 21 days, PPVC's floor cycle is shortened to approximately four days.

The adoption of PPVC also encourages an advanced determination of requirements, resulting in minimal changes as well as early and precise mass manufacturing of complete and usable floors. With prefabrication, more activities are done off-site, so noise and dust pollution is reduced.

Deputy Prime Minister Tharman Shanmugaratnam, who is the chairman of the National Productivity Council, visited the new buildings at NTU for a first-hand look at the PPVC construction method.

"The construction industry is going through a transformation," he said. "We have to go through this restructuring where we focus on (productive) technologies from the moment one is designing the project, all the way to the final installation and finishing."

Mr Tharman added that more can be done to raise productivity in the built environment sector, and this requires a greater push for the adoption of game-changing construction technologies such as PPVC, Cross-Laminated Timber and off-site manufacturing for on-site assembly.

He also mentioned that more construction projects in the future will be required to meet some element of pre-cast or prefabrication, and the public sector will take the lead in championing the change in the way buildings are constructed.
Crowne Plaza Changi Airport Hotel Extension is the First Private Commercial PPVC Project in Singapore

Crowne Plaza Changi Airport Hotel Extension (CPEX) is the first private commercial Prefabricated Pre-finished Volumetric Construction (PPVC) project in Singapore, which involves the construction of a 10-storey, 243-room extension to the existing Crowne Plaza Hotel. In total, 252 PPVC modules (each weighing about 20 tonnes) were installed. The new extension is connected to the existing building by a two-storey linkway. The main lobby and basement car park remain at the existing hotel.

BCA and OUE Limited hosted Minister for National Development Lawrence Wong at a site visit to the CPEX project. Around 50 guests from various public agencies were also present. Guests were invited to witness the module installation process as well as the modules’ interior finishing, which were completed in Shanghai.

During the visit, members of the CPEX project team Richard Hassell (WOHA) and Thierry Brezac (Dragages Singapore) gave a presentation on the process and shared their experiences. With PPVC, the project achieved around 40% savings in manpower. In addition, floor cycle times were reduced from around two weeks to just three to four days.

Minister Wong shared that construction productivity is critical to Singapore’s future. He further emphasised that Singapore cannot continue building using the old ways of relying heavily on foreign workers. The industry must change its mindset and accept new technologies to improve construction productivity.

To find out more about PPVC and some of the other game-changing technologies, please visit the websites below.

THE WINNING FORMULA: INNOVATIVE AND COLLABORATIVE BIM

Three projects show how BIM can be leveraged in innovative ways

The use of BIM is integral to the Virtual Design and Construction process. It helps to surface problems and clashes before the actual construction begins. This allows project teams to make better-informed decisions and fosters greater collaboration amongst the team members. Three award-winning projects – recognised with the BCA BIM Platinum Award under the Project category at the Singapore Construction Productivity Week 2015 – demonstrate how they leverage BIM in innovative ways not only for better collaboration, but also towards a higher predictability of time, cost and quality in their projects.

Optimising Design for Lean Construction

Parametric design was applied in several ways to the project to facilitate the design development.

One application was to determine the configuration of the randomly cut multi-coloured stones for the stone wall facade, which best represents the designer’s intention. This also enabled the contractor to provide very specific visual instructions to the stone supplier.

Automation in the design process with parametric study also helped in optimising the design of the wind funnel structure through examining 114 patterns of the design for lean construction and constructability.

BIM for Construction

The team used BIM to study the constructability and plan for the construction activities with sequencing of works. Temporary works such as scaffolding and tower cranes were also modelled to determine the most efficient construction strategy.

On site, 3D models were manipulated using iPad for site verification and to track the progress of works. 3D scanning was also introduced to compare the BIM model (as designed) with the actual site condition (as-constructed).

Communicating and Collaborating Visually

BIM provided clear visuals of the issues and helped to facilitate early and more precise decision-making amongst the project team members. Visual coordination using the model also drastically reduced clashes, particularly the Mechanical & Electrical (M&E) services, prior to fabrication and on-site installation.

The modelling and coordination efforts were extended to the M&E sub-contractors for the air conditioning and mechanical ventilation (ACM), electrical services, plumbing and fire-protection works as well as the facade sub-contractor and steel fabricator.

Utilising 3D Printing

3D printing was utilised to create physical models of complex areas for better visualisation and to study the various options for structural framing with architectural and mechanical, electrical, and plumbing (MEP) works.

Information Sharing

To communicate the information from the models to the site team, the BIM 360 Glue app was used with an iPad. This enabled the construction team to review the models on site. This was also used for discussions with sub-contractors on the sequencing of works for complicated areas and for checking the site condition. A collaboration cloud-based system was also introduced to share the 3D project models information.

Mapletree Business City II (MBC II)

The new heartbeat of the Alexandra Business Corridor located at the fringe of the city, MBC II is the second phase of the Mapletree Business City. The business park development features a 30-storey tower block which integrates state-of-the-art business facilities, sports and recreational amenities and eco and user-friendly features.

BIM as the Communication Platform

The architectural model developed by the lead consultant, DCA, was made available to the main contractor for construction planning purposes. The main contractor’s appointed consultants and sub-contractors were involved in the intensive coordination process using BIM as the communication platform.

Critical issues were discussed using the 3D models and resolved in the coordination meetings before shop drawings (e.g. for precast elements) were generated for fabrication and construction on site. This resulted in early detection of constructability problems and the production of more well-coordinated and better quality documentation.

Coordination using BIM was further extended to the external works, curtain wall and structural reinforcement design beyond the usual coordination between the three disciplines.

Yishun Community Hospital (YCH)

YCH consists of two in-patient tower blocks, one Geriatric Education and Research Institute Tower, and two basement levels with an underground tunnel, as well as an overhead link bridge connecting to the neighbouring Khoo Teck Puat Hospital.

Innovative Construction Methods

YCH adopted the top-down construction method where the construction of the basement and the superstructure proceeded simultaneously. YCH is also the first public hospital to use the precast column structural steel system that combines the use of reinforced concrete columns and structural steel beams in its construction. By leveraging BIM and innovative construction methods, the project avoided abortive works on site through the early identification and resolution of design conflicts and had reduced its construction schedule by two months.
To help firms reap the full benefits of BIM and grow their BIM collaboration capabilities beyond just modelling, the new BIM Fund V2 was released in July 2015.

The fund will help BIM-ready firms defray part of the costs in training, consultancy, software and hardware.

To be eligible, applicants will need to submit a joint application together with another firm of a different discipline. Come September 2016*, the BCA BIM Fund V2 application will be going ONLINE. Steps on how to do so is shown below.


*This is the estimated launch period. Do check our website for the latest updates!

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**Team Collaboration and Sharing of Information**

3D models were shared between the consultants, the main contractor and the specialist contractor for structural analysis and design, coordination and visualisation and even fabrication of the steel structure and quantity take-off for the assembly part list.

Sub-contractors for the MEP works, lifts and escalators, water features, interior fit-outs, softscape works and facade created 3D models for their respective works. They were integrated with the main models for coordination, construction planning and sequencing. Sub-contractors’ modellers and engineers were co-located at the main contractor’s office. This enabled information to be accessed, shared and coordinated more effectively.

**Engaging End Users**

The team actively engaged end-users such as dentists, nurses and staff from the hospital planning department of Alexandra Health System in discussions.

3D models were presented using the iPad via the BIM 360 Glue app and their feedback helped improve the functional layout of spaces such as the dental consultation room.

**Innovating and Re-engineering with New BIM Technologies**

iPads and BIM 360 Glue were used on site by the project team to pull information from the 3D models for discussions and verification. The main contractor also explored and tested out technologies for virtual reality walkthroughs, site layout and navigation tools, 3D scanning and more. This helped overcome the challenges faced and allowed the re-engineering of processes during the construction phase.

**Coordination between different sub-contractors’ models**

(Images credit: Fujitec Singapore & WaterCraft Engineering)

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**Before Applying**

1. Meet the **PROJECT SIZE** and **NUMBER OF DISCIPLINES REQUIREMENTS**.
2. Prepare all supporting **DOCUMENTS** - quotations and details for training, software, hardware and consultancy services, where applicable.
3. Arrange for pre-consultation and present to BCA on proposed **SCOPE OF PROJECT, BIM METHODOLOGY and EXPECTED OUTCOME**.

**Applying for the Fund Online**

1. **Submit** APPLICATION **ONLINE** via Business Grant Portal (BGP) at https://www.businessgrants.gov.sg together with supporting documents.
2. **Receive** your application outcome via email within **21 WORKING DAYS** after the pre-consultation presentation.

**Upon Successful Application**

1. **View the LETTER OF OFFER** online at BGP.
2. **Accept** the offer online at BGP **WITHIN 1 MONTH**.
3. **Start your CONTRACT OF SERVICE**.
4. Keep all **FINANCIAL RECORDS** (e.g. receipts, invoices etc.).
5. **BCA Officer to attend AT LEAST 1 PROJECT COORDINATION MEETING**.

**Claiming of Funds**

1. **Submit** your **CLAIM FORM, FINANCIAL AND FINAL REPORT** and **ALL SUPPORTING DOCUMENTS**.
2. **Once BCA approves** your final report and claim application, you will be reimbursed within 3 months.
STRATTS CONSTRUCTION’S PRODUCTIVITY AND INNOVATION WEEK 2016

It was the first ever ground-up event initiative by a company to spur productivity. Straits Construction’s inaugural Productivity and Innovation Week, held from 29 March to 1 April 2016, hosted productivity workshops, lectures, exhibits and a productivity challenge. These activities brought their employees together to rethink and improve processes, and to work towards more positive working environments.

The event reflected the company’s strong commitment towards driving innovation and productivity. The ground-up initiative was organised to create a positive work environment where the employees were encouraged to embrace innovative thinking and productivity mindsets.

Dr John Keung, BCA CEO, was invited to grace the event as the Guest of Honour. He delivered a speech at the closing ceremony on the second productivity roadmap, which emphasised three fronts:

• Developing workforce capabilities
• Embracing impactful productive technologies and approaches (such as Design for Manufacturing and Assembly)
• Adopting productivity mindsets with active industry collaboration (such as using Building Information Modelling and Virtual Design and Construction)

Mr Wong Chee Herng, CEO, Straits Construction, agreed that increasing productivity was the way forward. He added that Straits Construction has invested heavily in productive machinery and equipment, and has also ventured into new technologies.

Winners of the Productivity and Innovation Challenge

In addition, 10 entries were shortlisted in the Productivity and Innovation Challenge and then exhibited. Among them, the prefabricated easy install metal staircase protection, passenger and material hoist call button and rolling tape particularly impressed judges.

The first prize went to the rolling tape project, a practical and handy tool for masking tape installation. Many observed that the project proved how productivity could be vastly improved with just a very simple innovation.

Companies Can Take the Lead

Dr Keung commended Straits Construction’s initiative. He remarked that progressive builders like Straits Construction would gain an advantage in the enhanced public procurement system, which aims to incentivise firms in their productivity drive.

Straits Construction has taken the lead to support the transformation of the built environment into an advanced and productive one. We encourage more to do the same in our journey towards higher productivity.

Mr Anton Moses, Senior Manager (Projects), Straits Construction, was the Organizing Committee Chairman of Productivity and Innovation Week 2016. He gave a welcome speech to 150 colleagues and business associates to mark the opening of the event.
To create awareness on the performance requirements (see sidebar) for Prefabricated Bathroom Units (PBUs) and the Prefabricated Pre-finished Volumetric Construction (PPVC) of in-built bathrooms, BCA’s Construction Productivity Centre organised an industry sharing session on drywall boards for wet-area use.

Over 100 industry participants comprising developers, architects, engineers, contractors and PBU suppliers attended the session held on 26 January 2016 at JEM. Speakers from Promat Building System, USG Boral Singapore, Buildables Pte Ltd and Slide & Hide (S) Pte Ltd presented on the different types of drywall boards suitable for PBUs and PPVC in-built bathrooms.

The participants agreed that it was a fruitful session and expressed appreciation to BCA for organising the session. It was indeed a wonderful opportunity for the industry to come together, network, and exchange knowledge and experiences.

**PBU Acceptance Framework**

Under the PBU Acceptance Framework, PBU suppliers are to submit the PBU details to the PBU Screening Panel.

Once cleared, the suppliers would be issued an In-Principle Acceptance (IPA) via the Building Innovation Panel (BIP). Thereafter, suppliers must proceed with Part 1: Documentation Audit of the PBU Manufacturer Accreditation Scheme (PBU MAS) before commencing production works.

For more information on the test standards, requirement and accreditation scheme, please visit the following websites:

1) PBU BIP Acceptance Framework, Test Standards and Performance Requirement:

2) PBU Manufacturer Accreditation Scheme (PBU MAS):
**Productivity Enhancement**

**Methods**

**Processes**

**BCA Academy**

**2016 Intake**

**BCA-SMU-WDA Advanced Management Programme on Productivity and Leadership Development**

7th intake commences on 22 July 2016 / Application closing: 17 June 2016

- Programme aims to provide participants with a broader strategic vision of the business environment to advance the built environment industry.
- Designed and facilitated by the Singapore Management University (SMU).
- Suitable for senior executives who would like to manage performance excellence, business transformation and organisational growth to deliver a quality and sustainable built environment.
- For more details, visit rps.smu.edu.sg/bca-smu-wda-amp.

**A 6-MODULE PROGRAMME WHICH INCLUDES LECTURES, SITE VISITS AND A 6-MONTH PRACTICUM CONDUCTED IN SINGAPORE AND STANFORD UNIVERSITY OVER A 9-MONTH PERIOD.**

**Stanford CIFE-BCA Advanced Management Program**

**Virtual Design and Construction**

Commcences early August 2016 in Singapore.

- Programme covers theories of Virtual Design and Construction (VDC) as well as a hands-on approach in VDC implementation.
- The use of VDC has been proven to improve performance, productivity and profitability in many projects by enabling more effective design processes, minimising changes, errors and rework for information, resulting in labour, time and cost savings.
- Suitable for Senior Managers and Head of Departments who are directly involved in BIM, VDC or other productivity drives in their respective projects and organisations.

For interested parties, please email to yong_wee_hau@bca.gov.sg.

**ANNUALIZED BY THE UNIVERSITY OF NEWCASTLE, AUSTRALIA.**

**Bachelor of Construction Management (Building) (Hons)**

Full-Time 3rd intake commences on 30 July 2016 / Application closing: 7 July 2016

Part-Time 4th intake commences on 3 April 2017 / Application closing: 10 Jan 2017

- Recognised as a professional qualification by the Construction Registration Board (CRB).
- Recognised as an academic qualification by PSIR (Incorporation Surveying).
- Accredited by AQF, AQSO, QSIB and BQS.
- Relevant Diploma graduates will enjoy advanced standing of up to 1.5 years.
- Scholarship/Financial aid available.

For more details, visit www.bca.edu.sg/bcm.aspx.

**WTU Funding may be available. Visit www.bca.edu.sg for more details/registration.**
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<td>BCA Academy, 200 Braddell Road</td>
<td>BCA Academy</td>
<td>Info: Mary Ann Samaniego, Tel: 6730 4539, Email: <a href="mailto:mary_ann_samaniego@bca.gov.sg">mary_ann_samaniego@bca.gov.sg</a></td>
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<td>BCA Academy, 200 Braddell Road</td>
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<td>BCA Academy, 200 Braddell Road</td>
<td>BCA Academy</td>
<td>Info: Mary Ann Samaniego, Tel: 6730 4539, Email: <a href="mailto:mary_ann_samaniego@bca.gov.sg">mary_ann_samaniego@bca.gov.sg</a></td>
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<td>Info: Mary Ann Samaniego, Tel: 6730 4539, Email: <a href="mailto:mary_ann_samaniego@bca.gov.sg">mary_ann_samaniego@bca.gov.sg</a></td>
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<td>BCA Academy, 200 Braddell Road</td>
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<td>Info: Liu Ziwen, Tel: 6730 4527, Email: <a href="mailto:liu_ziwen@bca.gov.sg">liu_ziwen@bca.gov.sg</a></td>
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<td>BCA Academy, 200 Braddell Road</td>
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<td>Info: Mary Ann Samaniego, Tel: 6730 4539, Email: <a href="mailto:mary_ann_samaniego@bca.gov.sg">mary_ann_samaniego@bca.gov.sg</a></td>
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### FOR ENQUIRIES, PLEASE CONTACT:

**BCA ACADEMY**

TEL: 6248 9999  EMAIL: bca_academy@bca.gov.sg

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**CONSTRUCTION PRODUCTIVITY AND CAPABILITY FUND (CPCF) COURSES**

- Certificate in Interior Finishing Coordination
- Certificate in Pavement Construction and Maintenance
- Certificate in Precast Concrete Construction Supervision
- Certificate in Waterproofing Supervision
- Certificate in Building Measurement
- Certificate in Geotechnical Instrumentation for Supervisors
- Certificate in Levelling and Setting Out
- Certificate Course for Structural Steel Supervisors
- NBQ in Project Supervision
- Higher NBQ in Project Supervision
- Advanced NBQ in Project Supervision
- NBQ in Supervision and Coordination of M&E Works
- Higher NBQ in Supervision and Coordination of M&E Works
- Advanced NBQ in Supervision and Coordination of M&E Works
- NBQ in Operation & Maintenance
- Higher NBQ in Operation & Maintenance
- Advanced NBQ in Operation & Maintenance

The additional courses are:

- Certificate courses (PMETs)
- Certificate course in BIM Modelling
- Certificate course in BIM Management
- Project Management for Professionals in the Building and Construction Industry (in collaboration with SCAL)
- Construction Productivity Management (in collaboration with SCAL)
- Design of Precast Concrete Structures for Engineers
- Workshop on Site Management of Precast Concrete Construction

For enquiries, please contact:

**BCA ACADEMY**

TEL: 6248 9999  EMAIL: bca_academy@bca.gov.sg
CONSTRUCTION PRODUCTIVITY AND CAPABILITY FUND (CPCF)

WORKFORCE TRAINING AND UPGRADING (WTU) SCHEME
Facilitates upgrading of workforce at all levels by co-funding up to 90% of the cost for selected skills assessment and training courses*

MECHANISATION CREDIT (MECHC) SCHEME
Provides assistance to builders to defray up to 70% of equipment costs*

PRODUCTIVITY INNOVATION PROJECT (PIP) SCHEME
Provides assistance to companies to defray up to 70% of the cost for adopting more productive work processes*

SCHOLARSHIP AND SPONSORSHIP PROGRAMMES
In partnership with built environment firms, BCA will co-fund scholarship and sponsorship programmes at the undergraduate, diploma, ITE, supervisory and foreman levels*

BUILDING INFORMATION MODELLING (BIM) FUND
Co-funds up to 70% of the supportable cost incurred by firms when leveraging BIM technology to improve multi-disciplinary collaboration*

*Terms and conditions apply.

For more information, please visit www.bca.gov.sg/CPCF/cpcf.html

Building and Construction Authority
We shape a safe, high quality, sustainable and friendly built environment