

### Part A: General Information

1. Your organization's main business? ( ) A. Architectural firm; B. Structural engineering firm; C. MEP engineering firm; D. General construction firm; E. Trade construction firm; F. Facility management firm; G. Others, please specify\_\_\_\_\_.
2. Your organization's BCA financial grade? \_\_\_\_\_ (if not applicable, please go to next question).
3. Years of your organization's BIM adoption experience? ( ) A. 0; B. 1-3; C. 4-5; D. 6-10; F. >10.
4. Your discipline? ( ) A. Government agent; B. Developer; C. Architect; D. Structural designer; E. MEP designer; F. General contractor; G. Subcontractor; H. Supplier/Manufacturer; I. Facility manager
5. Years of your work experience in the construction industry? ( ) A. 5-10; B. 11-15; C. 16-20; D. 21-25; F. >25.

### Part B: Perceptions on NVA BIM implementation activities and their resulting wastes

6. How would you evaluate the level of agreement on the following activities being NVA according to one of your past or ongoing building projects. (1 = strongly disagree, 2 = disagree, 3 = unsure, 4 = agree, and 5 = strongly agree).

#### *Conceptualization*

- Lack of involvement by government agency
- Inadequate project objectives and performance metrics set by owner
- Owner resists to use BIM in the whole project
- No reward/risk sharing arrangements among major stakeholders are set by owner
- Lack of involvement by engineers (not appointed)
- Lack of involvement by general contractor (not appointed)

#### *Schematic design*

- Lack of involvement by government agency
- Lack of joint control and agreement on project targets and metrics by major stakeholders
- Architect, engineers, and contractors do not work together in design modeling
- Architect does not share its complete model with engineers
- Architect and engineers do not submit their schematic design models for regulatory approvals
- Engineers not involved early in this phase to contribute in architectural modeling
- Lack of involvement by general contractor and key trade contractors to contribute site knowledge (not appointed)
- Lack of involvement by manufacturer/supplier (not appointed) to contribute fabrication knowledge
- Lack of involvement by facility manager (not appointed) to contribute operations and maintenance knowledge

#### *Design development*

- Lack of involvement by government agency
- Insufficient design review and feedback by owner
- Architect, engineers, and contractors do not work together in design modeling
- Architect does not share its complete model with engineers and contractors
- Coordination of building systems is deferred until construction phase due to unavailable trade contractor input until then
- Lack of involvement by general contractor and key trade contractors to contribute site knowledge (not appointed)
- Construction model is not developed due to unwillingness of architect and engineers to share their BIM models
- Lack of involvement by manufacturer/supplier (not appointed) to contribute knowledge of material selection, transportation, site erection, and so on

- Lack of involvement by facility manager (not appointed) to contribute operations and maintenance knowledge

#### ***Construction documentation***

- Not fully defined and coordinated between architectural, structural, and MEP design models
- Insufficient communication between architect and engineers
- Information such as bill of materials, assembly, layout, detailed schedule, testing and commissioning procedures is not documented after design
- Long-lead items are not identified and defined during design for early procurement
- Shop drawing process is not merged into design as contractors and manufacturer/supplier cannot document construction intent
- Prefabrication of some systems cannot start as design is not fixed

#### ***Agency permit/Bidding/Preconstruction***

- Architect and engineers only pass two-dimensional (2D) drawings or incomplete three-dimensional (3D) BIM models to contractors and manufacturer/supplier
- General contractor has to re-build BIM model based on insufficient documents from designers
- General contractor extends 2D drawings (without BIM) from designers to guide construction

#### ***Construction (including Manufacture)***

- Owner and designers enable changes during construction
- Architect and engineers need long time to respond to contractors' RFIs as their design models cannot directly guide site work
- Architect and engineers do not update their design models
- Contractors and manufacturer/supplier have excessive RFIs and paperwork
- General contractor communicates insufficiently with other key stakeholders
- Low proportion of building components in superstructure and fitting out using off-site manufacture
- Congestion and many interfaces on site
- Incomplete 2D drawings or 3D BIM models for trade contractors and manufacturer/supplier

#### ***Handover/Closeout/Operations and maintenance***

- As-built BIM models are not handed to facility manager who uses insufficient levels of detail 2D as-built drawings
- Many disputes/claims/litigations between general contractor and owner and designers
- Facility manager does not have sufficient BIM-based design and construction information for operations and maintenance

7. How would you rate the frequency of occurrence (1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always) and impact on productivity (1 = insignificant effect, 2 = minor detrimental effect, 3 = moderate detrimental effect, 4 = significant detrimental effect, and 5 = catastrophic effect) of the resulting wastes in the same project.

- Defects
- Requests for information
- Reworks/abortive works
- Waiting/idle time
- Change orders
- Activity delays
- Overproduction/reproduction
- Transporting/handling materials
- Unnecessary inventory
- Excess processing beyond standard
- Unnecessary movement of people and equipment
- Design deficiencies (errors, omissions, additions)
- Safety issues (injuries)