

# 4D construction learning environment

## virtual tour making

### 1. Project planning

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# 1 Overview

This guide is for project teams contemplating adding to the 4D construction learning environment, curated by Dr Chris Landorf, School of Architecture, at The University of Queensland. The main points to consider in initiating, establishing and implementing such a project are outlined here.

## 2 Scoping the project

Establish likely coverage

- who will use the tool for what and how (programs, courses, intended learning activities)
- the development time line (lead time for project establishment, the actual building construction period to be photographed, image and document processing testing)
- budget

During the preparation and implementation of the project, these key decision points will need re-visiting, possibly several times, in light of resource availability as well as personnel turnover.

### 2.1 Learning activities

A reasonably detailed list of potential learning activities to be supported by your 4D construction learning environment is a priority, because this will drive:

- focus and content of photography
- development of supporting resources

Ideally, there should be a small library of likely activities for each discipline (by program and course), noting:

- desired learning outcomes
  - theoretical content and practical skills
- types of task most likely to support this
  - individual, group work or teamwork
  - resources and tools needed for the task
- assessment strategy.

### 2.2 Photographic survey plan

The most useful approach is to sketch out a preliminary storyboard, which can later be combined with construction site plans to map out and agree on likely camera positions (nodes).

Bear in mind that documenting all aspects of the construction process as frequently as possible can reduce the effectiveness of the virtual tour as a learning tool because:

- important elements and progress on site can become imperceptible
- navigating through the site, once the photographic data have been incorporated into the virtual tour application, will prove difficult and time-consuming.

Where learners would benefit from watching certain processes with minimal time gaps between views, consider taking video or a series of short time-lapse images of that process to be used as an additional resource.

### 2.2.1 Survey focus

Determine key areas of interest (from learning activity objectives) that will be subjects of the photographic surveys. Things to consider might include:

- ground works and retaining elements
- structure and bracing
- reinforcement design and post-tensioning layout
- concrete slab construction and service penetrations
- installation of basement and roof plant
- heating, ventilation and air conditioning systems
- wall framing and construction
- facade installation
- architectural details
- significant architectural features and spatial qualities
- finishes and landscaping
- environmental or live building aspects.

## 2.3 Construction documents

At a minimum for a 4D virtual tour, you will need access to the site plan, construction program and 'for construction' building floor plans and other available drawings to refine the photographic storyboard and plan survey nodes as well as compile resources to support learning activities.

### 2.3.1 Node placement and minimaps

Agree a preliminary plan with the construction management team/site manager about the:

- likely camera positions (survey nodes) over life of project
- frequency of surveys
- access issues to be considered.

The site and floor plans also form the basis of the 'minimaps' used as the main navigational tool in the published version of the 4D tour of the project site. (See Node mapping guide).

### 2.3.2 Other resources

Consider which 'other documents' would be desirable resources for learners and make lists of:

- topics of likely interest
- document types to be collected and/or emulated.

As with the photographic surveys, it is important to be selective in order to minimise collection, storage and transfer time costs for the project as well as the navigation and download costs for end-users.

## 2.4 Intellectual property and confidentiality

When your initial project plan has been drawn up, you will need to:

- obtain permissions from intellectual property rights-holders for access to and use of material such as
  - plans, drawings and specifications
  - project administration documents (reports, meeting minutes, etc.)
- make arrangements for preserving confidentiality of
  - identity for individuals and organisations represented in the material as well as on site during photographic surveys
  - 'commercial in confidence' items not covered by the assignment of intellectual property rights to the client
- arrange actual access to documentary archives (login, etc.)
- make arrangements for sign-off by document providers.

## 3 Estimating resources and costs

The overall cost of producing a 4D construction site virtual tour learning environment can be tailored to meet limited funds (for instance, a fixed grant) by restricting frequency and coverage of the photographic surveys and taking a disciplined approach to collection of supporting construction documents. Additional learning resources, such as video interviews and time-lapse photography of specific processes, are technically optional, so best planned after the basic budget needs have been calculated.

Do not try to cut costs by skimping on personnel training in survey photography, image processing and data collection or using elderly computing equipment for image processing.

### 3.1 Equipment and software

The project will need access to a variety of equipment, software, hardware, and digital storage, which may need to be purchased (see Equipment Guide).

- Photographic equipment
- Image processing software licences and multi-core, high RAM PC or equivalent
- Tablet/ notebook for logging survey and node information on site
- Large storage space on a fast access file server (with auto back-up)
- Arrangement for very large file transfer facility to UQ
- Other
  - full personal protection equipment (PPE) (construction helmet, protective glasses, gloves, high visibility long sleeve shirt, long trousers and steel-cap boots).

### 3.2 Staffing costs

Count on at least two part-time assistants (e.g. students) over the project period. For a moderately sized project, allocate 1.5-2 FTE days per survey (photography, image processing and resource inventorying), with the time rotated/shared between assistants. Surveys should be spaced to coincide with events of interest on site but usually not more than once per fortnight. Allow for training replacement personnel during project life.

- Training
  - valid construction induction card (a White construction card in Australia)
  - site induction and sign-on register
  - photographic equipment and virtual tour photography (consider hiring in a professional photographer with virtual tour experience for initial workshop, allow 1-2 days for practice and test shoots)
  - image and document handling and processing (allow at least one day for practice sessions with software and data handling e.g. folder locations, files naming conventions)
- Survey photography (see Photography guide for details)
  - A survey can be done by one person, once procedures are established
  - All nodes to be covered in the survey must be visited for photography on same day (best time for light, least shadow, is 10:00-14:00)
  - Allow time at start for survey preparation (site sign-on, confirming nodes for day with site manager, setting up camera equipment, checking exposure levels)
  - Time taken will increase with increase in number of levels and nodes
  - Allow time post-survey to download images from camera SD card to appropriate folders (following folder structure and name convention)

- Image processing (see guide for workflow details)
  - Time for this is minimised by
    - taking good quality images at each node
    - ensuring survey and node folder names follow 4D folder structure and naming convention from start
    - using multi-core PC with adequate RAM and fast access storage
    - batch processing image stitching and panorama rendering as soon as possible post-survey
- Other documents and resource production (see Resource Inventory guide)
  - Base on learning activities rather than copies of everything as
    - Filenames may need editing (e.g. to remove spaces or other characters)
    - Contents may need redacting
    - All documents and other resources need to be inventoried (using ResourceInventory.xls template)
  - Best collected and/or produced in tandem with survey photography and stored in 4D folder structure from start.
- Data transfer to UQ
  - Time to upload data for transfer to UQ depends on zip file size (e.g. approx 1 GB for a virtual tour with 9-10 nodes), available bandwidth and traffic load. The process requires monitoring
  - Plan for regular 'small' transfers (one zipped survey at a time), start early in day and don't use that PC for other activities while upload in progress.

### 3.3 Building the new online site

4D construction learning environment sites are currently administered and maintained by eLIPSE in the EAIT Faculty at UQ. While much of the work to build and maintain a new site is automated (via build scripts), some tasks, especially during the survey upload period, require staff intervention. These costs need to be established and included in the budget.

A first requirement is detail of the scope and length of the project i.e. how many surveys over what period, the volume and type of other resources to be handled, some estimate of the storage requirements and so forth.

Once the online site has been created and tested, with around 3 months data, consider periodic updates (every 3-6 months) to minimise the re-build costs.