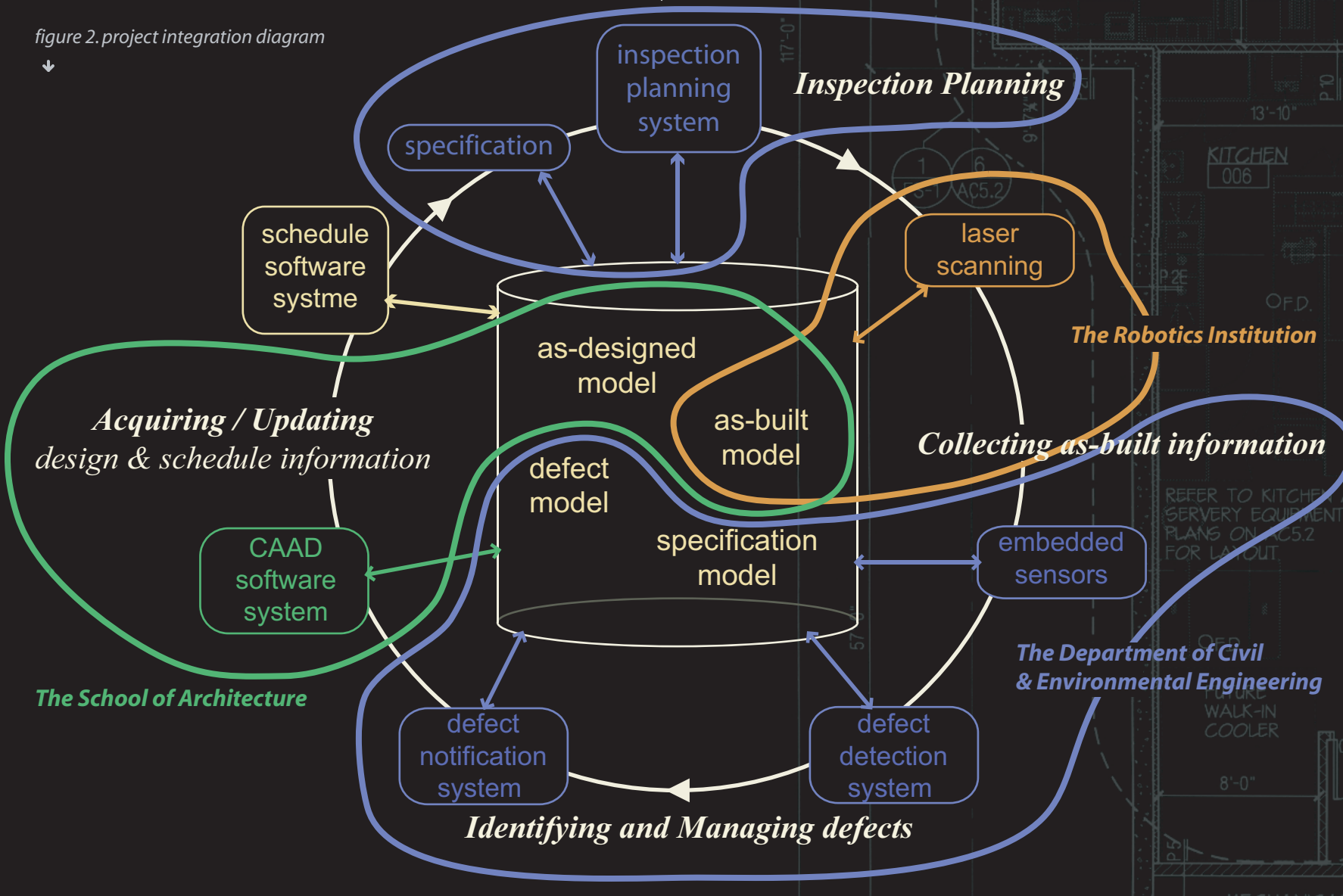


figure 1. building life-cycle. refs: Gielingh + CSI (Construction Specification Institutes)

figure 2. project integration diagram



Digital Diary:

A building is 'something that is built,' as well as 'the act, process, art, or occupation of constructing' — in this research we examine building as a whole both in space and over time.

A **digital diary of a building** is a **document** and a **plan** — things, collectively, concepts, designs, decisions, activities, indeed, the whole gamut of entities associated with a building, that have happened, and things that one plans to do.

Associated with documents is the act and manner of *documenting*, which has changed over time and changes in way information is captured and processed. *Current technology brings into practice novel methods of capture and measurement.* Laser scanning is one such exemplar. Sensor information is another. What these methods offer is the capability for gathering information about a building in chronological fashion, and subsequently, in basing design and other building decisions on a reality other than conception.

Premise:

- Each building has a story to tell
- ... a story that varies as the *story tellers* vary
- ... a story that varies as the *listeners* vary
- ... and a story that varies as the *readings* vary

This story is a chronicle of change from a vision through a reality and, perhaps, to a memory.

asdmCon proj. & Case Study:

The work presented here arises out of case studies from our ongoing research project, asdmCon (advanced sensor-based defect management at construction site). This collaborative project involving Architecture, the Robotics Institute, and Civil and Environmental Engineering investigates ways of integrating suites of emerging evaluation technologies to help find, manage, and limit the impact of construction defects. The focus is on the transformation of design documents, geared by technology developments in reality capture, in detecting changes between a 'previous' as-designed condition to a 'current' as-built state.

The system for active project control and management uses a core Integrated Project Model (IPM), which is continuously updated and maintained.

- The IPM currently comprises a 3D design model with specifications from construction documents, a construction process model, and an as-built model of the condition at the construction site.
- The as-designed model is obtained from a commercial parametric design software.
- Laser scanning provides accurate 3D geometric as-built information (e.g., component identity); similarly, embedded sensors provide frequent quality related information (e.g., thermal expansion).

The integration of as-built and continuously sensed information to the project model, the subsequent analysis for defects, and any consequent update to the design and schedule models enable project managers to manage defects actively. A potential benefit is in creating a history of the IPM that can be advanced to the stakeholder together with the BIM.



figure 3a-c. site condition at July 16 '04



figure 4a-f. site condition at Oct 07 '04



figure 5. as-designed model
figure 6. as-built model
figure 7. as-designed + as-built model

Representational Flexibility:

The collaboration between multiple actors from different domain interest requires that the IPM be represented in user specific ways. In order to support these different views, we are developing a system that consists of a data model, its representation captured by and structured within the *Sorts* representational schema formalism.

Quite simply, a *sort* consists of compositions of other *sorts*. At the basic level, a *sort* is a set of similar data elements. A comparison with other *sorts* invokes a comparison of respective data types, their reciprocal relationship, and overall structure. The elementary data type of *sort* is defined as a *primitive sort*, and the *primitive sorts* construct a *composite sort* under compositional operation.

Figure 8 to 10 show the three *composite sorts* ('Building Element Type + Material Usage', 'Building Story Containment + Material Usage', and 'Element Type + Building Story Containment'). These *sorts* are composed by the '+' operator on the three *primitive sorts* ('Building Element Type', 'Material Usage', and 'Building Story Containment').

Documenting in Digital Diary of a Building:

- As-designed information (from architectural service)
- + As-built information (from laser-scanning)
- + Sensor information (from construction inspector)

Reading in Digital Diary of a Building:

Flexible *sortal* representation

Planning in Digital Diary of a Building:

Appropriate response to the construction inspector by the defect management system

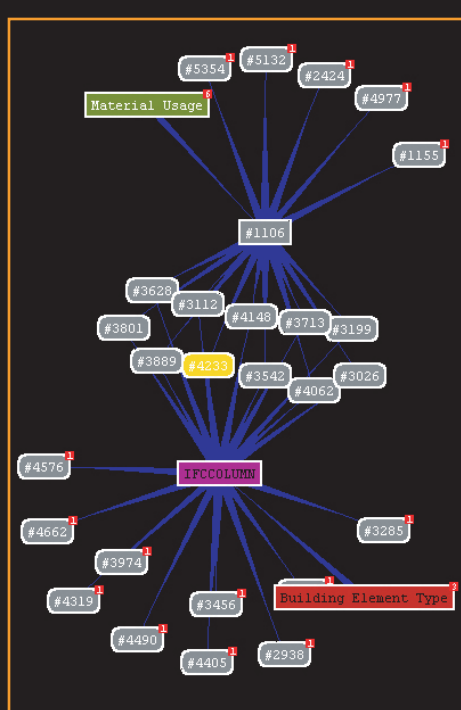


figure 8. type + mat.

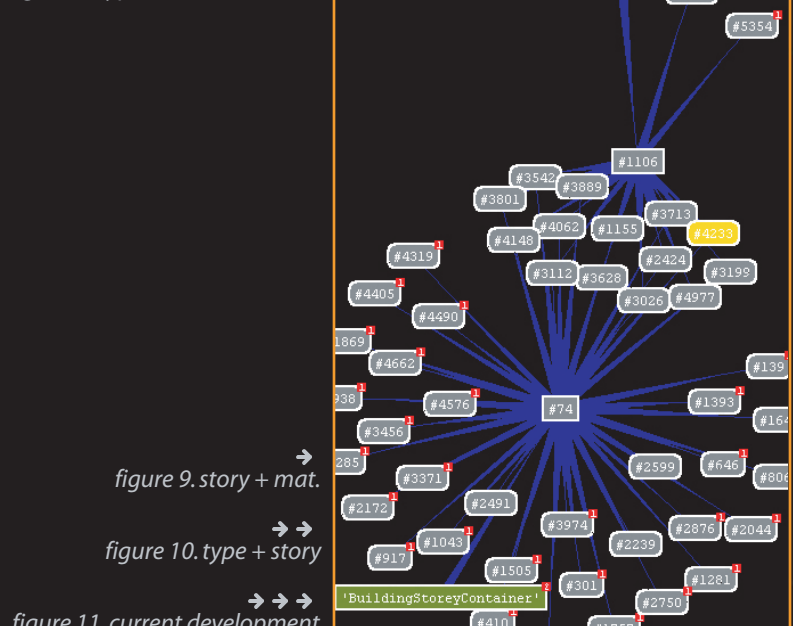
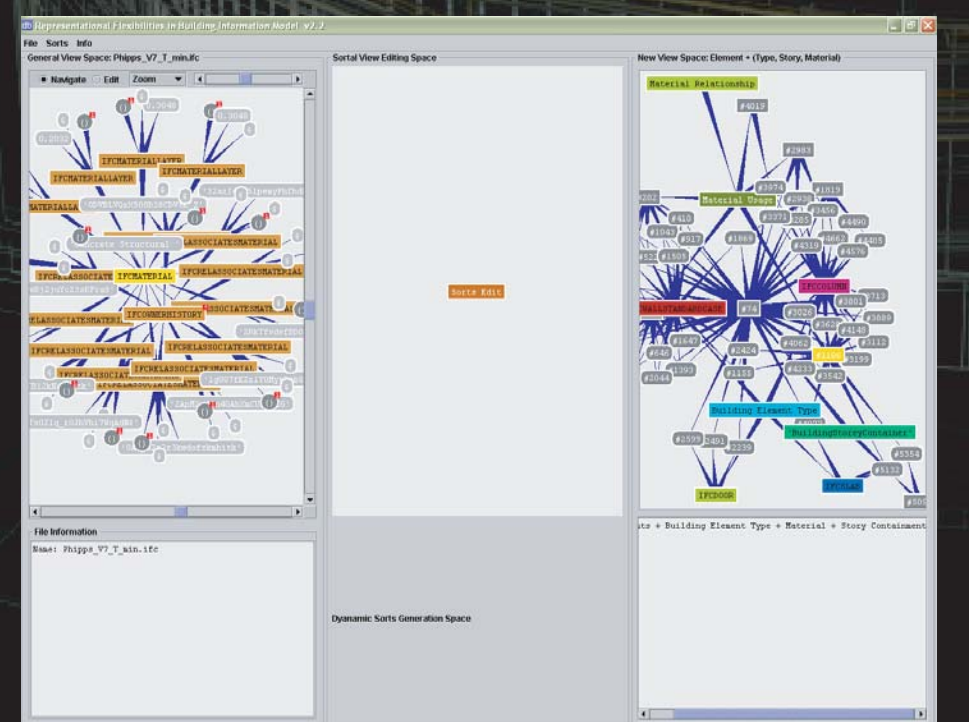
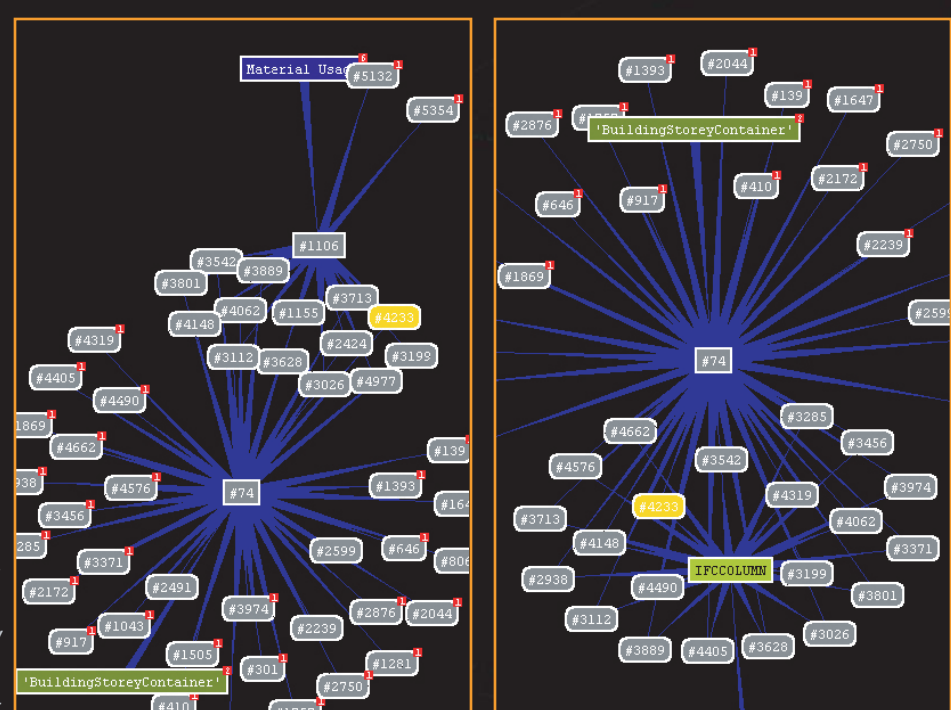


figure 9. story + mat.

figure 10. type + story

figure 11. current development



a system for retrieval and update of building information over a building life-cycle

Digital Diary of a Building

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asdmCon project is a collaborative endeavour between the school of architecture, the dept of civil & environmental engineering, and the robotics institute

asdmCon project [advanced sensor-based defect management at construction site . http://www.ce.cmu.edu/~itr/]