Using Project Information Clouds to Preserve Design Stories within the Digital Architecture Workplace

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Abstract
During the development of an architectural design a series of design stories form. These stories chronicle the collective decision making process of the diverse project team. Current digital design processes often fail to record these design stories because of the emphasis placed on the concise and accurate generation of the virtual model. This focus on an all-encompassing digital model is detrimental to design stories because it limits participation, consolidates information flow and risks editorialisation of design discussion. Project Information Clouds are proposed as a digital space for design team participants to link, categorise and repurpose existing digital information into comprehensible design stories in support of the digital building model. Instead of a discrete tool, the Project Information Cloud is a set of principles derived from a proven distributed information network, the World Wide Web. The seven guiding principles of the Project Information Cloud are simplicity, modular design, decentralisation, ubiquity, information awareness, evolutionary semantics and context sensitivity. These principles when applied to the development of existing and new digital design tools are intended to improve information exchange and participation within the distributed project team.

1. Preserving design stories within Project Information Clouds

Design stories form within architectural projects through the interweaving of design conversation, decisions and outcomes. These design stories are valuable in determining a project's current state and they increase the accessibility of information within the design team. Unfortunately, current digital architectural design tools emphasise production and communication of outcomes ahead of the preservation of conversations and decisions. To resolve this shortcoming the concept of Project Information Clouds is proposed as a means of digitally recording and maintaining these design stories. The Project Information Cloud is not a discrete entity but a set of principles. These principles when applied to the development of existing and new digital design tools are intended to improve information exchange and participation within the distributed project team. The principles that comprise the Project Information Cloud are derived from concepts similar to those that fostered the World Wide Web.

Although the architecture, engineering and construction (AEC) industry was slow to adopt digital design processes it is now undergoing rapid digital evolution. This digital migration was both a response to and an enabler of increased information processing demands. Hampering the recording of design stories during this evolution was the disconnect between the tools used to communicate and record design outcomes. Whilst digital communication through email and the Web have significantly improved the quantity of project communication[1], this data often fails to be directly or indirectly associated to the digital

design outcome in any structured way. Likewise whilst digital tools used to model architecture can record design outcomes in exacting detail, they do so in a closed, virtual environment devoid of real context. Not only does this closed environment restrict participation, it also limits the ability of those interacting with the model to comprehend design decisions. Subsequently, whilst the AEC industry currently has powerful tools for communicating vast amounts of data and recording virtual outcomes in exacting detail, it lacks a digital vocabulary for weaving these two distinct information streams into coherent and maintainable design stories.

2. Deriving value from digital architecture's design stories

Architecture is as much about personalities and decisions as it is about the eventual built form[2]. A project has multiple design story threads, each one is a subset of the personalities, decisions and outcomes contained in the overall design. The understanding of these design stories is instrumental in enabling a project team to collaborate effectively during the course of the design and construction process. Whilst of limited value at the moment of project conception, these stories appreciate over the building's life-cycle to fulfill the role of decision making aids and historical learning resources. Traditionally design stories were established through direct participation and narrated to others should the need arise. Digital design is eroding these bonds through its ability to break down geographic constraints and consolidate project information around tightly controlled, data-rich models. This has led to more distributed and efficient design processes. However, it has reduced the ability for all design participants to comprehend and in some cases take part in ongoing design stories. Ironically in an effort to improve efficiency and distribution, digital design tools may in fact be degrading the underlying strength of the design process.

The project team must be able to digitally establish, reinforce and derive value from design stories. Therefore, they must be able to participate in the linking, categorisation and repurposing of all project information, whether it be complex virtual model, conventional plan or digital message. In order for this to take place there needs to be a shift in the way design participants treat their digital archives. Digital design artifacts cannot continue to be isolated and shielded from other project data. Instead these data points and their associated meta-data should be considered as part of a larger network, which when viewed as a whole forms a Project Information Cloud. There are two challenges to overcome if discrete project data is to be treated as part of this larger meta-network. The first is the organisational and legal constraints which accompany any professional exchange of data. Whilst a Project Information Cloud will need to respect the ownership and privacy requirements of existing data, the contributed meta-data used in the establishment of design stories should be considered property of the collective project team. Communal ownership is an essential element of this meta-layer because it will ensure all parties are free to copy, preserve and build upon existing digital stories in perpetuity. The second and perhaps more difficult challenge is to overcome the dominant trend within digital architecture to record all design outcomes within a single, complex and highly regulated digital building model.

3. Why digital building models compromise design stories

To efficiently manage the increased amounts of project information, the current trend in digital architecture is to build increasingly complex and information-dense virtual models. The premise of this trend is that the more comprehensively and accurately a virtual outcome can be modeled, the more efficiently the project team will be able to manage the information and processes associated with it. This objective has seen the traditional notion

of Computer Aided Architectural Design (CAAD) evolve into the concept of the Building Information Model[3] (BIM). Unlike CAAD, which at its core is a digital extension of the drafting table[4], BIM accurately records the analytical and semantic characteristics of an architectural design within a highly structured, semi-intelligent digital model. BIM is not a fundamentally new idea and draws much of its technical inspiration from Product Model technologies proven within the aerospace, shipbuilding and manufacturing industries. This combination of CAAD and Product Model results in an architectural information modeling tool capable of utilising semantic data structures to create efficient and versatile working environments[5]. However to attain these benefits the design team must consolidate all significant architectural information around a single, highly structured BIM. Regrettably, by establishing this concise and complex point of truth, the ability of all participants to accurately record and comprehend design stories is diminished.

3.1 Complexity reduces participation

Participation is important to design stories because architecture is the physical representation of a collective decision making process[6]. BIM imposes process and knowledge barriers to participation due to its dependence on a single, complex data structure. In an effort to ensure the digital building model's integrity, the authority to manipulate the data is restricted. Even when permission is granted participants must understand and be capable of using the complicated software interfaces which govern the building model[7]. This participation bottleneck means the project team generally relies on selected participants to funnel relevant design data and decisions into the BIM. Owing to their status in the project team and close association with the digital building model, the role of digital shepherd generally falls to the architect. The architect undoubtedly is appreciative of this fact as it reinforces their place as the project's information and decision making hub. Unfortunately, those who take on this role can consciously or subconsciously filter out information vital in the recording and comprehension of design stories.

3.2 Rigid centralisation leads to editorialisation

Compounding BIM’s participation bottleneck is its rigid and often proprietary data structure. This limits the type and quantity of information capable of being stored within the digital building model. Whilst this enables consistency and efficiency it often requires third-party information to be editorialised and associated with a foreign semantic system before it can be included within the project BIM. This manipulation can potentially lead to degradation of the design stories through editorialisation and confusion. Vendors of BIM are aware of these data storage limitations and are continually extending the semantic structures within their products[8]. However this semantic extension occurs at the risk of increased complexity and also with the knowledge that no rigid structure can handle all potential data or semantic needs during the telling of design stories.

3.3 Virtual accuracy confuses practical reality

Accuracy within an architectural project is crucial but it is equally important to know where inaccuracies and tolerances lie. Architecture ultimately manifests itself in the physical environment and it is important for the project team to understand where, how and why the physical form deviates from its virtual blueprint. Traditional design representation depicted an abstract and partial description of the intended built form. In contrast BIM's capacity to depict a highly accurate, yet ultimately idealised, virtual truth risks impeding the ability of design participants to comprehend or accept the discrepancies between the virtual and

physical realms. This is an issue that becomes pronounced as rapid design changes and construction inconsistencies are introduced into the process. If those administering the BIM cannot keep pace with these changes then information will be lost, incorrect decisions made and the design stories will suffer.

It is possible that eventually BIM implementations will evolve to account for the issues raised in this discussion. However, it is highly unlikely that within the foreseeable future a single digital building model will efficiently or accurately capture a project's design stories. Therefore, to ensure accurate recording of the design stories, the Project Information Cloud must exist as a distinct yet supporting element to BIM.

4. Learning from the Web to create the Project Information Cloud

Attempting to accurately record design stories using BIM highlights the inherent problem of using a centralised, highly structured data model to capture decentralised, unstructured decision making. A better means of capturing such data is to establish a distributed Project Information Cloud where all participants can contribute equally. Fortunately, many of the underlying principles and technologies necessary to create such a space exist already within the World Wide Web. The Web is the most successful distributed digital information network currently in existence. This success stems from its ability for anyone to create and link to other relatively unstructured data in meaningful ways.

The AEC industry has not ignored the Web but it is yet to embrace its full potential within the architectural design process. As with every industry, the availability of the Web and email has revolutionised the speed and distance across which project teams can communicate and exchange data. However, the actual processes of the industry itself have yet to be considerably influenced by the Web's principles or technologies. Project intranets have been adopted in a limited fashion within the AEC industry. However, these have primarily acted as digital extensions of traditional filing cabinets rather than as new methodology for collaborative design[9]. Whilst these tools can be valuable management and auditing aids, their centralised nature and the fact they are controlled by one group of design participants generally relegates their role to digital document manager for a specific project team or organisation. If implementations of the Project Information Cloud are to be based on similar technologies then they must overcome these shortcomings. This can be achieved by adhering to a common set of principles which emphasise decentralisation and ubiquitous data formats that all participants can utilise. Establishing a common set of principles will ensure that design stories can be created and openly syndicated amongst the distributed project team.

5. The principles of the Project Information Cloud

For the Project Information Cloud to be established seven guiding principles should inform the methodologies and technologies that constitute it: simplicity, modular design, decentralisation, ubiquity, information awareness, evolutionary semantics and context sensitivity. These principles are inspired by the concepts that have driven development of the World Wide Web[10] yet reflect the objective of the Project Information Cloud to be a common, distributed environment for exchanging design meta-data and preserving cohesive design stories.

The principles of simplicity, modular design and decentralisation are intended to ensure implementations of the Project Information Cloud are capable of accommodating the largest

and most fragmented project teams. The principle of simplicity aims to ensure that the underlying data formats and structures that form the Cloud's fabric are easy to understand and replicate. This principle will ensure a broad range of digital design tools can evolve to interact with this space and the design stories it contains[11]. The principle of modular design aims to ensure that undue influence cannot be exerted by a single participant or software vendor. To achieve this, any component of the Project Information Cloud should be able to be replaced by a similar, independently developed component. The centralisation of digital information is a key inhibitor to storing design stories within the Building Information Model. To avoid this problem the principle of decentralisation declares that the Cloud cannot be formed around, or rely upon, a specific digital information source. Within this space all points of data are of equal significance to ensure scalability and equal participation by all project members.

The principles of ubiquity, information awareness, evolutionary semantics and context sensitively are intended to promote the intelligent distribution of design information throughout the project team. The principle of ubiquity should influence the nature of the digital information exchanged. Rather than stipulating data formats the emphasis of the Project Information Cloud should be on identifying the most common formats available within each project team. As this data is referenced in the Cloud, the principle of information awareness will then ensure that these changes are efficiently syndicated throughout the design team. The principle of evolutionary semantics states that the taxonomy of the Project Information Cloud must be capable of changing[12]. This will assist in meeting the diverse and shifting classification requirements of the design stories. Finally, the principle of context sensitivity ensures that design team participants are only presented with information that is appropriate for their role or the project's current state. Through the embodiment of these seven principles implementations of the Project Information Cloud will be successful in digitally recording a project's design stories.

6. Conclusion

Design stories are a valuable outcome from the architectural process. Despite this, project teams lack the ability to easily weave digital information streams into cohesive design stories. The current trend towards centralised Building Information Models has further degraded design stories as these models impose barriers to participation and rigid semantic data structures. The concept of a Project Information Cloud is proposed as a means of allowing participants to record design stories within a meta-data layer that inherits properties of the World Wide Web. By learning from the underlying lessons of the Web the AEC industry can position itself to evolve its digital methodologies and tools. This will enable the formation of Project Information Clouds. Once in place these clouds should improve the project team's ability to digitally record design discussion and its relationship to the Building Information Model. It is envisaged that the Project Information Cloud will provide AEC professionals with a more capable means of utilising their design stories for problem solving and collaboration.

Endnotes

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