FROM ABSTRACT DATA MAPPING TO 3D PHOTOREALISM: UNDERSTANDING EMERGING INTERSECTIONS IN VISUALISATION PRACTICES AND TECHNIQUES

Visualization Research Unit, Birmingham Institute of Art and Design, 19 June 2007

User Generated Content Mapping: The Evolution of Form in the Cistercians in Yorkshire Project

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INTRODUCTION

The Cistercians in Yorkshire project was chosen for the 'Abstract Data Mapping to 3D Photorealism: Understanding Emerging Intersections in Visualisation Practices and Techniques' event in order to highlight specific practises of visualization which are readily transferable across a number of diverse subject areas within the humanities whilst holding cross-domain significance.

The process of mapping out and positioning all the distinct phases of visualisation onto a single slide where they could be seen in overview (FIGURE 1) produced a number of interesting insights.

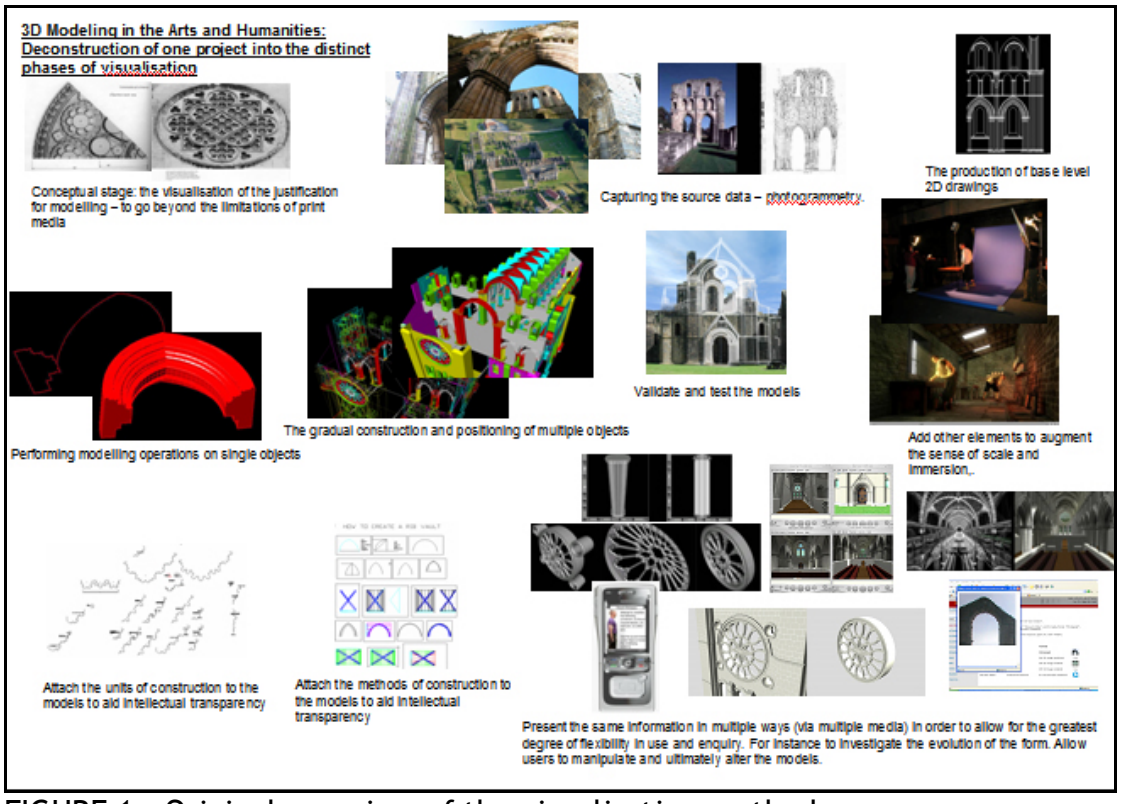

FIGURE 1 – Original overview of the visualisation methods

Primarily this diagrammatic mapping out of the visualization methods led to the realisation that such methods can invariably be represented by traditional tree structure formations with the usual parent/child nested relationships. For example if virtual cultural heritage reconstruction is considered to be the parent *methodology* then the children from that relationship could be (among others) the visualization *techniques* of data capture and 3d modelling (FIGURE 2). The distinction in this instance between visualization methodologies and their component visualisation

techniques is intended to be useful for promoting dialogue and relationship building.

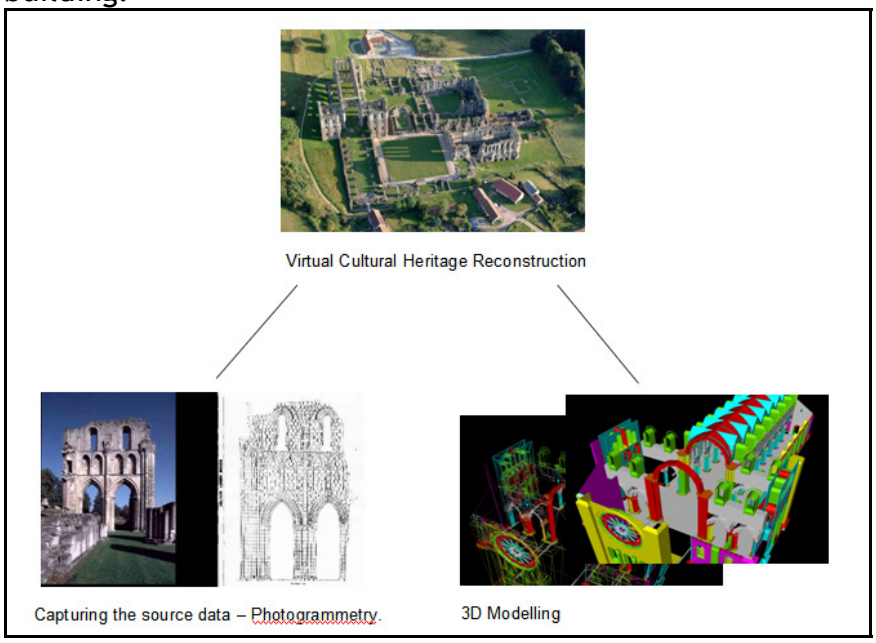

FIGURE 2 - Parent/child nested relationships of visualisation

OBJECTIVES

The main objective of the project was to question whether more can be learnt about a specific building or style of architecture if it is possible to interact with the source data in ways that are not possible either on site or via traditional media. The capacity of print to supply the entire set of reasoning that leads from the design of the 2D plans to the final 3D form is usually restricted by the authors prescribed forms of analysis. As a result the opportunity to query the data, at the junctures of its development which are specific to the individual researchers concern is lost.

The key research issue is how to make models that answer questions. In order to contribute to current academic debate it is essential that access to the source material and supporting evidence for every reconstruction is established and maintained. The whole range of information that might be encountered in the *process* of the objects lifecycle must be communicated as an integral part of the *product*. This information provides intellectual transparency as well as the basis for authenticity. Inheritance and the implicit structural hierarchy of the reconstructions are utilised to allow the visual desegregation of a design into its original elements - where the output of one phase can be seen as the input to another.

The ability for users to have an active hand in the construction of their own ‘take on things’ via visualisations which can be dynamically generated on the fly and ‘saved’ was considered a vital element contributing to effective learning outcomes. What helps lead to the cross-domain significance of the project is this dynamic creation of visualisations by the user. The visualisation methods and techniques that produce the dataset and the visualisation methods that allow the audience to interrogate that dataset

are equally important and lead significantly to a cross pollination of process and product based modelling. The processes which result in this user generated content will be described and mapped out.

DEVELOPMENT PROCESS

A wide variety of visualisation procedures were used to create the content for the web and mobile based application. The first phase of development involved recording the source data (the physical remains from five archaeological sites) in a number of ways. These ranged from the process of photogrammetry (a visualisation technique where geometric coordinates are determined by measurements made in two or more photographic images taken from different positions) to locating and piecing together fragments of masonry in conceptual and physical space. The recording of architectural mouldings using profile gauges is a physical process (real world data) which produces two dimensional cross sections of geometry (abstract data) which are then used as 'input' for a further level of transformation which takes place within virtual space. So at this level alone it is easy to see how each method/process/technique needs to be unpacked and how parent/child relationship representations are useful for understanding intersections within such visualisation practices.

The photogrammetric process resulted in hard-copy 2D prints that were scanned and scaled into an industry standard modelling package (AutoCad). They were then overdrawn to provide a base set of reconstruction drawings (elevations and ground plans). The next phase of development involved using these 2D CAD drawings to create 3D solids using a number of specific modelling procedures. The most common of these is the extrusion (FIGURE 3).

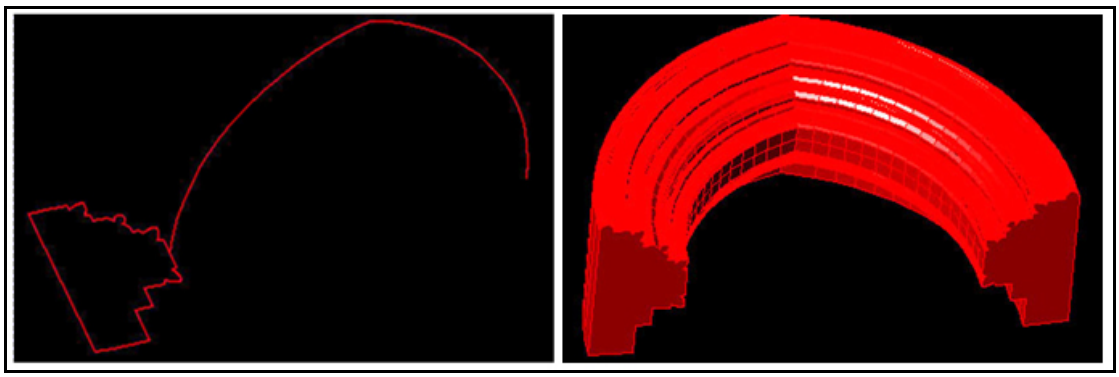

FIGURE 3 – Visualisation Technique – The Extrusion

These extrusions were used throughout the model and each time an extrusion was carried out it was documented and that documentation was tagged (metadata) to the object itself. Gradually single objects were carefully placed into position according to the ground plan and elevation survey data. There were a number of other visualisation techniques used to give a sense of scale, and to augment the sense of immersion within the models. The main technique involved the compositing of real video (of people) via green-screens into the models (FIGURE 4).

FIGURE 4 – Visualisation Technique – Compositing

That led to another level of (iterative) development – the validation of the models. This validation stage could be treated as another higher level 'parent' methodology with a variety of child techniques which that methodology houses. The main validation activity involved camera mapping (visualisation technique) the 3D wireframe models onto the actual survey data (FIGURE 5). Interestingly this activity is done during the creation of the models but can also be actively re-examined by the users who have access to all the survey data and can make their own measurements via the interface.

FIGURE 5 – Visualisation Technique – Camera Mapping

Although we could reconstruct much of the fabric of the buildings from the fragments which remain, there were sections for which there is no surviving evidence. In these cases the architectural consultant formulates a reconstruction to show the most likely appearance of the building based on analogy with other more complete sites. These levels of hypothesis once formulated are embedded into the visualisations via the use of colour coding.

HIERARCHICAL DOCUMENTATION ENABLING USER GENERATED VISUALISATION

One major part of the project was to ensure intellectual transparency. If the user is able to query the data at many stages in its development then it will be possible to dissect and access the models from as many distinct research areas as possible. This should also help to ensure that users are able to ask their own questions whilst analysing the associations between pieces of information rather than just isolated facts. Different user groups use the same data in diverse ways and as a result different visualisations of each component are available at every stage (for instance a wireframe or a rendered view of the same data). Users can drill down through the final presentation of the model (the front end to the whole data set) into all the component objects via an interface which allows either direct interaction with the models or selection via drop down menus.

These objects can then be extracted from their hierarchical structures, manipulated, measured and reconfigured according to the users unique research query. This helps to ensure flexibility whilst maintaining intellectual transparency throughout. For example each abbey can be represented as a database of their constituent architectural mouldings (FIGURE 6). A significant amount of the architectural style is imbedded in the structure of these mouldings along with invaluable information about their origins. The user is able to search and transform these mouldings at specific points in order to test hypotheses, investigate evolutions of form and carry out ‘randomly play’. Questions relating to the levels of certainty, the actual construction process, the evolution of the structures, and their related influences could also be tackled.

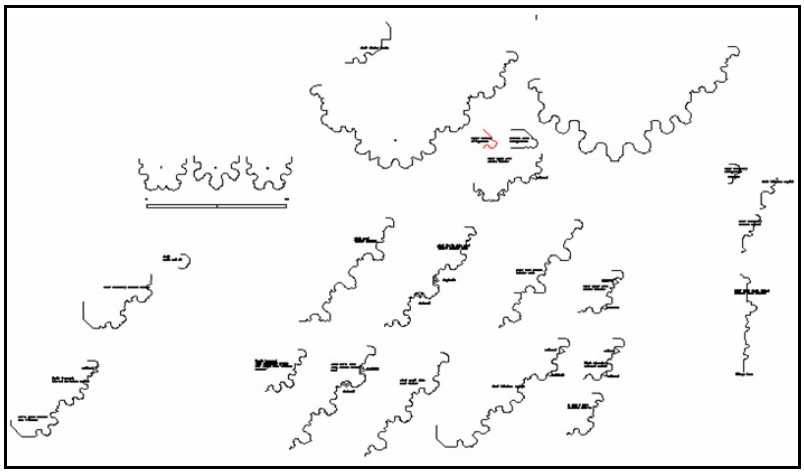

FIGURE 6 – Visualisation Technique – Documenting the Units of Construction

This investigation of architectural style and the potential examination of the linear or non linear evolution of that style requires and is arguably only possible with the interactive transformation from the units (2D), to the final form (3D). Arguably if the data set contains (even the potential) of an evolution of form then this should be made available for inspection and investigation.

Another visual aspect of the project was to attach the methods of construction (of the 3D models) to the models themselves (FIGURE 7) so they could be interrogated and reused (best practise).

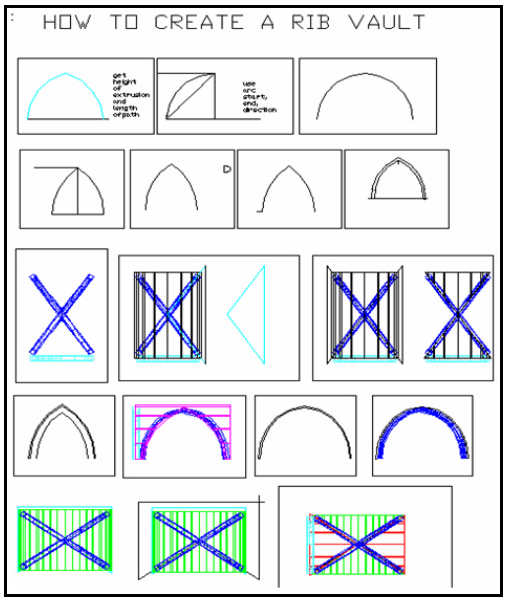

FIGURE 7 – Visualisation Technique – Documenting the Methods of Construction

What is interesting is that attaching 'the units of construction' and 'the methods of construction' are documentation activities done by the author in order to allow the user to generate their own visualisations. The question is how can this process be fully mapped out? It seems much easier to map out the activities of the author. Ultimately this highlights one issue which is central to the project - that it is not strictly an example of process or product orientated modelling but arguably an active combining of both methodologies.

On the authors side real world physical data is abstracted into 2D and then transformed via various visualisation techniques into augmented 3D data. This process is reactivated by the user but in reverse and in ways not predicted in the first round of visual transformation. The major difference between the visualisation carried out by the user and the author is that all the processes are virtual for the user - no physical processes a carried out. A future visualisation procedure could be rapid prototyping where users select or take cross sections through specific objects and 'save them' by transforming them back into physical space (3D printing).

PRESENTATION VISUALISATION

In order to allow for the greatest degree of flexibility in use and enquiry the outputs of the project can be visualised in multiple ways (via multiple media) these include via the web and in situ with the ruins via handheld devices including PDA's and mobile phones which use GPS to locate the user and present the appropriate reconstruction.

CONCLUSION

The fundamental question arises how are these visualisation methods and techniques relevant in areas other than the humanities? This project encapsulates a number of different types of visualisation and interestingly the distinction between arts, humanities and science made in the group session does not seem to apply here – the visualisation methods are used for both aesthetic reasons as well as for representing information and testing hypotheses. Also the requirement of the dynamic creation of visualisations by the user resulted in an implicit combining of process and product orientated modelling which is common to applications in art, science and the humanities.