Intelligent virtual knowledge for 3D-CAAD and urban modelling: misconception, counter-knowledge and logic

A.L.R.M. Ismail

University of Portsmouth, School of Architecture, King Henry Building, King Henry 1st Street, Portsmouth PO1 2DY, UK

Abstract

Intelligent Virtual Knowledge (IVKnow) is an innovative logical method for identifying and selecting an appropriate technique for '3D-CAAD' and Urban Modelling. The concept developed as a result of investigative and modelling works that identified three factors influence the production of '3D-CAAD Modelling'. The paper presents the theoretical and practical nature of those factors. The role of the logical process is addressed in question to hypothesise upon its potential in managing the large scale models. The main scenario of this paper, is not what to model, but how to model.

1 Introduction

Researchers and practitioners exploring the role of CAAD models should recognise the need for a more disciplined approach to '3D-CAAD Modelling'. It should be acknowledged as a legitimate discipline worthy of serious research and conscientious study. Many academics and professionals are not aware of modern methods that address modelling. As a result, the '3D-CAAD Models' have limited and short-lived functions. The current researches on CAAD Modelling are studies of contrast. Attitudes have not yet changed, progress has been made, though much remain to be achieved before the discipline reaches full maturity. Various CAAD users produce different quality of '3D-CAAD Models'. The user’s creativity and computer knowledge may seem the obvious reasons for determining the quality of the end results.

This paper presents numerous issues that need to be considered before carrying out modelling tasks. It argues that creativity and computer knowledge are not the prime factors for producing acceptable results. They are part of a complex logical process.

It is here to demonstrate the theoretical and practical problems that undermine the process of computer based architectural design and its progress.
These often influence or decide the type and form of '3D-CAAD Modelling'. The prime factors that undermine the unexpected regression in modelling tasks are the lack of critical thinking, good organisational skills, and basic technical computer knowledge [4]. Björk [1] and Nederveen and Tolman [8] suggested that there might be advantages in standardising the process of modelling and the representation of its associated data. Although, the composition of a model should differ from another to reflect its unique characteristics. The paper presents prerequisites of the logical processes of modelling.

2 Theoretical aspects of modelling

Several practical '3D-CAAD Modelling' and investigative field works were implemented to hypothesise and theorise on the factors that influence the modelling process. Examples of modelling tasks varied in scale and size; from individual buildings to large urban zones. The extents of details were also considered to be crucial prior and during the modelling processes. Some technical mishaps were also encountered. Fortunately, they provided greater insight to the nature of problems. Consequently, the three prime factors that determined the end results of modelling were largely attributed to the misconception, counter-knowledge, and logic.

Misconception
It is a common problem associated in particular with modelling and in general with the misuse of Information Technology. It exists due to limitations of the users' technical knowledge and incompetence in understanding the logical process of CAAD and modelling. Such users tend to select the modelling applications based upon impractical preferences. For example, a user may select a modelling application because he/she is familiar with the tool or others have used it for some reasons. The issue of its suitability for the modelling task is usually unintentionally disregarded. Such users do not have the basic knowledge of the modelling techniques that are available at their disposal. Therefore they do not produce practical results.

Counter-knowledge
Some users are familiar with the basic technical knowledge of IT and the modelling process. Although, a novice user may believe that he/she comprehends the most suitable method for the modelling task, nevertheless it could be completely wrong and inadequate for the approach. The majority of novice CAAD users are generally reprehensible of the Counter-knowledge. This is true when they do not understand the relevant theories that influence the used modelling approach.

The development process of '3D-CAAD Models' does not depend on the user's creativity alone but on complex technical abilities that are often ignored, therefore causing needless complications throughout the process of modelling. The result of such process is typically an 'Idle Model' that can not be re-used.
without imposing unnecessary costs and resources to rectify the mistakes to enhance its performance.

**Logic**
There is a logical process that could be applied at the earliest stages of modelling which encompasses competitive understanding of technicalities and the theoretical background of the used approach. Such process could be applied at a strategic level that consists of modelling criteria, modelling process, computer management, and the organisational skills alongside the technical competence and designers’ creativity. Intelligent Virtual Knowledge (IVKnow) may provide an insight to the type of problems associated with complex and large scale modelling projects. It should provide a framework for the structured and ill-structured aspects of modelling. Figure 1 illustrates the integral parts of the IVKnow concept.

![Diagram of IVKnow components](image)

**Figure 1: Relationship between components of the Intelligent Virtual Knowledge (IVKnow).**

### 3 The logical processes of IVKnow

There are two logical processes that could be iterative and selective depending upon the complexity of the modelling tasks and the participant users’ knowledge. The first deals with the implementation of the logical stages that encompass the identification of the intelligence, conceptualising the modelling problem, and managing the knowledge. The second phase, which is a concurrent process, deals with the validation of the adopted techniques. Figure 2 summarises the logical processes in relation to the IVKnow components.
For managing and modelling large and complex tasks where a great effort is required, it is indispensable to categorise the intelligence source, to identify the virtual modelling approaches, and the available methods for representing the knowledge. In some exceptional cases (i.e. the selective procedure), when the user has a profound knowledge of the available modelling approaches, it would be invaluable to concentrate on the process of knowledge representation to avoid the costly managerial mistakes that could be rescued at the earliest stages of the logical process.

![Diagram](image)

**Figure 2: IVKnow implementation and validation processes.**

### The practical process

There is a well-defined process that practically addresses the problems undermining the modelling approach, namely the 'Modelling Criteria'. The implementation of such criteria is determined by the methodological procedure of the 'Modelling Process' which addresses the practicalities of adopted techniques. A user may consider revising the criteria to suit the process, and vice versa, depending upon the capabilities of used tools. The 'Modelling Process' is a part of the 'Modelling Criteria' and they are closely interrelated. The criteria ultimately should precede the process aiming at the production of acceptable (i.e. agreed) results. Novice decision-makers and users usually concentrate on the 'Modelling Process' alone therefore producing models contain 'invisible garbage' [4]. The 'Modelling Criteria' should embrace a number of theoretical and practical issues, some of which are:
Abstraction
When considering modelling criteria, hence a process for solving a particular problem, many levels of abstraction can be assumed. At the top level of abstraction, the potential solutions are stated in broad terms using the language or the specific terminology of the domain. At the bottom end, a more procedural approach should be applied. At this stage, the specific terminology of the potential modelling software should thoroughly be understood and used coherently and consistently. Otherwise, it would prove to be laborious to sustain coherence at proceeding stages.

The product model
There is a common misconception, among novice decision-makers and users, entails the confusion between modelling purpose and its type. The final outcome of modelling need to be assumed at the earliest stages, hence, it is called the 'Target Model'. There are assumptions that have to be made about its functionality and performance; which should cautiously address the users' expectations. The end result of modelling could marginally or completely be different for a number of reasons. Therefore, it is called the 'Product Model'. The form and potential role of such models should have been envisaged and predicted before completing the modelling tasks. Björk [1] suggests that product models are the 'product' of a conceptualisation stage for structuring modelling data that are specific to its domain.

Product models can variably be implemented depending upon the decision-makers' or users' knowledge and the applications' type. There are less important factors that do not relate to modelling but might have some contributory elements to the process of implementation.

Information about product models could initially be presented in abstraction indicating the hierarchical organisation and relationship between the model components. When testing such relationship during modelling, some difficulties may be encountered to realise the assumed relationship. As a result, the 'Target Model' may never be achieved. It is for the user to decide whether another working relationship in the 'Product Model' would suffice or another modelling application ought to be considered. Therefore, selecting a new modelling application should always be based upon the futility of the adopted approach and not as a result of the 'feeble single mindedness'.

Procedural refinement
It is an early top-to-bottom strategy for enhancing both the criteria and process. A provisional hierarchy may develop by decomposing the abstraction and working towards its implementation in a trial fashion. The user would need to test the procedure by selecting any part of the abstraction and carry out some selected modelling tests to examine the suitability and functionality of the technique. The procedural refinement is precisely a method for examining and elaborating the modelling abstraction. Decision-makers or the technique users may begin with a general statement of objectives at the top level of abstraction. The statement should describe the modelling information conceptually which provides no details about the working relationship of the model components.
Refinements assist the model developer to elaborate on the original abstraction providing relevant detail as and when each successive modification implemented.

**Model and component’s hierarchy**

Organisation of the model structure represents control of its components; either the sub-models or the objects. However, it should not represent the procedural aspects of modelling such as modelling process, repetition of tasks and order of modelling decisions. Graphical representation and especially tree diagrams should be used to illustrate the model and its components’ hierarchy.

**Performance**

Any model whether it is an aspect model; a stand alone model serving a specific domain, or a shared model to serve more than a domain should have some pre-planned expectations. The role of a model as an aspect or shared model determines it’s assumed performance. Also its initial performance determines whether a 'Target Model' or a 'Product Model' could be achieved. The work of Dotsi et al [2] suggests that very often modelling techniques are mainly used for illustration and presentation purposes (i.e. after the completion of design work) and not as a checking device during the generation of architectural design. When developing an aspect or a shared model, the anticipated performance has to be addressed at the earliest stage. Should this be ignored, it is insurmountable that a shared model could involuntarily become an aspect model or possibly a 'redundant model'.

**Logical data exchange**

When an aspect and/or shared model are identified as the 'Target or Product Model', the flow of logical data should be conceptualised to its relevant detail. Structuring and documenting the logical flow of data between the models enhance the 'Modelling Criteria' and provide a proof of the working relationship between the numerous parameters.

**Information transfer**

Portability is probably one of the common problems still associated with IT, unintentionally ignored and misunderstood by the novice users. They tend to carry out modelling as a non-stop activity, accumulating information: structured on top of the illogical. The result is usually a huge model that could not be transferred or manipulated with relatively acceptable performance.

**Front-end users**

The 'Modelling Criteria' considers the front-end users as the users of the aspect models with modelling literacy. When developing a shared model, users of an aspect model require particular type of modelling information specific to their domain. There is a need for defining such information that would consequently have a diverse effect on the nature of the logical data exchange. It is vital to consider the implication of an aspect model that contains information that is principally nonessential to the domain. Such criteria for modelling may
offer a reasonable control prior to engagement with the modelling process. The front-end users should have control over these constraints to achieve results. Therefore, their needs must be addressed before carrying out the modelling tasks. Decision-makers and model developers also abandon the involvement of front-end users and tend to concentrate on the glorified aspects of modelling.

4 Conclusion

Modelling on a large scale requires a host of expertise and does not depend upon the creativity of their developers. The main factors which undermines the functionality of models could be attributed to the lack of the theoretical knowledge, the practical and technical experience of modelling, and good managerial skills. The concept of 'IVKnow', figure 3, is a methodological technique that could support the decision-makers and '3D-CAAD Modelling' enthusiasts in achieving practical results.

![Figure 3: A methodological modelling matrix.](image)

References


