

Chapter 11 – TOOLS: REFERENCE MODEL RELATIONAL DATABASE & UML TOOL

INTRODUCTION

Pushing boundaries, the SAS-050 group sought after well developed software tools that would allow the group to express the Conceptual Model in ways that are useful for both validation and supporting studies. In order to capture the model and facilitate C2 analysis, a visualisation tool was needed. During the development of the model's key variables and the relationships, SAS-050 encountered some difficulties identifying a tool to capture multi-layered relationships. The need for new tools arose in order to explore different approaches and avoid shortcomings of previously used tools. With the lack of a readily available suite of tools that complied with the requirements set forth by the group, a proposal was made to express the model in both UML and MYSQL software. This effort made good use of a combination of available tools to achieve the group's mission, but it is clear that better developed tools would be useful to the community in the future.

REQUIREMENTS FOR TOOLS

In order to develop a concise model of C2 concepts, the group established a set of criteria to select a tool. These criteria are identified below:

- Provide multiple lenses; i.e. give different view to different people so that people with different perspectives see the same thing.
- Have the ability to bring other models to bear and to make sure they map.
- Be able to handle structure, process, and organisation as variables.
- Be able to handle multiple instantiations (and allow the user to “fix/make stable” particular variables).
- Allow for qualitative analysis, exploration, and browsing.
- Incorporate metadata.
- Be flexible enough to allow users to manipulate structure as a result of incorporating metadata.
- Allow users to specify particular kinds of nodes and links, and tool should help ensure consistency of definitions, usage, etc.
- Be capable of tracking changes within the model.

These criteria span both CM development and future use. The need for these tool support requirements can be seen in Figure 11-1.

TOOLS: REFERENCE MODEL RELATIONAL DATABASE & UML TOOL

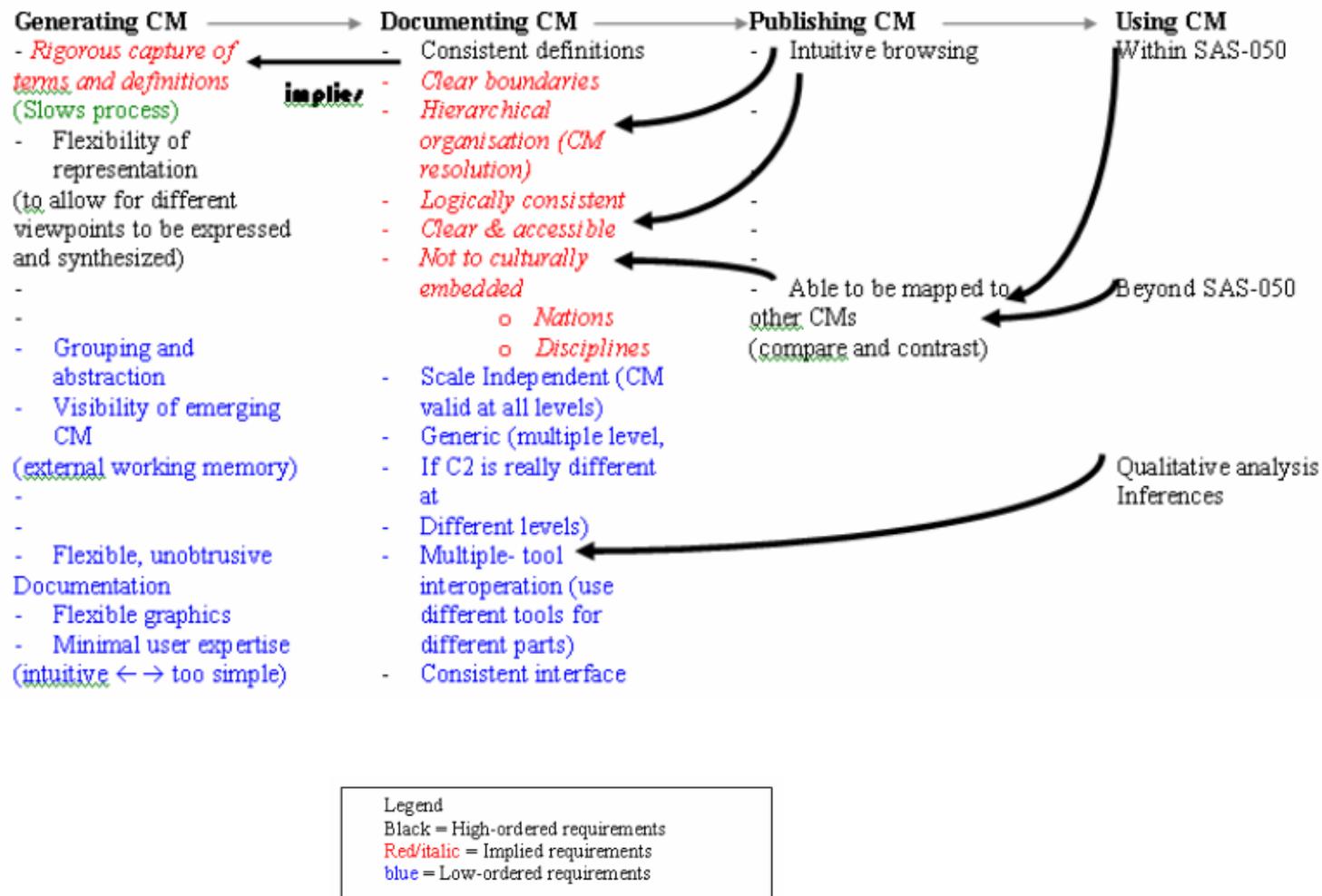


Figure 11-1: Requirements for Tool Support (including Facilitation).

HISTORY OF TOOLS EXAMINED

A wide range of tools were considered for use by the group. A subcommittee reviewed the suggested tools and critiqued the capabilities of each. The tools considered were:

- Octopus
- Decision Explorer
- UML
- Mind Manager
- Analytica
- PowerPoint
- Visio
- DPL
- Netica
- Influence analysis / system dynamics tools
- Influence diagram tools
- Casual Mapping tools
- Social networking tools (Blanche)
- MYSQL Relational Database/Visual Links

Initially the group began to capture their thoughts in PowerPoint documents. As the model increased in complexity, it was necessary to use a more advanced tool to combine multiple C2 concepts. After investigating the variety of tools listed above, the group agreed to capture their work in Analytica. Intended as a visual tool for creating, analyzing, and communicating decision models, Analytica depicted influence networks operating through the different levels of scale. While this tool provided a means to navigate the model, it was difficult for the user to understand the model in its entirety. This software package became overwhelmed by the amount data and it was necessary to identify an alternative tool with effective user interfaces. This additional functionality became a priority, since the CM should be able to support multiple views and tools. In the end, the combination of UML and MYSQL software satisfied the majority of tool requirements deemed necessary by the group.

DISCUSSION OF TOOLS USED

PowerPoint

- Strengths
 - Worldwide acceptance.
 - Ease of use.

- Weaknesses
 - Lacking a means of organisation.
 - Too generic.

Analytica/HTML

- Strengths
 - Easy navigation.
 - It can be exported in XML format (XMI).
 - Free viewer version of software to facilitate multinational collaboration (interoperability).
 - Configuration control.
- Weaknesses
 - Designed to be a visual tool for decision models rather than reference material.
 - Unstable due to Conceptual Model size.
 - Difficult to visualize multilayered relationships.

RELATIONAL DATABASE/MYSQL

The model is currently represented in MYSQL, an open source relational database management system.¹ The relational database was created using a standardized query language (SQL), which is fast and flexible. It allows for data to be stored in multiple tables rather than putting all of the data in one area. These tables are linked by defined relations making it possible to combine data from several tables upon request.

The team chose to utilize a database structure to capture their work for a variety of reasons:

- The database provides a means of configuration control. The group was able to view the material captured in the database and make suggestions for change. The proposed changes were then updated by a single user in order to maintain configuration control.
- The Reference Model must be available to a broader audience. The database can be posted to the group Web site where visitors can navigate through the model.
- In order for the Reference Model to prove useful for the C2 community, it must be accessible for use by other software applications such as statistical analysis packages, Visual tools, and modelling and simulation.

The database consists of a set of tables that depict the variables along with their definitions and relationships. A search function can assist the viewer in navigating the Reference Model. The data can also be imported into analysis packages such as Visual Links.

- Strengths
 - Easy navigation both in HTML and within tools.

¹ <http://www.mysql.com/why-mysql/>, <http://www.mysql.com/doc/F/e/Features.html>

- Software source code can be automatically generated (Attn: this requires appropriate design methods).
- It can be exported in XML format (XMI).
- It is a tool independent standard.
- Password protected for configuration control.
- Weaknesses
 - Math analysis/modelling not readily available (unlike in Analytica).
 - Finding the best way to model a system according to OOAD principles is more of an art than of a science.
 - Efficient modelling of complex systems and processes requires proper training: Package & class diagram + object diagram.

UML (INESC/INOV CONTRIBUTION)

UML is a language for the visualization, specification, construction and documentation of a system and its artifacts. UML is not a methodology. It provides a language and requires the user to find the best way to employ it.

It is not a software development process. It can be used for system analysis, for example. It is a standard and thus it is not dependent on specific tools. And it can be applied to many application domains.

We can have different, complementary views of the same system, which we call perspectives or projections. The UML concepts can be divided into elements, relations between elements, and diagrams.

Examples of structural elements are classes, objects, components, nodes, interfaces, etc. Behaviour elements can be states and state transitions. Grouping elements are packages, which can incorporate other model elements. Finally, notation elements can be placed as comments in the model.

There are several kinds of relations such as association, realization/instantiation, dependency, generalization, and state transition, aggregation, and composition, etc. Relations can have attributes like role and multiplicity. Diagrams can be of many kinds in order to capture different aspects of a system, be they functional, static, or dynamic.

In the case of the SAS-050 conceptual model, we believe that it can be best represented using packages, classes, and objects.

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- Weaknesses
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CURRENT STATUS/FUNCTIONALITY

Currently the model is represented in UML and MYSQL. These software packages allow users to access the CM and utilize its contents to assist in the instantiation of C2 assessment modelling. Each tool facilitates the importing and exporting of CM data from or into particular tools that may have specialised views or analysis functions desired by different user groups. The broader community can access the CM through a password-protected link posted to the SAS-050 Web site (www.dodccrp.org) once released in early 2006.

RECOMMENDATIONS

The group recommends utilizing the model through a suite of tools. Multiple tools have added value as they allow the user to visualize the data in a variety of forms. The UML model proves useful for model navigation, while the MYSQL database provides a table format that can be imported into other software packages, which may be more tailored to a specific project. The CM is relevant to different user groups and can be customised for particular purposes. Utilizing the CM in this manner will increase both decisionmakers and analyst's comprehension of C2-related subjects.