Using Task Structure to Improve Collaborative Scenario Creation

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ABSTRACT

This paper provides a task structure design for collaborative scenario elicitation. Task structure design is part of this effort to design a new Collaborative Scenario Creation (CSC) system. The complexity of the scenario creation process hinders participants, especially novice participants, from prudently designing scenarios. Research in Group Decision Support Systems (GDSS) shows that task structure helps to improve processes and collaborations. To design task structure for collaborative scenario elicitation, this paper invokes the Entity-Relationship data modeling methodology.

KEY WORDS:

Collaborative Scenario Creation, Task Structure

INTRODUCTION

The Scenario is a popular tool for strategic planning and emergency preparedness planning. Scenario-based planning's unique strength is that it embeds real life complexity and uncertainty into coherent, plausible, and systematic stories, so that planners can discuss issues and make plans more effectively. Traditionally, many scenarios were created with "BOGSAT" (Bunch of Guys/Gals Sitting around a Table) approach (Eriksson, 2003). Development of information technologies, such as Group Decision Support Systems (GDSS) opens new doors for scenario creation. However, empirical studies show that general purpose GDSSs do not support collaborative scenario creation as well as was anticipated (Hickey, Dean, and Nunamaker, 1999; Yao, Konopka, Hendela, Chumer, and Turoff, 2005; Turoff, Chumer, Hiltz, Hendela, Konopka, and Yao, 2006).

Task structure is, in our view, the key to success, based upon a recent study in a controlled experiment that did compare the absence of a task structure to a Delphi task structure, using the same asynchronous Computer Mediated Communication System (Turoff, Hiltz, Yao, Li, Wang, and Cho, 2006; Cho, 2004). For groups of either 5-7 or 10-14, both the number of ideas, and the number of ideas and unique ideas (isolated to two groups out of 44), were statistically significantly greater for the Delphi task structure than for the CMC alone, for both total ideas and per/person ideas. We also propose that with task structure, participants can exchange complex knowledge and experience more effectively.

SCENARIOS

While scenario has numerous meanings, to futurists, it signifies, "an imagined sequence of events, especially any of several detailed plans or possibilities" (Coates, 2000). For planners, it is to use story-telling to depict potential developments of the current situation (Turoff et al., 2006). Scenarios have a long history of application. Modern application of scenarios can be traced back to post World War II, when political and military situations were getting more and more complex, and gained popularity due to seminal work of pioneers like Herman Kahn, Pierre Wack, and etc. (Mietzner & Reger, 2005). Now, scenarios are widely used by military, public, and private organizations. Scenario design is an effective approach to reduce complexity and uncertainty of the object problems/issues and/or the environment by weaving the possibilities into coherent, plausible, and systematic stories. Because of this, in the eyes of planners, a scenario is not a forecast of the future, but only a glimpse of several future possibilities (Mietzner & Reger, 2005). The important scenarios for planning are the ones that follow an "if … then …" type structure, so they incorporate a rationale of causations. In the threat planning area, this is done by a structure of offense and defense scenarios for the same situation.

COLLABORATIVE SCENARIO BUILDING

Because building of scenarios requires knowledge and experiences in many different domains, it is almost impossible for a single person to create any complex scenario (Gordon, 1994). More importantly, collaboration can reduce negative impacts because of personal biases (Duncan & Wack, 1994) and avoid blocks in making sense of the environment (Weick, 1993). For that reason one would prefer large teams, employing a wide range of expertise needed for a complex emergency scenario. We have previously been experimenting with field trials of having opposing teams develop emergency oriented attack and defense scenarios in an asynchronous environment, over a period of weeks, as input to a gaming cycle, in order to seek iterative improvement of the opposing scenarios (Yao et al., 2005, Turoff et al., 2006). We were using, in these trials, a commercial grade Computer Mediated Communication system that allowed a basic comment-reply hierarchical structure. Even with teams of 5 to 9 students, we found that over a period of weeks the team discussions generated a great many ideas and much material. However, the tree structure of comment-response was highly inefficient in the organization of inputs, and what we discovered was that in trying to produce a final product from the activity, there was a tendency to ignore material that arrived at much less details, compared with those undergone adequate discussion. On the other hand, because a scenario's nature is possibility, ambiguity, and uncertainty, it will not be easy to communicate highly uncertain information and complex components without a specific structure. Structure, goes a long way to eliminate ambiguity in the collaboration process. Our previous field trials confirm this judgment (Yao et al., 2005, Turoff et al., 2006). As a result, we have decided the critical need to accomplish this sort of collaborative game is to provide a structured communication process that is oriented to collaborative virtual team efforts for building a model, by filling in a database structure that also allows collaboration at a detailed level. For example, if someone proposes a required event in the scenario, but cannot fill in the detail about a required resource such as a type of bomb, someone else in the team can fill in the detail needed to describe the bomb. The system will record who filled in what fields in any object and also allow replacement edit suggestions (e.g. delta edits) whenever someone can suggest an improvement.

TASK STRUCTURE

Studies about a close relative of collaborative scenario creation (CSC), collaborative writing (CW), reveal that the hypertext model is an effective way in organizing CW materials Hypertext models represents information in non-linear format and use linkages to connect fragments of a document (Turoff, Rao, and Hiltz., 1991). This model seems appropriate for our task of scenario creation, because a scenario is composed of smaller elements such as events, resources, variables, outcomes, triggers of events, etc.

The following section focuses on the task structure design for collaborative scenario creation GDSS. We choose the Entity-Relationship (ER) model to represent task structure, because relational databases are the most popular database structure and ER modeling is the most popular data modeling method for relational database design. We also find attractive the ER model's intrinsic compatibility with hypertext model. We use the following three steps to conduct task structure data modeling: surveying literature to identify the concepts, synthesizing the concepts into entities, and establishing relationships among the entities.

First, we identify the concepts related to scenario creation because of the literature. This shows that the following concepts are important to structure definition of a scenario.

1. Event: A sequence of events is the core of any scenario. It is the center of the Bow-Tie Diagram (McConnell & Davies, 2006). Events may have certain prerequisite conditions to happen, such as resources or other conditions. Normally, we can include at least three possible outcomes for each event: most optimistic outcome, most pessimistic outcome, and most likely outcome.
2. Variable: Variables are used to describe status (Coates 2000). Status of the environment includes information on multiple dimensions - for example, the number of injuries, casualties, damage to facilities, etc. Each variable represent a dimension and each point in the multi-dimension space represent a status. Events can be impacted by variables, and can in turn generate changes in variables.
3. Status: The status of a scenario is the current value of all the variables that represent the current condition of that scenario in the time line describing the occurrence of events.
4. Outcomes: Outcomes are the right-side contents in the Bow-Tie Diagram (McConnoll & Davies 2006) to represent the possible consequences of an event. An outcome can be depicted by the status variable changes.
5. Prerequisites: Prerequisites are conditions on the left-side content of Bow-Tie Diagram (McConnoll & Davies 2006) and are used to represent the preconditions for an event to happen. Prerequisites for an event can be both

resource requirements as well as conditions defined by variables.

6. Resources: Resources are material, financial, human roles, and others needed to carry out events. Resource type is the categorical classification scheme for different resources. At the first level, we have at least four major resource types: equipment, financial, human roles, composite (i.e. made up of combinations of other defined resources), and others.
7. Triggers: Triggers are special types of prerequisites, in the sense that when the conditions are fulfilled, the events will be carried out automatically. Triggers are important to specify for the automatic execution of scenarios.
8. Assumptions and Objectives: The effects of events are based on certain assumptions and the objective the event is expected to accomplish if it is controlled by humans. Assumptions are the implicit beliefs that are taken into consideration together with explicit objective or subjective evidence to generate conclusions. Without understanding of the assumptions, it will be difficult to understand how the conclusions are reached. Clarification of assumptions and objectives is a way to externalize implicit knowledge.
9. Themes: The term "theme" is used by Coates (Coates 2000) to describe the profile of the scenarios. Theme is a way to group scenarios. Grouping the scenarios around themes not only helps to reduce information load for participants to seek information, but also provides a way for participants to review or reuse elements that have been identified for the same theme of scenarios. It is the collection of all the individual objectives and assumptions into a summary for a give scenario.
10. Scenarios: Scenarios are on the top. They are composed of events, statuses and their interactions. Each scenario also should provide background, purpose, and constraint information, which are determined partly by themes, and partly by specific requirements of the scenarios.
11. Time and Location: The time and location have great impact on the results of the events. Time and location also constrain what and how events can be carried out.
12. Roles and Accounts: Users can only access and make changes to the scenario elements belonging to their groups. Second, each scenario element records creator information. Only creators of the element can change or accept changes to the element - others can only comment or suggest changes to the element. There is one exception - if the creator initiates an element, but leaves some fields blank, others can fill in these fields directly.
13. Constraints and Limits: In forming a complete scenario, specific constraints and/or limits may be placed upon the total scenario. Obviously the simplest way is to associate costs and resulting financial limits for resources consumed in any specific scenario. Numeric limits may also be placed on the quantity of a given resource, such as people and equipment. This is another factor that can stimulate creativity in the design process.

After having all the concepts, the second step is to extract and combine entities from these concepts. We identify fourteen entities: LOCATION, TIME, EVENT, PREREQUISITE, OUTCOME, VARIABLE, RESOURCE, RESOURCE TYPE (equipment, material, human roles, and finances), SCENARIO, STATUS, TEAM, THEME, ACCOUNT, and ROLE. The last step is to establish relationships among the entities. Several intermediate entities are added to represent many-to-many relationship, such as VARIABLE VALUES, SUBTHEME, and SCENARIO-EVENT. To represent better the entities and relationships, we use ERWin to draw the conceptual model using Crow's Foot notation. ERWin is a data modeling product of Computer Associates. Figure 1 shows the diagram.

We only identify entities and relationship in the conceptual model. This approach will provide flexibility for others who want to adapt the conceptual model and design their own CSC systems. They can create a logical design, based on the conceptual model, by including any important fields they need to add to the entities. These element entities further can be linked to other element entities by relationships. This actually reflects the essence of the hypertext model in scenario writing (Turoff et al., 1991).

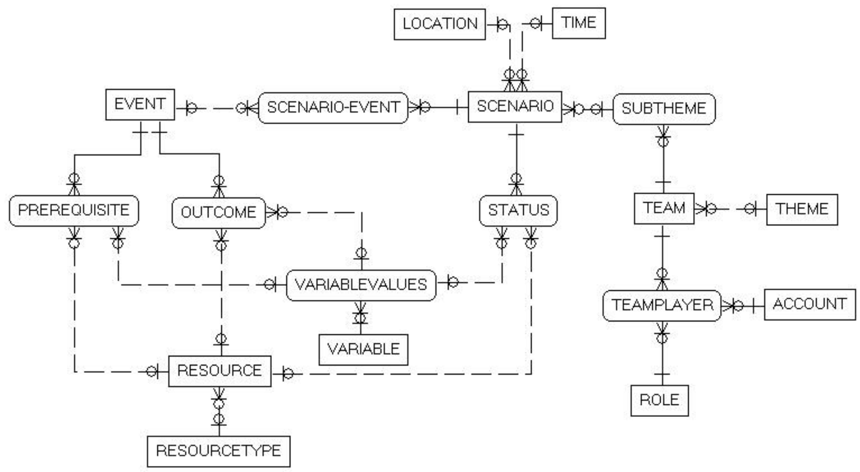

Figure 1: Conceptual Model for CSC Task Structure

CONCLUSIONS

Although scenarios are a useful aid for strategic planning and emergency preparedness planning, as well as training of the planners and responders, it is difficult to create high-quality scenarios. This problem is more prominent when novice participants are involved to create scenario in virtual teams. Asynchronous group support systems provide new opportunities for scenario-based planning. They not only allow collaboration among planners in different places and at different times, but also can provide additional process gains through process and task support. This paper focuses on the opportunity provided by task structure. Carefully designed task support not only improves the scenario creation process, but also promotes collaboration among participants. We hope that others who want to design CSC type systems can find this conceptual model useful for other possible support systems.

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