Emergency Planning as a Continuous Game

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ABSTRACT

Currently there are serious problems with organizational abilities to plan the response to emergencies. This paper presents a fundamental premise that the use of a game employing competing human teams operating on a continuous asynchronous basis over long periods of time is the way to develop high confidence emergency plans within a given organization.

INTRODUCTION

As emergencies become more frequent in organizations and society as a whole we begin to realize that the approach to planning has become extremely superficial. A group of high level managers or executives get together for a once a month meeting and submit pieces of plans prepared by their staffs and the group spends maybe a half day a month pasting the pieces together. This plan by committee is just one of many different committee activities that these individuals are engaged in and there is often little participation by those that end up having to execute the plans. In addition, many factors that should be considered are often ignored due to a lack of experience of those planning the details of the emergencies they are dealing with. This is not the way planning is done in those companies that deal with carrying technological products from R&D to development. However, it does seem to be the approach for emergency planning in a lot of governmental organizations, and especially for those concerns that cut across different agencies, types of governments, and external organizations.

An excellent example is the recent evacuation fiascos in Louisiana and Texas. There was no consideration in the planning of the human behavioral factors that were to determine the outcomes and the necessity to consider exception occurrences to the smooth regular flow of vehicles out of the danger zone. The ignored factors started with a lack of drivers for buses who were more concerned with getting their families to safety, especially since they could not be included in the buses. The lack of planning for the families of all classes of emergency workers in a major evacuation was not something ever considered by the planners. What happened in Louisiana led people in Texas to have little faith in their government and the assumption that the government could direct sections of a metropolitan area to a phased evacuation completely fell apart as a great many people decided they had to leave as soon as possible to avoid what had happened in Louisiana.

Many people have misleading biases about the behavior of individuals and groups in crisis situations, which lead to unfortunate assumptions for emergency plans. Most groups involved in an emergency situation never panic but the assumption of panic is what seems to justify misleading calming statements to the public rather than frank assessments of the situation. As the public detects a less than open communication from the leadership it is far less likely to follow suggestions and much more likely to act on its own intuitions for survival. For example, while some may loot stores for gain, much of the looting that occurred in New Orleans was for supplies locked up in stores that were needed for survival. In a real local emergency government powers should be used to requisition local supplies when they are the only ones immediately available.

A lot of publicity is given to the training exercises where people play the role of casualties and there are a lot of impressive photos taken of what seems like real execution of plans. Too often these seem designed to make a public

showpiece rather than to test the effectiveness of an underlying plan. One feels that all the players have a scorecard to indicate exactly what is going to occur and that real surprises to test the plan are few and far between. For the testing of limited objectives such as improving triage decision making, these exercises might be very useful, but they hardly ever seem designed to test the underlying plan for its degree of flexibility in responding to exception situations.

It sometimes seems that emergency plans are being designed like Information Systems where no exceptions are allowed to assumptions of perfect data and external situations where nothing deviates from the assumption of a perfect plan. In the real world we know that anywhere from a third to two thirds of commercial software is designed to handle exceptions.

True emergency plans are not a set of goals, which are usually fairly obvious. Instead they are both offense and defense scenarios constructed from a set of potential events woven into a story, with assessments of possible outcomes of interaction between possible offense and defense events. The events are defined by the roles and talents of the people and organizations that must be involved, the actions that are taken, and the physical resources needed. Defense plans without offense plans are largely meaningless. In essence a comprehensive risk analysis is the foundation of an emergency plan.

Scenarios are actually a very common approach to planning in highly unpredictable situations such as mergers and acquisitions and other areas that require normative types of forecasting and assessment (foresight in today's terminology) (Clemons 1995, Coates 2000, Duncan and Wack 1994, Gausemeier, Fink, and Schlake 1998, Godet 2000, Schoeffler 1955). They are also useful in developing requirements for information systems and designing prototypes. Scenario gaming has also been proposed as a component of Group Decision Support Systems (Mayer and DeJong, 2004).

THE ROLE OF GAMING

Many people in Emergency Preparedness see games as training tools and it is certainly true that this is a useful and popular objective. However training can only be effective if it is based on viable and quality plans. The real issue is how one develops meaningful plans. The view here is that even games for training must evolve from plans that emphasize the following properties:

- They are based upon realism with respect to the behavior of both individuals and organizations.
- They are based upon threats that are innovative and able to stress the best of defense plans.
- They have to be designed to encourage cooperation and improvisation among those that will actually carry out the plans in a real emergency.
- Planning itself is viewed as a continuous process among individuals representing all the many agencies and entities that will be involved in responding to the emergency.

The approach to this being taken by the NJIT effort in gaming (Turoff et al 2006) is to borrow some concepts from military gaming and simulation in terms of developing opposing plans by competing virtual teams of individuals (Benson et al 1998, Hammond, 2001, Hutchins et al 1998, Wilson 2001). A process based on offense and defense plans developed by two opposing teams is the best way to produce truly innovative and comprehensive plans. This type of approach can be applied to large variety of situations.

- Terrorist attacks on specific facilities such as chemical plants or nuclear plants.
- A disaster (hurricane, flood, earthquake) in a specific geographical area where the offense is a team representing "mother nature" and which can create specific impacts such as what areas are flooded, what roads are blocked, what buildings have collapsed, etc.
- A competitor of a company introducing a new product competing with the defending company's product in a specific marketplace.

Practically any type of emergency can be examined by creating two opposing human teams made up of individuals who have some degree of expertise in exploring the particular circumstance for the given competitive involvement.

There are many possible uses for the plans that are evolved, which are illustrated in figure 1 on the "spectrum of competitive planning." Once an offense or defense plan has been created and provides a well defined and specified scenario, it is possible to develop a "canned" event driven automated enactment for that particular plan. It then becomes possible to have an automated offense played against a human defense team, or an automated defense plan

played against a human offense. Playing an automated offense against human defense carrying out the prescribed defense it is a way of training novice defense players in the nature of the defense plan. When we play an automated defense plan against a knowledgeable human offense team we can stress the plan and expose further difficulties that had not been considered before. This serves the very different purposes of stress testing and training. Finally, if we can make decent outcome estimates of the stochastic interactions between the canned offense and defense plans we can go further and initiate a Monte Carlo type simulation to estimate the span of sensitivity and most probably risk outcomes of the opposing plans. This becomes very important for assessment of investing further resources to improve the desired likelihood of positive outcomes.

Offense Defense Planning (Hegelian approach)	**Human Offense**	**Computer Offense**
Human Defense	Plan Improvement by experts (Non-zero sum competitive game)	Training for learners
Computer Defense	Stress testing of plan details by experts	Simulation for sensitivity and risk assessment based upon probabilistic factors

Figure 1: Spectrum of Gaming as Planning for Emergencies

The nature of analysis of the interaction between the opposing plans created by the human teams is a judgment made by an expert or team of experts. However, it is traditionally very dependent upon the degree of optimism or pessimism that is adopted about each of the opposing sides, see figure 2. Mixing pessimism and optimism leads to conservative but costly positions. What is desirable for planning purposes is to allow a certain degree of optimism on both sides. Classically this led to armaments spirals in the era of the cold war. However, our choice for maintaining realism and reasonableness is to impose resource constraints on both sides of the game. This keeps the plans within meaningful boundaries.

It is difficult to apply this in the natural disaster area since nature's resources to create disasters seem to be growing at a more rapid rate today than the human resources available to counter them! In an actual situation, however, one might provide the offense with specific limits like the size of the hurricane or the inches of rainfall in a given area. For competitive products it is quite easy to provide both teams with the same level of research and development resources to carry out the development of the competing product.

Assumptions	**Offense Pessimistic**	**Offense Optimistic**
Defense Pessimistic	Stupid for both Peace is best!!!	Safe and costly for defense (defense conservative) Stupid for offense
Defense Optimistic	Safe and costly for offense (offense conservative) Stupid for defense	Armaments spiral usually results Realism through resource constraints

Figure 2: Optimistic vs. Pessimistic Range

What ever mistakes are made in designing a plan are extremely costly in the real emergency because they determine the initial resources available and the initial sequence of actions taken. Such mistakes often include the omission of things not considered

CURRENT EFFORTS

In prior work (Turoff et al 2004) it was pointed out that scenarios of events need to be integrated into operational emergency response information systems as a fundamental metaphor for the design of interaction. Here the reasons are put forth why a gaming approach is needed as an integral part of on going emergency preparedness planning system. Currently a commercial conferencing system (i.e. WebBoard) is being utilized as a medium to allow competing virtual teams to operate continuously and asynchronously in their individual private conferences. The

game is well described in a recent publication (Turoff et al 2006) but figure 3 provides an overview of the teams involved and the transfer of materials between the teams.

Most important is the fact that the people involved in the game can carry out the process over extended periods of time in a continuous process. The actual involvement might only be a few hours a week per person, depending on the time commitments to other responsibilities. However, a few hours a week by every individual would probably allow a monthly cycle in the development of new versions of a plan. The introduction of the ability for each competing team to make requests for added resources creates an opportunity for any team to improve its current version of its plan. The incentive to do this is based upon the intelligence they are leaked from the results of the opposing plan. Furthermore, they have to convince the "judges" that their new resources would make a significant improvement in their current plan. Each team also incorporates a support team for gathering intelligence and public information the objective of the given team. The following structure has evolved from two separate trials of the game (Yao et al 2004, Hendela et al 2006).

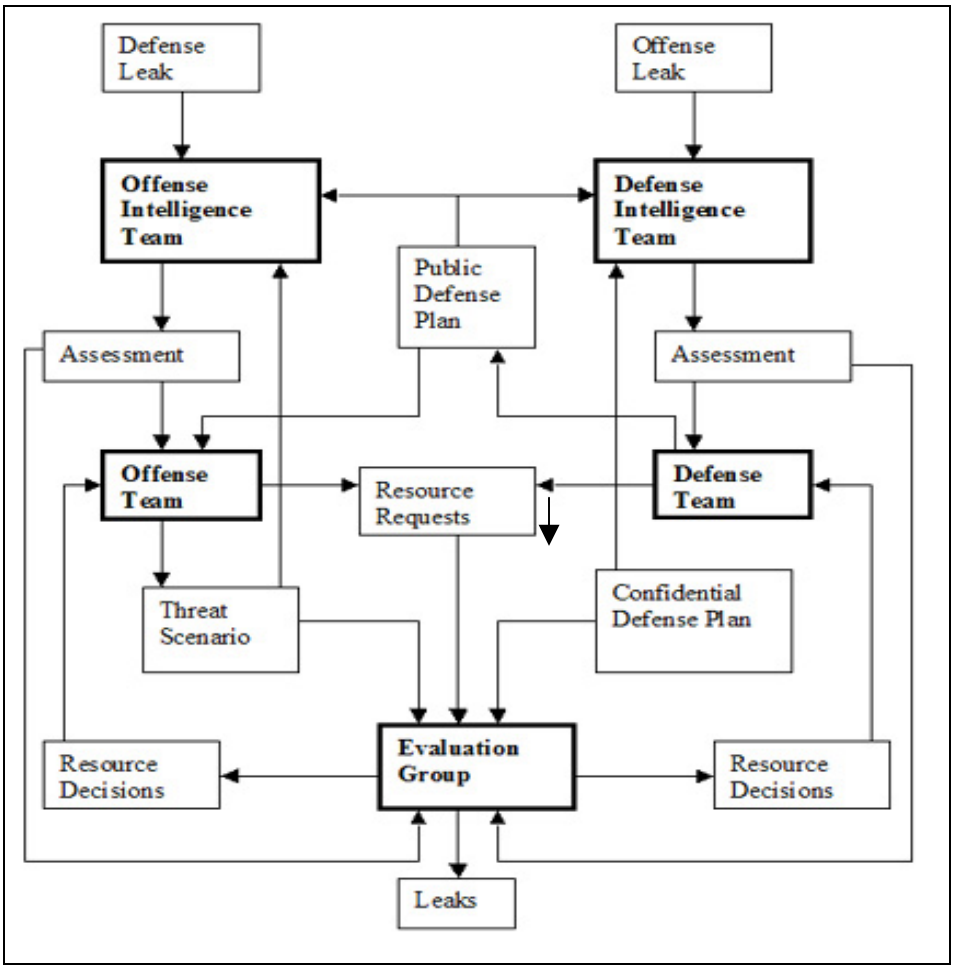

Figure 3: Current structure of the game

As one observes there are actually five different teams and the function of offense is the mirror image of that of the defense. The only significant difference between the two is that the defense has both a public defense plan and a confidential one. This was felt to be a realistic reflection of the real world situation in most cases. The changes that have been made to the structure proposed earlier has resulted from our prototyping trials (Yao et al, 2005, Hendela, et al 2006)

We based our design for an emergency preparedness planning game on some concepts and ideas from the Delphi Method (the Policy Delphi structure in Linstone and Turoff 1975) to set up competing teams to evolve and improve

scenario plans for both the offense and the defense. In the literature on establishing the degree of validity or the evidence for a scientific finding there is one philosophical scientific approach that has considerable merit in the crisis planning process. This is the Hegelian Inquiry Process as characterized by (Churchman 1971, Linstone and Turoff 1975, Mitroff and Turoff 1975). In this process two opposing worldviews are created (Hegelian binary opposites) that are constructed to be the most extreme opposites. These two views about the future are then compared with the expectation that a collaborative group can reach a consensus on a synergistic combination that represents an improvement over either extreme view. This latter outcome is not guaranteed by the process. In military planning for defense a version of this process is the creation of a "defense conservative (pessimistic)" plan and an opposing "offense optimistic" plan. Wherever there is a choice for the defense one assumes the existence of Murphy's Law, and every benefit of the doubt about offensive capabilities is assumed for the offense. Then one compares the two plans for defense and offense to expose the most serious weaknesses for correction. For motivation purposes in the game we have used the resource constraints to allow a degree of optimism for both sides of the game.

There has been very little study of the use of asynchronous communications to carry out learning games (Hsu 1989, Worrel et al 1995). However we do know that the development and creation of scenarios are a stimulant for reflective thinking and that conflicting ideas and paradoxes do stimulate creativity in some situations (Go and Carroll 2004). Our current effort focuses on providing a data structure that will make it much easier for the participants to gather their contributions, compare, and reflect on their scenarios and plans to try to better match them to the intelligence information being provided. This is consistent with our long term efforts at NJIT in structured asynchronous group communication processes for dealing with complex problems (Hiltz et al 2005). In the gaming area and in the associated area of complex collaborative modeling, there is still much to be done for Computer Mediated Communications systems to meet their long term promise of providing Collective Intelligence capabilities for groups (Hiltz et al 1986).

We hope in later versions of the game to include the type of online collaborative policy analysis Delphi software that we have evolved for large groups. That system allows a group to build lists of items (e.g. goals, criteria, tasks, etc), discuss them, and vote on individual items as part of a dynamic and evolving discussion guided by the current votes and dynamic vote changes taking place (Turoff, Hiltz, et al 2004). This would make the convergence process of teams a lot more efficient but such software is not a common commercial product yet. The development effort beyond the basic system will be the addition of such virtual team software for training as well as for professional utilization.

We are currently working on a database to support a content structure for the details of specifying plans as it becomes difficult for the players to track all the details created in the basic discussion threads. The same content structure will allow an easy conversion of either of the resulting plans into a component of an event driven scenario for the prior mentioned applications of training or stress testing.

OBSERVATIONS

Everyone would like an emergency organization to be an HRO (High Reliability Organization). An HRO is a bit like the elephant in terms of the very different views that exists in the literature about what it is, in terms of individual, group or team, organization, and system (Staw et al 1981, Perrow, 1984, 1986, Gladstein and Reilly 1985, Weick 1987, Clarke and Short Jr. 1993, Grimaldi 2002, Van den Eede et al 2004 2005, Day and Schoemaker, 2005). This paper provides a concise summary of these views to make a significant point: the only method available to organizations to arrive at an HRO state that encompasses, to various degrees, all these requirements is a continuous asynchronous planning process. There is no simple way around making this effort for the reality of becoming an HRO unless one is committing a full time dedicated military type system/organization as the foundation of the HRO. What we have proposed in this paper for a planning process is a communication structure that would allow an HRO to be created among dispersed professionals in different physical organizations. Below is a summary list of the characteristics that are suggested from the literature as necessary for an HRO at the individual, group/team, organizational, and system levels of consideration. This is not just from the HRO literature but from some literature on reliability in general. However, it is probably not exhaustive. Many papers in this field tend to view the problem from only one or a few of these levels. The system level is in the sense of General Systems Theory (Ashby 1956). In terms of HRO the system is the combination of the humans, the information System, the communication systems, and any physical system that is part of the total HRO at any given time in the emergency phases that take place.

Individuals must:

- Learn to improvise
- Respect talent and expertise
- Be willing to undertake personal risks
- Exhibit cognitive flexibility under adverse circumstances
- Recognize that errors of commission and omission can be a natural human process.
- Extend trust to promote cooperation and mutual support, and open communications
- Be able to decide between trained responses and recognition of a need for improvisation
- Provide operators/roles both the responsibilities and related authorities to act when problems occur
- Blaming individuals for human errors that are encouraged by the system interface design may keep error prone systems operative.

Groups/Teams must:

- Develop team spirit
- Defer to expertise
- Practice new approaches
- Expect and track surprises
- Expose and learn from mistakes
- Experiment and improvise as a group
- Have a sense of at least semi-permanency
- Leaders who can delegate authority to talent
- Recognize that networks conquer hierarchies in emergencies
- Be enterprise wide, multidisciplinary, and/or multi agency teams
- Have leaders determined by the nature of the emergency or problem
- Be allowed to form in a dynamic manner for the context of the current problem.
- Have shared commitment to common objectives and clear understandings of roles
- Practice open communications to reduce uncertainty and provide situation awareness

Organizations must:

- Seek ideas externally
- Commit to resiliency
- Envision alternative futures
- Place multiple bets, experiment
- Eliminate internal incompetence
- Evaluate accuracy of past forecasts
- Test and challenge basic assumptions
- Adopt uncertainty reducing strategies
- Use at least a five year planning horizon
- Maintain legitimacy with their constituents
- Be reluctance to simplify or utilize reductionism
- Undergo meaningful emergency preparedness audits
- Use knowledge management to assure organizational learning
- Maintain peripheral vision to detect the unexpected (Unk Unks)
- Understand the true cause of errors and seek to eliminate or mitigate their effect
- Have decentralization flow from a centralized culture of common goals and objectives.
- Incorporate plans with the widest possible range of alternative situations and complexity
- Extend the coverage of plans to be more effective; do not narrow them to be more efficient.
- Recognize that risk management is a subset of the planning process, not the other way around.
- Have roles that are well defined and/or specialized, with information systems to support these roles

Systems that have high reliability must:

- Use redundancy to reduce complexity
- Decouple systems when they exhibit problems.
- Maintain slack resources to reduce system complexity
- Use slack resources to allow error correction to take place
- Recognize that tightly coupled complex systems are more prone to failure
- Mix the reliability of a bureaucracy with the flexibility of an adhocracy by utilizing "sense making" and "change management"
- Provide requisite variety though human operators and oversight

Although listed last, "requisite variety" is a key to many of the characteristics of HRO's listed above. Requisite variety means that the variability of the external inputs to a system can produce a similar degree of variability in the outputs. As a result one can only regulate the behavior of a system if the controls (regulator) for the system have the same degree of variability.

In a crisis the external factors such as a hurricane can have tremendous variability and the system necessary to respond to it and regulate or mitigate the outcome becomes extremely complex very quickly. It is further complicated by the need for timely regulation as delays generate both additional fatalities and other losses. Unless the core emergency management organization and teams are an existing entity with sufficient requisite variety it will not be able to cope. Katrina was a very clear demonstration of what happens when a total general system fails to accomplish its objectives because of a lack of requisite variety. We have to create a single HRO out of all the human organizations involved in responding to a major disaster to be able to satisfy the law of requisite variety.

Part of the confusion about what constitutes an HRO in the literature is that some authors look at a system as two separate components: e.g., the physical system such as a nuclear power plant as separate from the individuals that make up the organization, or the individuals that operate the facility. In fact, the physical system and the individuals and groups that maintain and operate the physical system are part of what has to be viewed as one total system. The concept of an HRO was evolved from the existence of a complex physical system that was a permanent entity. Some times too much emphasis is placed on the physical system without considering its relationship to the various levels of the human system: individuals, teams, and organizations.

When we consider the area of civil emergency preparedness the physical system often does not come into being until the emergency is expected or detected. However, the organization that is going to operate and support it has also to come into existence in terms of the coordination and cooperation of many different entities that normally are engaged in other activities. This can be any type of crisis involving federal, state, and local governments, as well as volunteer type organizations. In the case of a company the situation is just as complex because every type of corporate unit necessary to the survival of the company has to be involved to provide for business continuity.

The first step in creating a human oriented HRO is working toward plans and a planning process that involves the people at all levels in all the organizations and units that will be needed in the real event. The virtual planning approach of a competitive set of teams can be set up to handle the continuous involvement of hundreds of people in an asynchronous process that would probably involve only half a day a week of effort, spread over one week.

The collaboration that begins to occur during emergency planning as a continuous game has the potential to “strengthen” and “tighten” the coupling between individuals and entities so engaged. This coupling can become stronger during continuous scenario planning suggesting an emerging structure of “high reliability” between collaborators. When the organization(s) shift emphasis from planning to response, those tight couplings or communicative connections developed during continuous planning are not lost but incorporated into the response activities of organizations reacting to the actual emergency. An HRO would begin to emerge due in large part to the collaborations between individuals and other organizational entities that began during emergency planning constructed as a continuous game.

FUTURE WORK

In order to have a continuous process for planning, the research group at NJIT is developing a database that will allow fundamental units of a plan, whether offense or defense, to be collaboratively authored by a team. The plans will be structured by the fundamental components of things like roles, resources, outcome alternatives, measurement variables, etc. to be independently defined so the same components maybe reused in alternative plans for different types of emergencies or response approaches.

Any units of interest maybe created with a very minimum of necessary information and the missing information may be entered by any other member of the collaborative team. Over time many teams contributing to the same data base can find it easier to tailor new variations from the existing units in the database. It will also be relatively easy to use such a database to create automated versions of a given scenario so that the teams can, in fact, try mixed combinations of human plans and automated plans.

Given the component nature of the data base it will be ideal for supporting (together with a flexible computer conferencing system) a continuous planning environment. It will also be easier to experiment with students and novices because developing a specific plan will be a much easier undertaking even for novices, given the library of objects that can be put together to develop a full plan. For use with professionals, newcomers to the emergency planning gaming network would start out as novices, learning current plans and attempting to act on them against programmed threats. Experts would generate new threats against stored defense plans and those who have graduated to planning responsibility would attempt to improve their plans continuously, based upon the results of the games.

Multiplayer game environments on the WEB easily support thousands of people, and so could emergency planning when developed as a gaming process. Two floods in the same location will produce different specific problems so that much of what we deal with in a major disaster is unexpected with respect to the details of what resources are needed where and when. We need a new type of virtual organization that goes beyond the limited concept of virtual teams. We need to create a very new type of organization that might be characterized as a "Virtual HRO" which can, when a crisis occurs, operate without the restrictions of the normal organizations from which the units have been contributed.

> The white man drew a small circle in the sand and told the red man, "This is what the Indian knows," and drawing a big circle around the small one, "This is what the white man knows." The Indian took the stick and swept an immense ring around both circles: "This is where the white man and the red man know nothing." -- Carl Sandburg, The People, Yes

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REFERENCES

1. Ashby, W. R. Requisite variety and its implications for the control of complex systems, Cybernetica, 1(2):83-99, 1958.
2. Benson, R., Kemple, W., Kleinman, D., Porter, G., and Serfaty, D., "An Example of Model-Based Empirical Research: A Soup-to-Nuts Evaluation of Alternative C2 Architectures" Proceedings of the 1998 Command and Control Research and Technology Symposium, Monterey, CA, June-July 1998.
3. Churchman, C. West, The Design of Inquiry Systems, Basic Books, NY City, 1971
4. Clarke, Lee, and Short Jr., Fames F., Social Organization and Risk: Some Current Controversies, Annual Review of Sociology, 19, 1993, 375-399.
5. Clemons, E. K., Using scenario analysis to manage the strategic risks of reengineering, Sloan Management Review, 1995, 61-71.
6. Coates, J., Scenario planning, Technology Forecasting and Social Change, (65), 2000, 115-123.
7. Day, G. S., Schoemaker, J. H., Scanning the Periphery, Harvard Business Review, November 2005, 1-12.
8. Duncan, N.E., & Wack, P., Scenarios designed to improve decision making, Strategy and Leadership, (22:4), 1994, pp 18-25, 46.
9. Gausemeier, J., Fink, A., & Schlake, O., Scenario Management: an approach to develop potential, Technological Forecasting and Social Change, 1998, (59), pp.111-130.
10. Gladstein, D. L. and Reilly, N. P., Group Decision Making under Threat: The Tycoon Game, The Academy of Management Journal, 28:3, September 1985, 613-627.

11. Go, Kentaro, and Carroll, J. M., The Blind Men and the Elephant: Views of Scenario-Based System Design, Interactions, (XI.6), November-December 2004, 45-53.
12. Godet, M., The art of scenarios and strategic planning: Tools and pitfalls, Technological Forecasting and Social Change, (65), 2000, 3-22.
13. Grimaldi, R. J., Why do Business Continuity Plans Fail? Risk Management; 49:5, 2002, 34-39.
14. Hammond, G., The Mind of War: John Boyd and American Security, Smithsonian Institute Press, Washington, 2001
15. Hendela, A. H., Yao, X., Turoff, M., Hiltz, R., Chumer, M., Virtual Emergency Preparedness Gaming: A Follow-up Study, Proceedings of the Third International ISCRAM Conference, NJIT, Newark N.J., May 14-17, 2006.
16. Hiltz, S.R., Fjermestad, J., Ocker, R. and Turoff, M. Asynchronous Virtual Teams: Can software tools and structuring of Social Processes enhance performance? Chapter for Volume II: Human Computer Interaction in Management Information Systems: Applications, Dennis Galletta, and Ping Zhang, 2005 (in press).
17. Hiltz, S. R., Turoff, M., and Johnson, K. J., Experiments in Group Communication via Computer, 1: Face-to-face vs. Computer Conferences. Human Communication Research, 13(2), Winter 1986, 225-252.
18. Hooper, J. W. & Hsia, P., Scenario-based prototyping for requirements identification, Software Engineering Notes, (7:5), 1982, 88-93.
19. Hsu, E, Role Event Gaming Simulation in Management Education, Simulation & Games 20(4), 1989, 409-438.
20. Hutchins, S. G., Kemple, W. G., Entin, E. E., and Serfaty, D., Innovative Measures for the Evaluation of Command and Control Architectures, Proceedings of the 1998 Command and Control Research and Technology Symposium, Monterey, CA, June-July 1998.
21. Kahn, H., Thinking about the Unthinkable, 1965, New York, Horizon Press.
22. Kemple, W.G., Porter, G.R., Benson, R., Hutchins, S.G., and Hocevar, S.P., "Research in the Classroom and Simulation Laboratory: Combining C2 Research and Education" Proceedings of the 1998 Command and Control Research and Technology Symposium, Monterey, CA, June-July 1998.
23. Linstone, Harold & Turoff, Murray editors: The Delphi Method: Techniques and Applications, Reading MA: Addison Wesley Advanced Book Program, 1975 (http://is.njit.edu/turoff).
24. Mayer, I. and De Jong, M., Combining GDSS and Gaming for Decision Support, Group Decision and Negotiation 13, 223-241, 2004.
25. Mitroff, Ian, & Turoff, Murray, Technological Forecasting and Assessment: Science and/or Mythology? Journal of Technological Forecasting and Social Change, (5), 1973, 13-134.
26. Nash, J. F., Non Cooperative Games, Annals of Mathematics Journal, 54, 1951, 286-295.
27. Perrow C., Normal Accidents: Living with High-Risk Technologies, New York: Basic Books, 1984.
28. Perrow, C., Complex Organizations: A Critical Essay, New York: Random House, 1986.
29. Quarantelli, E. L., The Disaster Research Center Field Studies of Organizational Behavior in the Crisis Time Period of Disasters, International Journal of Mass Emergencies and Disasters, 15(1), 1997, 47-69.
30. Schoeffler, Sidney, The failures of economics: A diagnostic study, Harvard University Press, 1955.
31. Schoemaker, P., Scenario Planning: A Tool for Strategic Thinking. Sloan Management Review, (36:2), 1995, 25-40.
32. Staw, B. M., Sandelands, L. E., and Dutton, J. E., Threat Rigidity Effects in Organizational Behavior: A multilevel Analysis, Administrative Science Quarterly, 26, 1981, pp. 501-524.
33. Turoff, M., Chumer, M., Hiltz, S.R., Hendela, A., Konopka, J., Xiang, Y., Gaming Emergency Preparedness, HICSS 39, January 4-7, 2006.
34. Turoff, M. Chumer, M., Van de Walle, B., Yao, X., Konopka, J., Crisis Planning via Scenario Development Gaming, Proceedings of 2nd International Conference of ISCRAM, Brussels, April 17-20, 2005, http://iscram.org

35. Turoff, M., Chumer, M., Van de Walle, B., Yao, X., The Design of a Dynamic Emergency Response Management Information System (DERMIS), Journal of Information Technology Theory and Application (JITTA), (5:4), June, 2004, pp. 1-36. (http://www.jitta.org)
36. Turoff, M., Hiltz, S. R., Li, Z., Wang, Y., Cho, H., Yao, X., Online Collaborative Learning Enhancement through the Delphi Method, Proceedings of OZCHI 2004 Conference, November 22-24, University of Wollongong, Australia, 2004, available at http://is.njit.edu/turoff
37. Turoff, M., Chumer, M., Hiltz, R., Klashner, Robb, Alles, Michael, Vasarhelyi, M., Kogan, A., Assuring Homeland Security: Continuous Monitoring, Control and Assurance of Emergency Preparedness, Journal of Information Theory, Technology, and Applications, (JITTA), 6:3, Fall 2004c, 1-24.
38. Van den Eede, G., Kenis, D., and Van de Walle, B., Combining flexibility and reliability for mainstream organizational learning, Proceedings of the 5th European Conference on Knowledge Management ECKM2004 (Paris, France, September 2004), 851 – 860.
39. Van den Eede, G., Van De Walle, B., Operational Risk in Incident Management: a cross-fertilization between ISCRAM and IT Governance, Proceedings of the Second International ISCRAM Conference (eds. B. Carle and B. Van de Walle), Brussels, Belgium, April 2005.
40. Van den Eede, G., Van de Walle, B., Ruktkowski, Anne-Francoise, Dealing with Risk in Incident Management: an application of High Reliability Theory, Proceedings of the 39th Hawaii International Conference on System Sciences, 2006, January 4-6.
41. Weick, K. E., Organizational Culture as a Source of High Reliability, California Management Review, 29:2, 1987, 112-127.
42. Wilson, I., From scenario planning to strategic action, Technological Forecasting and Social Change, 2000, 65, 23-29.
43. Wilson, M., Toward an Ontology of Integrated Intelligence and Conflict" Decision Support Systems Inc. HTTP://www.metatempo.com/DSSIOntology.pdf 2001
44. Wolfe, J. N. R., Computerized General Management Games as Strategic Management Learning Environments, Simulation & Gaming, 28(4), 1997, 423-441.
45. Worrell, W., Hiltz, S. R. Turoff, M. and Fjermestad, J., An experiment in collaborative learning using a game and a computer mediated conference in accounting games. Proceedings of the 28th HICSS, Vol. IV, pp. 63-71, IEEE Computer Society Press, 1995.
46. Yao, X, Konopka, J., Hendela, A., Chumer, M., Unleash Physical Limitations: Virtual Emergency Preparedness Planning Simulation Training, Methodology, and Case Study, Proceedings of AMCIS, August 2005.