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Title: Improvisation as a Training Framework for Emergency Managers

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ABSTRACT

This paper describes the rationale and preliminary studies underlying our ongoing effort to develop improvisation-oriented training systems for Emergency Managers, in the context of multi-organizational crisis response. We view improvisation -- the ability to “rework knowledge in novel ways under tight time constraints” -- as an ideal framework for training emergency managers to cope with the rapidly evolving, complex task of coordinating the response to a large-scale crisis. Our efforts focus on response personnel at the operations center level and higher, rather than the field-response level; it is at these higher levels where many of the problems of coordination and communication, such as those observed in the response to Hurricane Katrina, will arise (Wachtendorf & Kendra, 2006). In this paper, we introduce some empirical findings that have guided the design of our system, and discuss them in the framework of theoretical discussions of improvisation, particularly in the emergency management context. We will discuss the attitudes of professional emergency managers regarding improvisation, perceptions of current training and practice in the field, and precursors to successful improvisation in the crisis management setting. Finally, we will discuss the implications of these findings for the design of emergency management training software systems.

Keywords: Improvisation, Emergency Management, Crisis Management, Simulation, Training

BACKGROUND

Recognition of the complexities inherent in a multi-organizational crisis response effort have led to a concerted effort in recent years in the United States to institute a standard, nationwide framework -- the National Incident Management System (NIMS) -- for emergency management and response in all jurisdictions and agencies (DHS, 2004). However, the response failures following Hurricane Katrina and other events point to a variety of systemic problems that remain unresolved. In particular, *ad hoc* disaster management coalitions comprised of disparate teams are prone to a number of problems, particularly with respect to communication, coordination, clear lines of authority and responsibility, and resource allocation (Suparamaniam & Dekker, 2003; Gheytanchi, *et.al.*, 2007).

At times, FEMA, state, and local officials seemed unaware of local capacities and vulnerabilities. On the one hand, one local official stated, “FEMA's deference was frustrating. Rather than initiate relief efforts—buses, food, troops, diesel fuel, rescue boats—the agency waited for specific requests from state and local officials.” On the other hand, communication failures left local officials unaware of the full extent of assistance required. As this state official commented, “If you do not know what your needs are, I can't request to FEMA what I need.” (Wachtendorf & Kendra, 2006)

Many feel that these problems are due to inadequate or inconsistent training among the participants. While this is no doubt true, what seems to be lacking in many organizations, at a more fundamental level, is the agility and flexibility to adapt to non-routine emergency situations in a timely manner. In other words, what is lacking is the ability to *improvise*.

[...] what we saw were failures to collectively make sense of the disaster and what was necessary to respond to it. Sense-making, a concept developed most comprehensively by Weick, is concerned with how people and organizations, constructing meaning in their environment, “construct what they

construct, why, and with what effects.” It is a concept that is closely connected to the *ability to improvise*, or to rework knowledge in novel ways under tight time constraints. (Wachtendorf & Kendra, 2006)¹

Despite what the popular usage of the term implies, improvisation is not simply “acting without planning”. Moorman and Miner define improvisation as the convergence of the composition and the execution of an action so that “in the limit, they occur simultaneously” (Moorman & Miner, 1998). Improvisation is characterized by the ability to recombine previously existing knowledge, skills, and other resources into novel combinations in response to the moment (Weick, 2001). Within the context of disaster management and response, improvisational skills do *not* replace existing emergency planning and preparedness processes or response protocols, but expand them in the face of rare, unexpected events. Research suggests that the ability to improvise may be centrally related to overall improvement in disaster management and response efforts (Weick, 2001).

Orasanu et al. (1998) find that the most common kind of decision error in aviation accidents occurs when the crew continues with the original plan of action in the face of cues that suggest changing the course of action. ... If firefighters were trained to become more skilled at improvising, then they might see the danger in an escalating fire sooner and disengage or reposition themselves or change their suppression tactics more quickly. The reason their situation awareness might improve is that when people increase their capability to improvise, they should increase the size of their response repertoire. The repertoire should get bigger because greater skill at improvisation makes it easier for people to recombine old skills and knowledge in new ways to deal with the unexpected. (Weick, 2001)

The ability to improvise successfully is dependent, at a basic level, upon the training and the proficiency of the improviser within the domain of practice. For example, jazz improvisation, perhaps the most famous example of organizational improvisation in the world, requires that the musicians practice their musical skills and their repertoire constantly (Barrett, 1998). The ability to successfully improvise (that is, to improvise with positive outcomes) as a group can also be successfully trained, by focusing on the skills required for successful group collaboration, as well as on the “rules” of collaboration in a given domain (Vera & Crossan, 2005). Mendonça and Fiedrich (Mendonça, Fiedrich, 2006) summarize the goals of training for improvisation in the emergency management context as:

- recognizing *when* to improvise,
- knowing *how* to improvise in a given situation,
- knowing how to *communicate* decisions and actions to other decision-makers and stakeholders,
- making *inferences* about likely present and future states of the environment.

Not only must the improviser determine whether or not pre-existing plans exist to account for various aspects of the disaster, they must also determine whether or not those plans can be carried out and whether or not they are appropriate given emerging needs. (Wachtendorf & Kendra, 2006)

Obviously, this characterization of improvisation implies that there exists some notion of what constitutes a “planned-for” situation -- and a plan for responding to it. It also implies that the improvisers (emergency managers) have the ability to recognize when the current situation is or is not within the assumptions of existing emergency plans; that they have a repertoire of existing processes, plans or plan fragments, and procedures from which to compose new actions in the moment; that they can predict with some accuracy how new actions should affect the present

¹ Emphasis added by the authors of this paper.

situation, as well as to recognize quickly when those predictions are wrong; and that collectively they are able to communicate and coordinate what is necessary to implement a new set of actions.

From this perspective, the shortcomings of current emergency management training practice, with respect to large-scale response, become apparent. Much of the training in emergency management consists of online classes and limited classroom instruction that may not be enough to adequately prepare emergency managers for real world situations. This problem is exacerbated by the fact that some of the necessary skills and knowledge required for large-scale incident response are called upon fairly rarely, so that even disaster managers and responders with much experience in local, day-to-day emergencies may not be as proficient at managing a more complex, multi-jurisdictional, multi-organizational event. Large, full-scale exercises to simulate such events, while invaluable and necessary, are time-consuming and costly, as well as difficult to coordinate among the different relevant agencies, and hence are conducted relatively rarely. As a result, currently the only way to get any proficiency in the skills required in major events is to have actually participated in several major events. Such experience is not as common as may be believed.

A great deal has been made of California's "experience" with disaster. This experience is believed to translate into real operational effectiveness. However, while dedicated and competent professionals remain, this experience is fading quickly – the Central Valley floods occurred 7 years ago, the Northridge Earthquake, 11, and Loma Prieta, 15. Experience is as perishable as it is invaluable. (Godley, 2005)

According to the most recent *Survey of State Directors of Emergency Management* by the National Emergency Management Association, **two thirds of state-level Directors of Emergency Management have been in their position for three or fewer years**, and approximately one third of them have fewer than twelve years experience in the emergency management profession² (NEMA, 2007).

Our goal is to build training software that will better enable emergency managers to develop the skills for successful improvisation, through shorter, focused, cognitively realistic representations of crisis response from the perspective of personnel in an *Emergency Operations Center* (EOC). The EOC is a pre-designated central location from which all off-scene activities are coordinated. For large, multi-incident or multi-jurisdictional responses, the overall jurisdictional response (city and/or county level) is managed from the city or county, or regional EOC. The key function of EOC personnel is to ensure that those who are located on the scene have the resources -- personnel, tools, equipment -- that they need for the response. They do not manage on-scene operations. The EOC also acts as a liaison between local responders and the State. State EOCs act as a liaison between local and Federal personnel (FEMA, 2006).

We have chosen to focus on personnel at the operational center level, rather than at the field-response level, because we are specifically interested in the skills needed to manage and coordinate an overall large event, rather than the response to a single incident. It is at these higher levels where many of the problems of coordination and communication will arise in large scale, multi-jurisdictional events (Macías and Aguirre, 2006; Wachtendorf & Kendra, 2006), and it is an area that is underserved by training and simulation software, relative to the first-response level. Our initial development efforts have focused on county-level emergency operation centers (EOCs).

² Forty-nine states, the District of Columbia and four U.S. territories completed the NEMA survey, for a total of 54 responses.

The remainder of the paper will introduce some empirical findings that have guided the design of our system. We will discuss the attitudes of professional emergency managers regarding improvisation, perceptions of current training and practice in the field, and precursors to successful improvisation in the crisis management setting. Finally, we will discuss the implications of these findings for the design of emergency management training software system.

IMPROVISATION AND EMERGENCY MANAGEMENT: A SURVEY

In order to help identify critical disaster management skills, as well as to identify gaps in current training practice, we conducted an online survey of professional Emergency Managers, accessible at <http://www.terrorismpsychology.net>. Subjects were recruited through postings to professional email lists and bulletin boards. As of the time of this writing, over 100 subjects have responded to the survey.

The survey sought to determine the prevailing perceptions of professional emergency managers about the state of both training and practice in emergency management, as well as their attitudes with regard to improvisation. On a theoretical level, the survey also included a set of questions aimed at trying to create an instrumental measure of “improvisational mindset” in individuals. This initial attempt to find an improvisational construct is discussed further in Appendix A.

The majority of respondents are male (82 out of 103 respondents)³; the median age is in the 40-49 range, with the mode being in the 50-59 age range (37 out of 103 respondents). The median span of time that respondents reported being with their current agency is in the 6-10 year range, with the mode being in the 1-5 year range (36 out of 100 respondents). Responses have come from professionals working in several states and at a wide range of agencies, from the federal to the local level, including Law Enforcement, Fire, Health services, hospitals, FEMA and state and local Offices of Emergency Management.

One of the first interesting results of the survey has been the relative newness of emergency managers in their positions: almost half the respondents (45 out of 100) report having been at their current agency five or fewer years. This finding does not necessarily reflect respondents’ overall emergency management or response experience: respondents reported having been deployed in some capacity to a median of 6-10 large (multi-organizational/multi-jurisdictional) incidents, with the mode being 20+ (20 out of 101 respondents). Respondents reported having some kind of command authority at a median of 3 such incidents. These results, however, are consistent with the findings of the National Emergency Management Association survey, discussed earlier (NEMA 2007).

Perceptions of Improvisation

The prevailing attitudes manifested in the study, both qualitatively and quantitatively, indicate a conception of crisis management very consistent with a conception of improvisation as “a mixture of the precomposed and the spontaneous” (Weick 1998). Nonetheless, many of the respondents tended to perceive the act of “improvisation” in a less than positive light; instead, they emphasize the importance of pre-planning, while acknowledging the importance of “flexibility” to successful crisis management.

Improvisation is a key skill, & comes with experience & training, but should be an emergency option based on solid knowledge & situational awareness, not used as a standard operating procedure or

³ Not all respondents answered all the demographic questions; the statistics reported here are for those respondents who did answer the relevant question.

Course of Action. Every major incident I have been in required some degree of improvisation, the worst required a lot, the best, the ones that you remember proudly, are where everything goes according [sic] to plan, & everyone goes home safely, or the entire incident is defused safely.

Plans and procedures anchor you but you must be flexible in your approach. Creative problem solving under pressure is the hallmark of the emergency manager.

Are you kidding? You have a plan so you have something to deviate from. Every incident is different, SOPs are followed as far as possible, but the ability to evaluate, adapt and overcome plays out in every incident.

Note the similarity of this last quotation to a quote attributed to jazz musician and composer Charles Mingus: “you can’t improvise on nothing; you’ve gotta improvise on something” (Weick, 1998).

Factor analysis on those questions intended to measure “improvisational mindset,” bear out this observation. The strongest factor in the responses (explaining about 18% of the variance) corresponded to the set of statements:

- Disasters can be seen as a process with distinct planning stages [vs. simultaneous planning and action]
- I feel at my best when I am forced to think on my feet.
- Reacting too swiftly can cause serious problems.

We interpret this as an “expertise” factor, based on the comments in the survey, as well as one-on-one conversations we have had with other professional emergency managers. These individuals are comfortable with spontaneous action, but are also aware of the dangers of blind reaction, and believe in the importance of planning for successful response. Further discussion of our attempt to find a construct for improvisational tendencies in emergency managers is discussed in Appendix A.

Issues in Multi-organizational Response

The results of the survey tend to corroborate previous research findings about issues that arise in multi-organizational response efforts. Communication was the most commonly cited issue in multi-agency response, both in terms of the interoperability of communication systems, and in terms of interpersonal communication (terminology, knowing who has what information). Other frequently cited issues include: the understanding or determination of roles and responsibilities, ambiguity in authority or the chain of command, resource availability, and coordination. Interestingly, some respondents also cited “ego”, politics, and the media as being primary issues.

The following sampling of quotations came in response to the survey question “*What are the primary issues encountered when managing a large scale disaster involving multiple agencies?*”

Communications. There needs to be a great deal more work done on interoperable communications. It is rarely an equipment deficiency, it is mostly a training, or operational, deficiency.

Communication is the key. There still are not effective communication strategies, especially backup methods in place. There are still problems with interoperability and simply letting folks know when and what information they should be communicating to whom is a challenge.

Lack of being able to obtain timely and accurate information. Misconceptions regarding the roles and responsibilities each agency has. Important decisions being made for political reasons and not for the

sake of doing what is best to manage the emergency.

"Communications, period. Not just radios, not just interoperability. Egos get involved (see state and local response, Katrina).

personal ego issues typically involved communication issues: techno [technology problems?] & failure to preplan how to effectively communicate between each other.

Respondents also cited the importance of “speaking a common language”, and “being on the same page” – the most important contribution of NIMS would seem to be the fact that it provides a framework that makes these two points possible.

"Mandating the use of ICS⁴ for all response personnel works well. Everyone is on the same page, and the common terminology greatly reduces confusion."

"If people are not trained, they don't understand how the system is supposed to work. If everyone is on the same page, it works well. However, if they don't know, all they do is get in the way."

Also mentioned were the value of interpersonal relationships – knowing the people in other agencies and jurisdictions who may be involved in a response with you.

Our region is doing well as we meet regularly, share documents and information and have developed personal relationships with each other. It's all about relationships. NIMS and ICS are all well and fine, however I have found that effective emergency management is about relationships.

As an aside, the survey revealed interesting perceptions within the population of respondents about the strengths and shortcomings of NIMS, and of current crisis management policy, including the role of politics. While we intend to explore these perceptions more fully in future analyses, in the current paper we will confine ourselves to the issues most directly related to training and improvisation.

Precursors to Successful Improvisation

Though no formal thematic analysis has been done on survey results at the time of this writing, some precursors to successful improvisation in the disaster management setting become apparent on initial readings:

Consistency /tolerance to inconsistency in training. A primary contribution of NIMS, as mentioned above, is that it should provide a common framework from which multi-organizational response efforts can be conducted. However, some respondents felt that training was often not consistent across jurisdictions and agencies, hindering coordination.

Different people from different states even though trained in NIMS perform differently. Can CA firefighters work with command structure of local fire departments in LA? No.

Other respondents observed that multi-agency response was most effective when all participants had trained together, testifying both to the value of interpersonal relationships, and the shared

⁴ The Incident Command System (ICS) is the combination of resources, procedures, and communications operating within a common organizational structure, designed to aid in domestic incident management activities. ICS is usually organized around five major functional areas: command, operations, planning, logistics, and finance and administration. The ICS structure is used by all emergency response organizations, from Federal to Local (DHS 2004). Although ICS is only part of the overall NIMS framework, it is the aspect that most readily comes to mind for many professional responders.

mindset that comes from consistency in the training.

The key is that ALL (or at least almost all) have trained at the same level and preferably together. Personalities (as in MBTI Type preference) play a BIG role in decision-making and communications. In our area LE, EMS, Fire, VOADS and the private sector train together in ICS, Critical Incident Management, etc. and it REALLY pays off when we activate and deploy together as we already "know" the other people.

[NIMS works] Somewhat well [when all participants have gone through similar training and exercise programs], because responders usually do not work multi-jurisdictional events on a regular basis, (crossing Co. lines).

Such issues are very related to the ability to communicate with other decision-makers, the primary issue in multi-agency response cited by emergency managers, and one of the four goals of training for improvisation listed by Mendonça and Fiedrich (Mendonça and Fiedrich, 2006). Ideally, one would eliminate such communication issues by increased consistency in training curricula across organizations and jurisdictions. Pragmatically, however, improvisation-based training may better address these issues by explicitly addressing what sorts of training (or organizational culture) differences may arise in a multi-organizational coalition: “traditional” responders versus public health workers, versus non-governmental or private-sector organizations, versus military responders, just to name a few examples. The understanding of what sorts of inconsistencies or communication issues may arise will allow the emergency managers to develop and practice the skills to recognize when these issues arise, and to develop strategies to deal with them quickly and effectively.

Hands-on training. Many respondents lamented the fact that training is often limited to classroom or online instruction. It was felt that such online or lecture-based training is inadequate to produce effective application of incident management principles. Instead, training should be reinforced by immediate and frequent exercise or application in real situations.

Also, those who have "heard" the material in training don't always really "understand" it - so the transition from training to application is sometimes about 10%. The longer the time period from training to field application the greater the gap. NIMS and ICS job aids should be used as the primary training reference so people will be able to use them in a real incident/event. Also, using ICS as a management and organizational structure for running day-to-day events helps reinforce the use under stress."

Equally significant for this discussion, research on the efficacy of “learning by exploration” suggests that functional and full-scale exercises – conducted as they are, outside the context of training and instruction in basic principles - are most valuable as methods for proving existing disaster plans and procedures, and for the practice of *already acquired* skills (Clark, 2004). With the exception of tabletop exercises⁵, current exercises are less efficient as actual *training* – that is, as a forum for novice disaster managers to acquire and develop new skills. Comments from respondents such as the above suggest that hands-on training, given in close temporal proximity to classroom instruction, would be of great instructional value.

Frequent practice of “the basics”. Many of the respondents felt that overall multi-jurisdictional response efforts would be improved if more of the participants incorporated NIMS

⁵ A *tabletop exercise* is a structured discussion among decision makers or responders, based on a scenario or set of conditions for potential emergency response situations. Its purpose is to promote preparedness by testing policies and plans and by training personnel. The emphasis is on slow-paced problem solving, in a low-stress environment, rather than on rapid, spontaneous decision-making (MSU, n.d.).

principles (including ICS) in “daily business practice.”

"The greatest problem is that other departments (other than fire, law, and OES) don't utilize NIMS other than trainings and exercises. Therefore, they don't remember and/or are not comfortable using NIMS and ultimately letting go of their day-to-day authority."

This suggestion may not be entirely practical, as ICS, in particular, presupposes a hierarchical and team-oriented structure similar to that of the military or the fire service. This operating structure may not be as representative of the day to day work environment of other organizations or agencies involved in a crisis response, such as law enforcement or health services. However, this comment does touch upon the observation that one must have a solid foundation in the basic principles and skills of the domain, developed and reinforced by frequent practice, before one can successfully improvise. Once the basic rules of the domain have been internalized, it becomes possible to more or less spontaneously transform and vary them in complex ways, to meet the situation (Barrett, 1998; Mirvis, 1998). For organizations that do not use an ICS-style structure on a day-to-day basis, it becomes even more important to practice emergency response procedures often enough to develop the fluency required for successful performance under the stress of a complex, dynamically changing event.

With respect to Mendonça and Fiedrich's four aspects of training for improvisation, both hands-on training and frequent practice contribute to the understanding of *when* and *how* to improvise, as well as the fluency in response protocols required for *communication* with other responders. For novices, hands-on training and practice with the participation of more seasoned emergency managers can also contribute to the ability to make *inferences* about the present and future state of the environment.

Consistent training up and down the chain of authority. Several respondents commented that executive level decision-makers and elected authorities did not properly understand their role in a major disaster, hindering response efforts by micro-management, or failing to fulfill their responsibilities on a timely basis. These respondents often mentioned the need to provide proper training to higher-level management. The hope seems to be that such training will not only improve the performance of higher level officials during a response, but will also increase their support of training, planning, and preparedness efforts prior to any disaster.

"Need more training by more people involved, especially upper management, Mayors and County Judges."

The problem with NIMS is in the rural setting, county officials have never been in the position of managing large-scale events. Most events are handled at the local event and do not even involve appointed/elected officials. Therefore they do not see the need nor stress the importance of NIMS training. NIMS must be supported from the top down.

Poor training & bad attitudes inexperience at senior levels can throw a wrench into the best plans. The higher the level of government, the more deadly the consequences of mismanagement (Katrina, Andrew).

These comments (particularly the last) are consistent with observations suggesting that once the scale of a disaster reaches catastrophic proportions, then the physical assets, the training of first response teams, and the technological tools available to manage the event become less important as compared to a relatively finite set of key decisions made by a small group of political actors or the mass behaviors of the general public (Macías and Aguirre, 2006).

Well-thought out, tested, practiced plans and procedures. As discussed earlier, many of the respondents emphasized the importance of creating, testing, and practicing Emergency Operations Plans (EOPs). While this would seem to contraindicate the use of an improvisational approach to training, we again recall the Charles Mingus quote cited above: “you can’t improvise on nothing” (Weick, 1998). Many of the respondents discussed the value of the planning process, not so much for the artifact (EOP) that comes out of the process, but for the process itself: evaluation of risk, evaluation of available resources, relationship building within and across organizations and jurisdictions. Done properly, the planning process contributes to the understanding of *when* to improvise (when an existing EOP may no longer be appropriate); *how* to improvise (by providing documentation of the goals that must be met at a given point in the disaster, as well as fragments of plans and procedures that can achieve those goals); how (and to whom) information must be *communicated* to other decision-makers.

You have to realize that plans are worthless but planning is everything. Planning helps the decision maker to make decisions quicker, make more appropriate decisions, and to be able to improvise better.

The key is that the planning process must be done properly. Respondents cited situations where responses were hampered because of out of date plans (plans that were not updated in response to, for example, population or demographic changes, or increased land development); out of date contact lists with other organizations; plans that had never been fully tested or evaluated before a real disaster situation hit; and incidents where pre-crisis precautionary measures dictated in the EOP were ignored, leaving the responders unprepared when the situation hit crisis level.

While many of the planning issues discussed above may seem to be outside the scope of a training system such as we discuss in this paper, the results of the survey do suggest that training and practice should be within the context of a jurisdiction’s EOPs. More about this will be discussed in the following section.

IMPLICATIONS FOR EMERGENCY MANAGER TRAINING SYSTEMS

Mendonça and Fiedrich’s goals for improvisation-based training	When to Improve	How to Improve	Communicate with other decision-makers	Infer likely present and future states of the environment
Corresponding training objectives				
Familiarity with existing plans and procedures	X	X	X	
Recognition of when situation is outside of plan scope	X			X
Familiarity with other organizations participating in response			X	
Recognition/Anticipation of organizational cultural differences			X	
Practice in a wide variety of situations	X	X		X

Table 1: Possible training objectives for improvisation-based emergency management training

The precursors to successful improvisation that we have identified above, together with Mendonça and Fiedrich's proposed goals for improvisational training, provide us with a set of guidelines within which to design an improvisation-based training system for emergency managers. Table 1 provides a preliminary mapping of how Mendonça and Fiedrich’s goals for

improvisational training might be translated to a set of specific objectives (this list is by no means all-inclusive).

Two important training objectives are familiarity with existing plans and procedures (both the general principles described by the NIMS framework, as well as the more local EOPs, mutual aid and other agreements), together with an understanding of the assumptions behind those plans, and recognition of when the assumptions are violated. Together, these two objectives touch upon all the goals of training for improvisation. Placing the training in the context of existing local emergency plans and procedures (rather than specifically in terms of “improvisation”) also has the advantage that it sidesteps the somewhat negative attitudes about the term “improvisation” among disaster managers, while still conferring the benefits.

Familiarity with other organizations that may also respond during large multi-jurisdictional events – and training with them as much as possible – improves the ability to communicate with other decision-makers. Large-scale incidents may bring in people from other organizations who have not worked with the local responders or emergency managers previously. As mentioned above, emergency managers should also be trained to anticipate and deal with communication and other issues that may arise in that event.

An example of a real-life situation that may have benefited from explicit consideration of the assumptions behind plans and procedures, as well as practice in communication with non-local responders, is the “firespotter incident” in the recent San Diego Fires (Davis & Blood, 2007). In that incident, 19 Navy and Marine helicopters stood ready to assist in the response, but were not allowed to fly, because under state rules, a California Department of Forestry and Fire protection “firespotter” must accompany each military or National Guard helicopter. Not enough firespotters had reported for duty by the time the helicopters were made available. Eventually, a compromise was made, whereby a single firespotter coordinated a squadron of three helicopters.

Although this situation was in fact resolved, it is possible that the compromise might have been brokered sooner, if the reasons for the firespotter rule - to coordinate water or fire retardant drops, so as not to endanger firefighters on the ground - had been considered explicitly, with an eye to satisfying the spirit of the rule, if not actually the letter.

Finally, the scenarios that are used for exercises should simulate aspects of a range of situations, from “textbook” incidents – incidents that are well anticipated by the EOPs - to rare, high impact events that involve situations and other organizations that are not encountered in more local disasters. This will provide practice in knowing when and how to improvise, and exposure to a variety of situations will help the trainees develop the intuition required to infer the effects of proposed actions on a given situation going forward.

We envision our system as one that complements an ongoing program of discussion-based, functional and realistic full-scale exercises. Accordingly, the system should be able to provide frequent, relatively brief scenarios that focus on drilling the thought processes needed by each role in the EOC during a response situation: coordination, communication, situational awareness, prioritization of requests and tasks – all within the context of their role, in close to real time.

Figure 1 illustrates how such a system might be instantiated. Brief simulations, perhaps spanning the activity of one or two operational periods during a response, are run by a training facilitator. Each participant has a view tailored to the role they play in the EOC; the activity on their screen reflects the information, messages, and requests that they would see in a real situation. For example, someone whose role involved tracking and fulfilling facilities requests (evacuation

shelters, housing accommodations for out-of-town responders, etc) would see requests for various facilities come in as messages. They would be responsible for locating appropriate facilities and arranging for their use and for coordinating supplies/furnishings for the facilities, using maps, “directories”, and other information sources provided through the simulator, and by interactions with other players.

The facilitator monitors the progress of the players, and can inject additional events into the simulated world, for the purpose of further evaluation of participant performance, or to guide them to exercise some specific set of skills. The participants can interact with the simulation, and with each other. The actions of the participants, and of the facilitator, will be recorded, for playback during an after-action analysis, so that participants can analyze the results of their strategies and actions, and identify skill areas that need improvement.

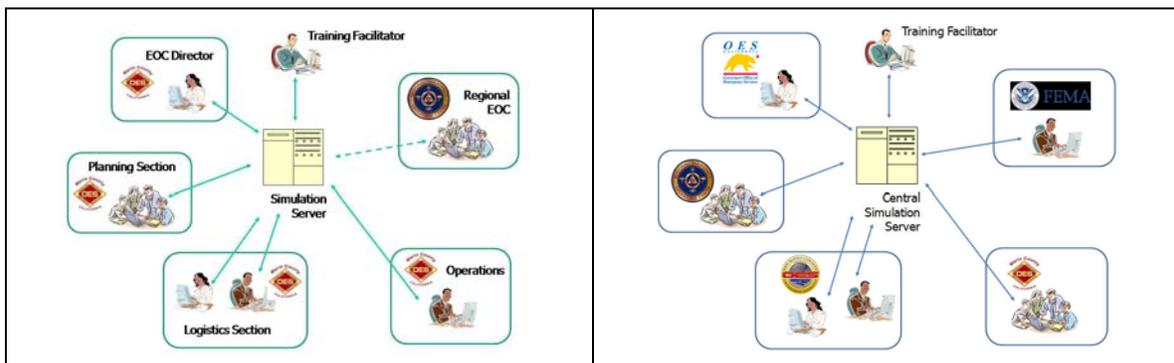


Figure 1: Participants can interact with the scenario and each other through a central server. A Facilitator also monitors the session, and interacts with the scenario.

In Figure 1, we show two possible uses of our envisioned system: to the left, players within a single local EOC practice their roles, with another player (possibly remote) representing a representative of the state or regional EOC interacting with the local EOC. To the right of Figure 1, players from multiple EOCs, and a player representing FEMA, practice the response coordination that would be required for a geographically dispersed incident, such as an earthquake.

Providing the trainer with the ability to inject events into the simulation in real time enables him or her to tailor a given scenario to the strengths and weaknesses of the specific set of players. It also enables a single scenario to be replayed several times, with gradually increased complexity, thus providing players with more opportunities to develop, practice, and improve improvisational skills. The training facilitation will also allow the novice managers to be monitored and guided by more experienced managers, particularly in developing skills related to situational awareness, and the ability to make inferences about how proposed actions will affect the ongoing situation.

The system will be distributed, to facilitate training games across multiple agencies and regions (as shown on the right hand side of Figure 1). This encourages relationship building and the development of cross-agency communication channels, two factors that our survey respondents identify as crucial to successful response performance (and successful improvisation). In addition, the additional exposure to fellow responders and crisis managers from a variety of agencies will give an emergency manager experience with a variety of different working styles and organizational cultures, and how to work with them in a response effort.

In the long term, we also hope to expand this system to training of executive –level decision

makers, and elected officials, providing a consistent training process up and down the chain of authority.

The Role of Policy

While we believe that an improvisation-based training approach will greatly benefit how emergency managers will perform in low-frequency, high-consequence events, it is clear that improved disaster response performance can not be achieved with only technology solutions or new training frameworks (Franco, et.al, 2007). In the long run, improved performance will only be achieved through policies that create an atmosphere conducive to successful improvisational training. As discussed above, training and practice must be extended in a meaningful way to include executive-level decision makers and elected officials. These same decision-makers must also actively support the disaster planning and preparedness process; this means providing for enough resources to enable emergency professionals to engage in frequent training and practice, including cross-agency practice, and to keep emergency plans up to date, in addition to their other duties.

We do hope, however, that the creation of tools to support an improvisational training framework, frequent practice and increased cross-agency training will serve as a catalyst for such change. Without tools to support the process of constant, cross-agency, multi-level skills practice, it is quite likely that such a process will not come into being. As an analogy, the Internet existed for decades, with a relatively narrow user base, before the creation of the World Wide Web brought widespread traffic, leading to entirely new, unanticipated industries and applications. Similarly, the creation of new tools to support processes for bringing about improved disaster response performance will hopefully spur the creation and widespread adoption of new processes and practices in disaster response and emergency management.

CONCLUSION

In this paper we described why improvisation is an appropriate framework for training of emergency managers and EOC personnel. We have identified some precursors to successful improvisation in the disaster response domain, based on the comments of professional emergency managers. Currently, we are designing a training system, based on the issues and considerations described here, aimed at the personnel who would staff a county-level Emergency Operations Center. Such a system will improve the ability of communities to cope with unexpected, large scale, highly complex disasters. It will give them the ability to evaluate the scope of the community's preparedness plans, and to develop and improve the improvisational and other response skills of their emergency managers, and EOC personnel, in advance of real events, in a more time- and cost-efficient manner. In addition, it will facilitate training exercises across organizational boundaries, further improving the national disaster preparedness.

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APPENDIX A: TOWARDS AN IMPROVISATIONAL CONSTRUCT

A 40-item questionnaire was generated and posted as a web-based survey using a commercial web survey service. Participants were recruited using emailed invitations to individual professional emergency managers and various listservs used by the emergency management community.

One of the goals of the survey was to begin the validation process of the 13-item improvisation questionnaire included in the survey. While this area has received a good deal of theoretical exploration, very little empirical information about how improvisation can be conceived of in the context of disaster management is available. Using three of the theoretical underpinnings of improvisation offered in the extant literature on the subject, three 4-item sub-scales designed to address different aspects of improvisation were developed *a priori*. The sub-scales included questions addressing *inventiveness*, *simultaneity of planning and action*, and *suddenness of events*. A final, face valid question, asking participants to rate the importance of improvisation to emergency management response was also included as a criterion item.

The internal validity of a new scale can be demonstrated by showing response consistency within the items in the measure. The total scale consistency was questionable (Cronbach's Alpha = 5.868). Further, the reliability of the subscales was poor with Alpha = .3996 for inventiveness, Alpha = .5045 for simultaneity of planning and action, and Alpha = .1596 for suddenness. Based on the inconsistency within the subscales, but marginal consistency for the overall scale, item-total statistics were explored. By eliminating three items that degraded internal consistency, a revised 10-item total scale was derived, with slightly better internal reliability (Alpha = .6264). Further, an examination of intercorrelation tables showed that while it was predicted that many of the items in the total scale would correlate significantly with the criterion item, "Improvisation is a fundamental skill for disaster managers," the data did not support this conclusion.

However, a number of correlations across items within different subscales were detected through this process, and as a result exploratory factor analysis was undertaken to probe for an unpredicted component structure that might offer insight into the participant's responses. While the number of participants necessary for factor analysis is typically greater than the cases considered for factor analysis here ($n = 55$ after cases with missing data were removed), preliminary tests of the appropriateness of factor analysis were at least marginally met (KMO test of sampling adequacy = .596; Bartlett's test of sphericity was significant). Principal factors extraction with varimax rotation was performed on the 10-item revised improvisation scale. Five factors were extracted using a standard decision rule to include only factors with eigenvalues > 1 . Visual examination of the scree-plot confirmed that a five factor solution was reasonable.

Interpretation of Factors

The first factor included three items:

- Disaster management can be characterized a process that has distinct planning and action phases vs. a process that requires nearly simultaneous planning and action
- I feel at my best when I am forced to think on my feet
- Reacting too swiftly can cause serious problems.

One way of interpreting this factor is a "general expertise" component. The extant literature and informal discussions with emergency managers suggests that these individuals hold a somewhat paradoxical ability to act rapidly in the absence of a formal plan and are comfortable thinking on

their feet, yet an equally cautionary stance is take – the professional emergency manager attempts to prevent unnecessary overreaction. This interpretation is also consistent with views drawn from the Naturalistic Decision Making (NDM) perspective on expertise (Klein and Salas, 2001).

The second factor includes two items, one from the inventiveness subscale and one from the simultaneity subscale. These are:

- During disasters I use resources / personnel in new ways
- I have been forced to rapidly devise a completely new approach to a problem.

This factor can be interpreted as “tactical inventiveness”, related to making sudden procedural changes to fit situational needs. Rather than what we have conceptualized here as improvisation at the emergency management level, this factor appears to better fit the idea of “procedural improvisation” (at the field response level) offered by Mendonca and others.

The third factor draws on one item from the inventiveness subscale and one from the suddenness subscale. These were:

- my role as a disaster manager is to be inventive
- If several significant problems arise, it is best to get more resources as quickly as possible (vs. reconsider the incident completely).

Again, this factor is somewhat paradoxical in that theoretically it was anticipated that improvisers would view reconsideration of the event as central to acting in an improvisational manner. However this factor suggests that to be inventive, one must also have resources to invent new solutions with. Understood from this perspective, this factor can be considered “strategic inventiveness” – a process that involves both the willingness to generate new ideas about how to handle a situation and the recognition that execution of these novel approaches is resource dependent. This can be construed as a more intensive, long-term approach, consistent with Moorman and Miner’s observation that inventiveness and improvisation are distinct concepts (e.g. it is possible to be inventive without improvising – inventiveness can have a distinct planning component) (Moorman & Miner, 1998).

The fourth factor only had one item load from the suddenness subscale:

- When faced with a complex, time sensitive problem, it is usually better to respond immediately with the resources at hand vs. wait to get the right resources.

Because of the single item loading, interpretation of this factor is difficult.

Finally, the fifth factor involved the criterion item, and an item from the suddenness subscale addressing time perception:

- Improvisation is a fundamental skill for disaster managers
- During a disaster my perception is that it moves faster than normal vs. more slowly than normal.

Interestingly, none of the other items loaded on the same factor as the criterion item, suggesting that the fundamental construct of improvisation continues to be elusive. However, the apparent relationship between improvisation and time perception lends preliminary support to one of the hypotheses underpinning this research – that slowed perception of time may provide a cognitive buffer which allows for improvisational thought to occur. If this is the case, a number of avenues for future research and development work open. For example, information systems designed to assist disaster managers may also be constructed to manage individual and group perceptions of

time to encourage improvisational thinking.

A list of the factors (components), along with their respective eigenvalues, percent variance explained by each factor, and cumulative percent variance explained are shown in Table 2 and Table 3.

Rotated Component Matrix

	Component				
	1	2	3	4	5
Inv 3: During disasters I use resources / personnel in new ways		.743			
Inv 4: My role as a disaster manager is to be inventive			.799		
Sim 1: (REVERSE) Faced with a complex, time sensitive problem it is better to				.876	
Sim 2: I have been forced to rapidly devise a completely new approach		.885			
Sim 3: Disaster management can be characterized as	.688				
Sim 4: I feel at my best when I am forced to think on my feet	.766				
Sud 1: Unanticipated, critical problem arises, it is important to					
Sud 2: Reacting too swiftly can cause serious problems	.794				
Sud 3: During a disaster, my perception of time is that it moves					-.700
Sud 4: If several significant problems suddenly arise, this indicates that			-.745		
Sud 5: Improvisation is a fundamental skill for disaster managers					.714

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a Rotation converged in 7 iterations.

Table 2: Component Matrix

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.366	21.513	21.513	2.366	21.513	21.513
2	1.687	15.341	36.854	1.687	15.341	36.854
3	1.245	11.317	48.171	1.245	11.317	48.171
4	1.117	10.156	58.327	1.117	10.156	58.327
5	1.021	9.285	67.612	1.021	9.285	67.612
6	.938	8.524	76.136			
7	.738	6.710	82.846			
8	.538	4.891	87.737			
9	.502	4.562	92.298			
10	.443	4.026	96.325			
11	.404	3.675	100.000			

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	2.001	18.190	18.190
2	1.546	14.050	32.240
3	1.384	12.582	44.822
4	1.318	11.983	56.805
5	1.189	10.807	67.612

Table 3: Total Variance Explained