An Analysis of the Risk Management Decision Making Processes & the Decision Support Systems in the Wildland Fire Agencies

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Abstract

This paper offers an analysis of the risk management process, decision support systems (DSS's), and other types of decision making, including recognition primed decision making, bricolage and sensemaking with the goal of improving DSS's and decision making.

Many types of risk management processes and DSS's exist in wildland fire, wildland fire, and prescribed fire at the tactical, operational, and strategic levels. DSS's may be thought of as any technology or knowledge that is used as an aid in decision making. In the wildland fire community, DSS's exist as check-lists, handbooks, implementation guides, computer programs, and more. This paper looks at several of these DSS's in order to understand their strengths, weaknesses, opportunities, and threats.

Many wildland fire suppression agencies and other high reliability organizations have embraced what may be called a rationalistic based decision making process in the form of risk management, programmed decisions, and more. Critics charge that while an attempt is made to rationalize decisions, many 'judgments' within the rationalistic systems reduce their logic making their rationality questionable. While rationalistic based decision making processes exist at all levels of the fire suppression agencies, naturalistic decision making is found primarily at the tactical level in the form of recognition primed decision making (Klein, 1998), or bricolage (Weick, 1993). Many argue that the risk management decision making school of thought is contra indicated by the naturalistic decision making school of thought. This paper offers a comparison analysis of various types of decision making processes. Finally the role of DSS's in the naturalistic and rationalistic based decision making is explored.

INTRODUCTION

This paper is based on the premise that the decision support systems (DSS's) used in wildland fire suppression should be integrated so that they function optimally together in a seamless manner. Ultimately this type of integration would begin to integrate the DSS's and their uses at the tactical, middle, and strategic levels of action. DSS's may be thought of as any technology or knowledge, whether in a material or immaterial form, that is used as an aid in decision making. Many types of DSS's exist in wildland fire, wildland fire use, and prescribed fire at the tactical, middle, and strategic levels. In the wildland fire community, DSS's exist as check-lists, handbooks, implementation guides, computer programs, and more.

The decision support systems examined here include the 59 fire guidelines (which include the 10 Standard Firefighting Orders, the 18 Watch Out Situations, the 7 Downhill Line Construction Checklist, the 4 Common Denominators of Fire Behavior on Tragedy Fires, the 7 Look Up, Down & Around Factors, the 4 LCES Components, and the 9 Wildland Urban Watch Outs) and the Region 4 Incident Organizer, (Version 2004). It is believed that these DSS's (the 59 fire guidelines and the Incident Organizer) should be integrated with the basic components of an Incident Action Plan (IAP), the Wildland Fire Use Implementation Procedures Reference Guide, and the proposed new fire doctrine. These documents provide the entire spectrum of rules and strategies that guide the fire and fire use communities. Despite the fact that such a large scale project is beyond the scope of this paper, it is never-the-less important to address the issue of a "full spectrum" of integration of DSS's because they operate at all levels of action from the tactical level, to middle level, to the strategic level. They operate on all sizes of fire and fire use. While in some ways the tactical, middle and strategic levels operate independently of each other, in other ways they are closely tied together, and an action or aim at one level may impact one or more of the other levels. So while this project is just beginning the discussion of the integration of rules, actions, and aims, the integration proposed here is only part of the picture, and it must be taken in a context of all levels of action and all levels of DSS's.

The need for the integration of the DSS's and planning and action at the tactical, middle, and strategic levels can be seen in two manners. First, the present set of DSS's is inconsistent with a significant amount of redundancy, fluff, and gaps. Second, those using the present set of DSS's are overwhelmed by the amount of checklists that range from the Fire Orders to computer aided decision systems. Both of these topics will be discussed in greater detail below.

This paper has both a general and specific goal. The general goal is to demonstrate the need and the process for the integration of all DSS's, i.e. those at the tactical, middle, and strategic levels. The specific goal is to present one such integration. The example of integration presented here is the integration of the 59 fire guidelines and the typical incident organizer (IO). The present study attempts to integrate the 59 fire guidelines and the typical IO in order to gain efficiency and effectiveness by eliminating the overlap between the DSS's to create a more seamless operating tempo, by gaining consistency in operation, and by integrating tactical, middle, and strategic level planning through a common body of DSS's. Since the DSS's have never been integrated, this analysis will address only some of the possibilities in integrating the documents.

WHY THE INTEGRATION OF THE DSS'S IS NECESSARY

This author's own research which consists of conversations with hundreds of firefighters and fire managers demonstrates two points. As they are now configured, the use of the DSS's at the tactical and middle levels is inconsistent and haphazard. People essentially pick and choose to rely on their own

personal set of Fire Orders, Watch Outs, and so on. Second, these same people believe that there are already too many DSS's to utilize effectively.

Vergari demonstrated in *Back to Basics for Fire Program Managers* (2005) that there is little consistency in the manner in which firefighters plan and act, and also that there is a wide variance of understanding and usage of tactics, objectives, and strategies. Vergari had worked with a team of people to develop the ICT 3 training module. Upon implementation of the simulations, Vergari noted that not only did the trainees act very differently to similar situations, but also that the simulation evaluators graded similar behaviors differently, and accepted almost without question a wide variety of outcomes. This demonstrated to Vergari that some fundamental training and behavior is problematic. A more unified set of DSS's could aid in developing a greater level of standard, and better, operating outcomes.

Black, et al (2007) examined errors and lessons learned in thirty prescribed fire escapes. She found that one common problem was an error in under rating the complexity of the incident. While she did not elaborate on whether the error was in the usage of the complexity analysis DSS or in implementation of the output of the DSS aided decision, this error demonstrates that DSS's can and are being misinterpreted, misused, or are somehow linked to outcome failures. It is the contention of this paper that the integration or linking of DSS's into a common, consistent structure would make these types of errors less likely.

Thomas, et al (2007) interviewed, as he calls them, the 'masters of fire' in search of their insights and tactics, or what may be called their wisdom or "deep smarts." Thomas found that these experts did indeed have a large body of useful knowledge to pass on to the fire community. In the discussion below, it is noted that while the DSS's do indeed need to be integrated, eliminating fluff and redundancy, there are still many gaps in the systems that need to be filled with what is common knowledge in the fire community, but also with this uncommon knowledge as manifested in fire experts. Integration of the DSS's is the best way to determine not only where there is redundancy in the system, but also where there are gaps.

STANDARD OPERATING GUIDELINES (SOG's)

Recently, this author has presented work consolidating the 59 fire guidelines into the ten essential factors in (wildland) firefighting (TEFF). The TEFF consolidated 59 firefighting guidelines, including the 10 Standard Firefighting Orders, the 18 Watch Out Situations, the 7 Downhill Line Construction Checklist, the 4 Common Denominators of Fire Behavior on Tragedy Fires, the 7 Look Up, Down & Around Factors, the 4 LCES Components, and the 9 Wildland Urban Watch Outs, into ten essential factors in wildland firefighting. (See Appendix T for more on the TEFF.) The principles behind the development of the TEFF are important in understanding both the purpose and the functioning of an integrated set of DSS's. As was reported in the Tridata studies (1998) after the South Canyon Fire of 1994, firefighters and fire managers do not believe any more checklists or other DSS's are needed. Despite this, rules and guidelines have continued to grow. As a result of the 30 Mile Fire, Incident Organizers and other documents and procedures have been changed and expanded. It is not clear what changes will occur as a result of the Cramer Fire and all the implications of the 30 Mile Fire have not yet played out. And it is likely that tactical level rules and guidelines will *continue* to growth despite the pleas to the contrary. The analysis presented here holds that the solution to this problem is not to force a moratorium on guidelines, rather it is to systematize and organize them in order to eliminate fluff, redundancy, and confusion and replace them with a tighter, more efficient system. Ultimately that system would develop from what it is now, a series of "orders," "watch outs," "checklists," "common denominators," and so on, and replace them with standard operating guidelines (SOG's) which direct flexible action with greater clarity than currently exists. An example of the weakness of the current system can be seen in the debate within the wildland fire community which occurred in the years following South Canyon over whether the Fire Orders were in fact invioble orders or whether they were

simply guidelines. (No clear policy directive on this debate was ever reached even though consideration of it occurred in the upper echelons of the firefighting community). A clear set of SOG's would end such a debate because they would clearly state where a standard operating procedure functioned and where it did not. And as discussed at the end of this document, there are methods for addressing situations where SOG's usefulness ends.

While the principle of establishing SOG's is not the focus of this paper, the integration of the 59 fire guidelines, the IO, and other DSS's is a step in that direction. And both SOG's and the integrated DSS's aim to systematize and standardize planning and action, as well as offer an aid to dealing with information overload.

INFORMATION OVERLOAD

The very necessity of using checklists, shortcuts, handbooks, DSS's, etc. demonstrates that there are innumerable factors impacting any given situation on the fireline. And because the environment is turbulent, i.e. changing rapidly in real time, the factors impacting fireline situations also change rapidly. Furthermore, while there are innumerable factors impacting a typical situation on a fireline, in a crisis situation, with the additional factors that arise, the number of factors interacting becomes infinite in a practical sense.

The principle demonstrated here is that the fireground and the training a firefighter receives are both capable of creating the potential for information overload on the fireline. The concept of information overload is experienced as a result of both the physical factors on a fire as well as the professional training received by all firefighters creates. These factors create an extremely large body of situational knowledge and background knowledge with which the firefighter must process.

Some people choose to use the existence of information overload to argue that a development of integrated, comprehensive DSS's or SOG's is impossible. Their solutions lie in either eschewing rational decision making (for recognition primed decision making (RPDM) or bricolage) or in standing by the status quo. But the fact remains that the firefighting community has never tried to organize a more concise set of operating directives. It is the contention of this author that it is quite possible to overcome information overload, and as discussed below, that integrated and systematized DSS's can operate well using the decision making styles of risk management, RPDM, or bricolage.

NESTING

The TEFF consolidated the 59 fire guidelines into only ten factors or guidelines that the firefighter on the ground needs to follow. The TEFF was designed so that if a firefighter notices or senses that there is a problem meeting the requirements of an individual TEFF, then they need to refer to the numerous rules that resulted in the formulation of that individual TEFF. For example, if a firefighter notices that communications are problematic, under a fully developed TEFF system, the firefighter might refer to any or all of the appropriate former guidelines such as Fire Order 7: Remain in communication w/ crew members, your supervisor, & adjoining forces; or Fire Order 8: Ensure instructions are given & understood; or Watch Out 5: Uninformed on strategy, tactics, & hazards; or Watch Out 6: Instructions & assignments not clear; or Watch Out 7: No communication link w/ crew members or supervisor; Downhill Line Construction Rule 3a: Crew supervisors is in direct contact w/ lookout who can see the fire; or any of a total of nine fire guidelines dealing with communications that are scattered throughout the 59 fire guidelines. In addition, as this author's analysis of the 59 fire guidelines demonstrated, there are also gaps and omissions of common situations, indicating that there may need to be new tactical guidelines added to any comprehensive curriculum on tactics & tactical DSS's.

The principle demonstrated here is that, like the TEFF, the DSS's are always shortcuts with a large body of knowledge, or rules, behind them. Large amount of knowledge are nested within shortcut guidelines such as the TEFF, the Fire Orders, and many other fireline guidelines. Thus, under the proposed new system of integrated DSS's and SOG's, no information is lost, it is only organized or nested for easy access.

HIERARCHICIZATION

The existence of information overload and the necessity of nesting that information implies that information must be arranged in a hierarchy, i.e. that some information is more important than other information. The principle of hierarchy implies that the firefighting community must decide the best short hand methodology and terminology for its DSS's so that general categories are examined first, and then as they either become problems or enter into the risk management decision making process, the information that backs them up would become apparent.

If these principles of standardization, nesting, and hierarchicization were firmly established in wildland fire, then both the curriculum and the DSS's which attempts to summarize the curriculum would be arranged so that firefighters could address problems with the most general rules, and then address finer points by moving into the more detailed levels of the nested hierarchy of information.

Returning to the example of the firefighter who notices that communications are problematic, if that firefighter had a DSS, backed by a parallel training curriculum, she or he would examine that problem in a similar manner to any other firefighter and presumably in a more efficient manner than a firefighter would today. The current author's research confirms Vergari's (2004) contention that there are only minimal *standard* operating procedures in that most firefighters report that they rarely refer to any of the Fire Orders, Watch Outs or any of the other fire guidelines or DSS's, and that they interpret and utilize them in very different manners. Most firefighter's have their own personal 'core' of the 59 fire guidelines which they use regularly. Any of the DSS's or anything that looks like a standard operating guideline (SOG) is only referred to when there is some minor or major crisis which makes a decision difficult.

Today none of the DSS's are good examples of dealing with standardization, information overload, nesting or the hierarchicization of knowledge. The existence of 59 fire guidelines that have been compiled over the entire history of modern wildland fire suppression, the fact that many locales have their own model of an Incident Organizer, the fact that many locales have their own model of an IAP, the fact that many locales have their own model of a Fire Plan, and the fact that locales are left to interpret strategic direction in such a way that results in very different policies all demonstrate that there is little coordination in the wildfire suppression community.

INTEGRATING THE FIRE GUIDELINES & THE INCIDENT ORGANIZER

How might the 59 fire guidelines and the Incident Organizer (IO) be integrated? First, many IO's today are designed to meet 30 Mile Accident Prevention requirements. This is fine, but in the interest of integration, the 30 Mile Accident Prevention requirements should not be the center around which an IO is formulated. Below are some suggestions as to how IO's and the 59 fire guidelines might be improved through integration, standardization, recognizing information overload, nesting or the hierarchicization of knowledge.

In relation to integrating the 59 fire guidelines and the IO, the reader must note that because the curriculum of fire training is not nested or hierarchicalized, the fact that the 59 fire guidelines and the IO's are not nested or hierarchicalized is not readily apparent. Firefighters have not been trained to think or operate based on any hierarchy of knowledge or SOG's. This point is important for the following

analysis because the integrations proposed here would be much more valuable if firefighters were trained in a manner that encouraged the use of SOG's, nested knowledge, and hierarchicalized knowledge. This analysis' proposal for the integration of all DSS's, for the integration of tactical, middle, and strategic level planning and action implies that such an integration of all firefighter training would also prove valuable. In fact, the wildland fire agency's development of a new foundational doctrine is a good beginning. For the purpose of this paper, the reader need only focus on the fact that as the discussion of the integration of the 59 fire guidelines and the IO proceeds, that this integration would be more useful to firefighters trained to think and operate based on integrated, nested SOG's.

Currently the organization of the IO is accomplished in 14 sections, including 1. size up, 2. resource summary, 3. objectives, 4. organization, 5. map sketch, 6. radio frequencies, 7. risk management, 8. decision points, 9. risk analysis, 10. incident complexity analysis, 11. summary of actions, 12. spot weather forecast, 13. work rest ratio documentation, and 14. the after action review.

Most IO's begin appropriately with a fire size up section. The suggestion here is that the size up should clearly be divided into two segments: the physical fire size up, and the resource size up. Currently this is done in section 1: the size up; and section 2: the resource summary. Some of the information about resources is done in its own section and is not seen as part of the size up. Some of the fire size up is done in section 10: the incident complexity analysis; and section 12: the spot weather forecast. It is important to integrate the fire and resources size up so that the incident commander (IC) and firefighters start their planning based on what they can do, rather than simply on what needs to be done. This ties both the IO and the incident's plan to the strategic plans of the administrative unit under which this fire suppression effort is operating in that the IC may request more resources, but the Fire Program Manager (FPM) may want to allocate those resources to another incident. The pairing of the fire situation with the available resources establishes the idea that a safe incident is one that accomplishes what it can with the available resources. It is felt that this would minimize any chance of "over-zealousness" as spurious as that argument was.

The fire size up itself should be divided into clear segments that address the TEFF factors of fire behavior, fire status, fuel type, weather, and terrain. In combination, these five factors represent more than 40 fire guidelines including some of the Fire Orders, Watch Outs, Urban Watch Outs, and others. This focuses the firefighters' thinking in terms of these five critical factors related to the physical fire, and should be accompanied by a similar focus on the fire guidelines that apply to these critical physical fire factors.

A radical change from current practice would have the IC or the person filling out the size up, indicate both current conditions, *as well as expected conditions.* While admittedly this is not standard practice today, training firefighters to track specific conditions and to tie these conditions to the 59 fire guidelines and the IO would integrate the practice of tracking trends, tying trends to specific actions on the fireline, and to link both of these to the incident's plan in the form of the newly integrated IO. Tracking conditions is inherently part of the risk management process in that one is to engage another iteration of risk management any time conditions change, whether these be physical or firefighting resource conditions on the fireground. The 59 firefighting guidelines also inherently require trend tracking in, for example FO 3: Base all action on current and expected fire behavior; Downhill Line Construction Guideline 7: Bottom of the fire will be monitored; if the potential exists for the fire to spread, action will be taken to secure the fire edge; WO 11: Unburned fuel between you & fire; and more. Tracking conditions on the fireline is another DSS schema to encourage firefighters to link SOG's, conditions, and tactics (i.e. actions). An example of one possible method to track trends can be found in Appendix M: The Trends Matrix.

As discussed above, section 2: the Resource Summary should be part of the initial size up in order to facilitate the standard procedure of establishing a plan that fits the resources. This should emphasize the principle that the IC and the firefighters need to be aware of the situation and the resources that they

have to deal with that situation. The Resource Summary should divide resources into the categories of those actually on scene, those assigned to the incident but not yet on scene, and resources who are unfilled requests. Again the purpose is to emphasize the importance of ingraining into the thinking of firefighters the necessity of matching plans and tactics to resources. As this author's analysis of the 59 fire guidelines and the development of the TEFF indicates, the fire guidelines, as currently constructed, do not emphasize the necessity of matching tactics to available resources unless one counts "Fight fire aggressively, but provide for safety first." There are six other fire guidelines that refer to firefighting resources, (See Appendix T), such as FO 9: Retain control at all times, and all of the other resource oriented fire guidelines, as currently constituted, refer to controlling people, and not to matching available resources to tactics. It is believed that this is one of the critical lapses in our fire fighting guidelines which has resulted from the haphazard development of these guidelines, SOG's, over the decades of modern fire suppression.

Next in the IO is the tactical planning section. The tactical planning section might include the already existing section of Incident Objectives, the Incident Organization, the Map, and Radio Frequencies. Following that, in the existing IO are the sections on Risk Management & Decision Points, Incident Risk Analysis, Incident Complexity Analysis. It is felt that these sections should be integrated in a different manner in order to solidify the linkages between the fire guidelines, which are the best axioms that we have for SOG's, tactics, and decision making.

Note that while IO's could be reformulated in such a manner as to integrate in SOG's, this analysis focuses only on integrating in the DSS's that we have: the 59 firefighting guidelines and the IO.

In the present IO, the first Incident Objective is written in: SAFETY of firefighters and public. After that, the IC is free to enter in one or more objective of her or his own. Because it was not their original intended purpose, there are no specific objective written into the current firefighting guidelines; however, some objectives are implied in WO 8: Constructing line without safe anchor point; WO 9: Building fireline downhill with fire below; and several implied objectives in the Downhill Line Checklist. These firefighting guidelines imply a direct or indirect line placement objective. Thus, the current firefighting guidelines are noticeably lacking in supporting the development of objectives. The generalist nature of all the current firefighting guidelines fail to provide clear direction for the setting of objectives which makes it clear that while these guidelines do present the firefighter with the possibility of information overload, they are, none-the-less, incomplete. While the current 59 firefighting guidelines do not address incident objectives, incident objectives are perhaps the most important single factor impacting firefighter safety. Safe objectives make for safe operations.

Next in the current IO is the Risk Management & Decision Points, Incident Risk Analysis, Incident Complexity Analysis. These section have many facets which strongly imply, but do not make, connections to the 59 firefighting guidelines and other DSS's, especially the Incident Response Pocket Guide (IRPG, 2006). For example in the Decision Points Section, firefighters are asked to confirm that "Controls in place for identified hazards?" Here is the connection to the 59 firefighting guidelines which could be made more apparent, nested, and hierarchicalized. The Incident Risk Analysis (215a) has a similar connection which needs to be integrated with the 59 firefighting guidelines in that certainly some of the Fire Orders, nearly all of the Watchouts, as well as many others may be applied here under the rubric in the Incident Risk Analysis of "Hazardous Actions or Conditions."

In the Incident Complexity Analysis (Type, 3, 4, 5) many of the 59 firefighting guidelines can be implied, but none are directly referenced. For example, under the sub-section Fire Behavior, one of the components is "Weather forecast indicating no significant relief or worsening conditions." This component of the IO is represented in several of the weather related 59 firefighting guidelines such as FO 1: Recognize current weather conditions & obtain forecasts; WO 14: Weather becoming hotter & drier. WO 15: Wind increases and/or changes direction; CD 3: When there is an unexpected shift in wind direction or in wind speed; UW 8: Strong winds. Certainly the references to weather could be improved

in both the IO and the 59 firefighting guidelines. Many other components in the IO Fire Behavior section and sub-sections could be more effectively integrated with the 59 firefighting guidelines creating a seamless set of DSS's.

While many of the components of the IO's Incident Complexity Analysis are closely related to the DSS of the 59 firefighting guidelines, there are also components of that are not found in the 59 firefighting guidelines, and probably should be. For example, the sub-section Firefighter Safety has three components: (a) Performance of firefighting resources affected by cumulative fatigue; (b) Overhead overextended mentally and/or physically; (c) Communication ineffective with tactical resources or dispatch. The only firefighting guideline referred to here is, possibly, WO 18: Taking a nap near the fireline. This demonstrates again that the current 59 firefighting guidelines are incomplete. And perhaps in an integrated set of DSS's, these factors would be address more effectively.

THE DECISION MAKING PROCESS

Inherent in the argument for a seamless set of DSS's that function to integrate tactical, middle, and strategic planning and action is an argument for a particular type of decision making. Recent discussions within the wildland firefighting community have often implied that rational decision making, such as that found in the risk management decision making process, is inadequate. Many wildland fire suppression agencies and other high reliability organizations have embraced naturalistic decision making. Below, recognition primed decision making (RPDM), bricolage, and sensemaking are examined under the rubric of naturalistic decision making, but it must be stated that the supporters of these methods may not prefer this typification.

Recognition primed decision making (RPDM) (Klein, 1993) and *bricolage*, (Weick, 1993, 2001) are methodologies, which are akin to decision making, wherein the decision maker's expertise allows him or her to make a correct decision. RPDM is a method of decision making where the decision maker utilizes a first impression, visa vie intuitive or blink decision making, to develop an alternative which is then analyzed to develop the final decision which is implemented. Weick holds that the bricoleur demonstrates intimate knowledge of the situation, makes careful observations, listens, trusts her or his ideas, and proceeds while being open to feedback. Sensemaking is a set of skills, similar to decision making, utilized in an upbeat, on-the-run manner (Weick, 2007). Sensemaking may be more effective than a decision because it is an on-going process. Decisions tend to be viewed as a cognitive event or break that the decision maker and others tend to own, i.e. invest time and effort supporting. Sensemaking is less a decision than a direction and therefore people follow it to the extent that it seems advantageous and are less likely to become fixated on it, as they might a decision. RPDM, bricolage, and sensemaking are seen as integral parts of high reliability organization decision making.

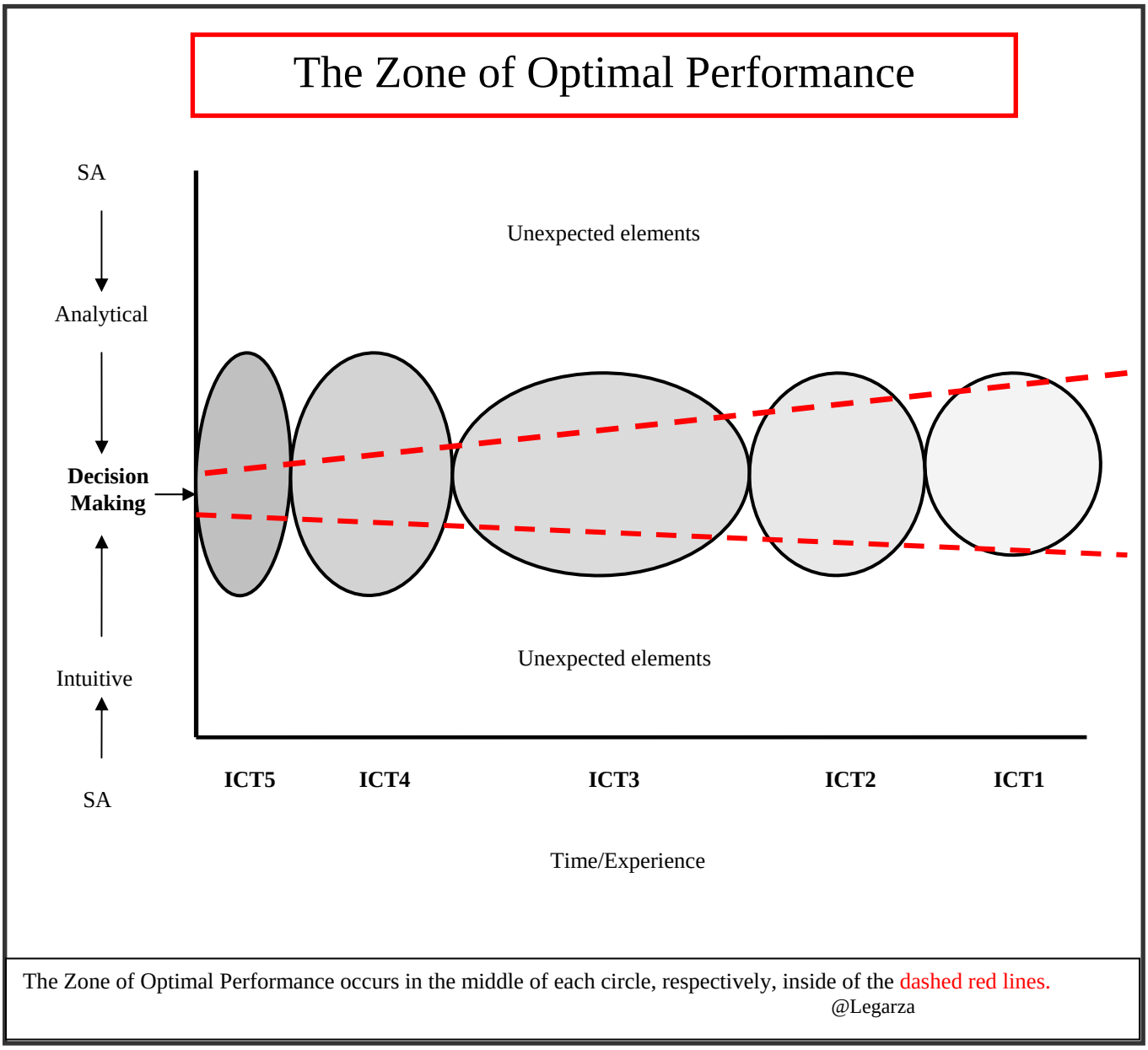
On the other hand, one of the primary models of decision making used by wildland fire suppression agencies is the risk management decision making process. The risk management process is listed on page one of the *Incident Response Pocket Guide* (IRPG) (January 2006). Many argue that the risk management decision making school of thought is contra indicated by the naturalistic decision making school of thought. However, this is not the case. It is this author's contention that all of these widely varied decision making systems can, and indeed do, work together in a manner that is beneficial to all. The system proposed here is one that would employ a seamless set of DSS's, SOG's and the risk management process of decision making to plan and act on fires at the tactical, middle, and strategic levels. RPDM, bricolage, and sensemaking are in many ways based on this system in that, however different, they take as their starting point the examination of excellent decisions made by accomplished actors.

The line between the use of the risk management process on the one hand, and RPDM, bricolage, and sensemaking, on the other hand, appears clear. However, the distinction is seldom clear in practice.

Utilizing Weber's analysis of the types of rationality (1948), the risk management decision making process operates via intellectual rationality, also known as instrumental rationality or the rational cognitive process, which is the ability to utilize people's rational problem solving capacities. Instrumental rationality may be thought of the process where one chooses the best means to achieve the desired ends. RPDM, bricolage, and sensemaking do not operate based on instrumental rationality because the decision maker is not using a cognitive process to choose the best means; however, they are choosing the same ends as those using the risk management decision making process. For Weber (1948), substantive rationality is the dominance of norms and values in the rational choice of means to ends. Substantive rationality creates the ability to draw on norms and values to make decisions and to motivate people to behave in a rational manner. Perhaps naturalistic decision making is best understood as substantive rationality because the decision is dominated by the values and norms (social rules) of effectiveness and success.

In practice most people rely on several decision making processes at once. For example in the situation awareness sub-process of the risk management process, one is to judge fire behavior. Because of the state of fire behavior analysis on the fireline today, most firefighters make their best estimate of that fire behavior, thus employing substantive rationality within the process of instrumental rationality. The people who successfully utilize RPDM or bricolage successfully are usually very accomplished in their field. Thus they have employed instrumental rationality many times, and it is based on this unquantifiable body of expertise that they make their substantive decisions.

The image below (Legarza, 2006) exemplifies the situations firefighters find themselves in. The DSS's, SOG's, and instrumental rationality in the form of the risk management process, operate best in the zone of optimal performance, i.e. between the dashed red lines. The ultimate goal of the DSS's, SOG's, and instrumental rationality must be to expand the area between the dashed red lines. But as Legarza recognizes, because firefighters are operating in a turbulent, high tempo environment, even if a firefighter does everything right, they may find themselves outside of the zone of optimal performance. Then one has the option, use one's training and education to gain the awareness or choices one needs to return to normal operations, or operate 'on instincts', one's best estimate, possibly using RPDM or bricolage, to choose a path of operation. While standard operating procedures as embodied in DSS's and SOG's are designed to address all contingencies, in practice this is impossible. When standard models reach their limits, when as Weick (1993) calls it, there is a 'collapse of decision making,' RPDM, bricolage, and sensemaking are useful decision making strategies.



The Zone of Optimal Performance occurs in the middle of each circle, respectively, inside of the dashed red lines.
@Legarza

Killion (2000) notes that RPDM can also be used by those with a large reservoir of experience to make decisions more quickly than would be possible using what he calls multi-attribute decision making, which is a form of instrumental decision making similar to the risk management process.

Naturalistic decision making may also be fruitfully employed within the zone of optimal performance, i.e. in standard situations, and in situations that do not require a very rapid decision. The use of naturalistic or the risk management process of decision making must ultimately come down to the characteristics of the decision maker. Naturalistic decision making can usually only be employed by the experts or masters in their field. Risk management decision making is optimally utilized by those with high levels of expertise, but it is also available and useful to people who are still gaining experience.

CONCLUSION

The importance of understanding these varied decision making processes is that in the development of DSS's, decision making skills, plans of action, etc., it is useful for actors to understand how and why they are making particular decisions based on particular decision making schemas. As we train and educate ourselves and others in fireline decision making, we must realize that we can move ahead on several fronts. We can move ahead in the integration of the DSS's and we can move ahead in advancing the skills of RPDM and bricolage.

APPENDIX M: THE TRENDS MATRIX

Below is an example of a matrix designed to allow the firefighter to track trends on a fire.

	Ten Essential Factors in Firefighting (TEFF)	Trends Matrix								
		Good			Medium					Extreme
		1	2	3	4	5	6	7	8	9
L	**L**ookouts									
C	**C**ommunication									
E	**E**scape Routes									
S	**S**afety Zones									
Fr	**F**irefighting **R**esources									
Fb	**F**ire **B**ehavior									
Fs	**F**ire **S**tatus									
Ft	**F**uel **T**ype									
W	**W**eather									
T	**T**errain									

APPENDIX T: TEFF THE TEN ESSENTIAL FACTORS IN FIREFIGHTING:

Lookouts, Communications, Escape Routes, Safety Zones, Firefighting Resources, Fire Behavior, Fire Status, Fuel Type, Weather, Terrain (LCES FFFF WT)

A summary of all the TEFF is found below. Of the 59 firefighting guidelines, they break out into the TEFF in the following manner:

TEFF	**Number of Guidelines**
1. Lookouts	5 Guidelines
2. Communications	9 Guidelines
3, Escape Routes	4 Guidelines
4. Safety Zones	4 Guidelines
5. Fire Resources	7 Guidelines
6. Fire Behavior	6 Guidelines
7. Fire Status	10 Guidelines
8. Fuel Type	7 Guidelines
9. Weather	8 Guidelines
10. Terrain	10 Guidelines
Total	70 (some Guidelines appear in more than one TEFF)
Average	7 per TEFF

Summary of the TEFF: The Ten Essential Factors in Firefighting

TEFF 1: Sufficient **Lookouts** are in place given the hazard assessment.

TEFF 2: Sufficient **Communications** are in place: generally communications are needed w/ lookout(s), crews, supervisors, & adjoining forces, but there may be other critical links.

TEFF 3: A suitable **Escape Route**(s) is known to all.

TEFF 4: A suitable **Safety Zone**(s) is known to all. The Safety Zone may be to exit the fire area.

TEFF 5: While more **Firefighting Resources** may be on order, Firefighting Resources are sufficient for firefighters to remain safe & to successfully implement current tactics.

 Factors over which you have total or limited control

 Factors over which you have no control, but must monitor

TEFF 6: **Fire Behavior** is understood in light of Weather, Terrain, & Fuel Type. Fire behavior is not doing anything unexpected, thus Firefighting Resources' tactics are succeeding as expected.

TEFF 7: The **Status or Scope of the Fire** is known to Firefighters, & current tactics are successful in light of amount of Firefighting Resources & to keep current Firefighters safe.

TEFF 8: **Fuel Type** is understood, and is exhibiting expected Fire Behavior

TEFF 9: The **Weather** is doing what is expected; no RH or wind trigger points have been crossed.

TEFF 10: The **Terrain** is not causing unexpected fire behavior, creating a hazard for Firefighting Resources, or compromising the Escape Route.

Side One of the TEFF Card (Actual Size)

	Ten Essential Factors in Firefighting (TEFF)	Trends Matrix Good			Medium				Extreme	
		1	2	3	4	5	6	7	8	9
L	**L**ookouts									
C	**C**ommunication									
E	**E**scape Routes									
S	**S**afety Zones									
Fr	**Fr**efighting **R**esources									
Fb	**F**ire **B**ehavior									
Fs	**F**ire **S**tatus									
Ft	**F**uel **T**ype									
W	**W**eather									
T	**T**errain									

Side Two of the TEFF Card (Actual Size)

	Fire Suppression Tactics Guide	
Engagement		Send Comments on TEFF to Patrick Withen
Anchor & Flank		McCall Smokejumpers, PO Box 1065,
Direct Attack		McCall, ID 83638 Cell: 276-275-1927
Frontal Assault on Head		pwithen@virginia.edu www.fireworld.info
Indirect	**Modify**	
Backfire/Burnout	Change Engagement Tactics	
	Pull Back to better line location (indirect)	
	Consolidate Forces	**Disengagement**
	Hold, Improve, Reinforce	Pull back closer to safety zone & break
	Patrol, Hold what you have	Retreat
		Evacuate
		Last Resort

Side Two of the TEFF Card provides a brief overview of Fire Suppression Tactics trisecting them into Engagement, Modification, and Disengagement.

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