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The Use of the Simtable in a Wildfire Prevention Program

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Certification Statement

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Abstract

The SFCFD needs an effective tool to enhance public education and wildfire prevention activities in the WUI. The Simtable is an interactive, three dimensional sand table incorporating state of the art agent modeling technology designed for firefighter education, training, and outreach. The purpose is to determine if the Simtable can be used successfully in a wildfire prevention program. Descriptive research reveals the basis for improving prevention activities; the development of the Simtable in comparison with the traditional sand table; and what is generally effective in wildfire education. A questionnaire, observations, and interviews indicate that the device is favorably regarded by educators, is well suited for use in prevention education, and will be a useful device in promoting wildfire prevention activities.

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Introduction

The Simtable is an interactive, three dimensional sand table designed for firefighter education, training, and public outreach. Simtable was developed by the Redfish Group in Santa Fe, New Mexico with the intention of expanding the scope of the conventional sand table, which has been used for many years to train wildland firefighters and military commanders, into a tool that incorporates agent based digital technology and provides real-time wildfire and evacuation simulation in a replicated geographic environment. Through the integration of cutting edge technology into the ordinary sand table, Redfish has created a new, effective, and dynamic tool for educating property owners regarding the hazards of uncontrolled wild fire in target areas.

The problem is to determine if the Simtable, developed primarily as a wildland firefighter training tool, can be used successfully in a wildfire prevention program. The purpose of this research is to determine the applicability of using the Simtable to promote wildfire prevention activities by property owners in the Wildland Urban Interface (WUI). The descriptive research method, incorporating observations, questionnaires, and interviews is the primary method used in this research paper. Some time is spent examining the background of the traditional sand table and the development of the Simtable to provide an appropriate context for the discussion.

The research questions are (1) How do wildfire prevention educators respond to the Simtable, (2) What do prevention educators regard as the primary and secondary use of the Simtable and, (3) do wildfire prevention educators believe the Simtable will be useful in promoting a prevention program in the WUI?

Background and Significance

The threat of uncontrolled wildfire in the Wildland Urban Interface (WUI) in Santa Fe County is a serious issue. Santa Fe County has a number of wildland urban interface areas; these interface areas, where human habitation and development intermix with volatile forest fuels and mountainous terrain, contain hundreds of homes and thousands of residents. The WUI in Santa Fe County is an environment where fire can move readily between structural and vegetative fuels, increasing the potential for fire ignitions and a corresponding loss and life and property (Geery, Williams, Meyer, Fluder, 2008).

The WUI is protected by the Santa Fe County Fire Department (SFCFD). The department has long recognized that, while the annual occurrence of wildland fire is generally a small percentage of the total annual emergency response volume, the human and property values at risk from a significant wildfire in the WUI are enormous and the destruction and disruption of these values by wildfire would be devastating to the entire community (SFCFD 5 Year Plan 2010-2014).

Santa Fe County, in North Central New Mexico, consists of 1,910 square miles and is home to 68 defined communities, 8 historic towns, and 142,407 residents (US Census Bureau, 2006). These residents are situated in 14 county fire districts and the incorporated City of Santa Fe, all of which could be impacted by wildland fire. Many residents in the unincorporated areas are situated in close proximity to the City of Santa Fe in the central portion of the county. These areas are primarily suburban and semi-rural in nature. Other more remote areas of the county both north and south consist primarily of ranchland, widely separated rural villages, and large parcels of federally controlled properties. Approximately 25% of the land in the county is managed by the Bureau of Land Management (BLM) and the United States Forest Service (USFS) and 60% is privately owned (Census, 2006).

Santa Fe County encompasses a diverse range of topography. Vegetation zones within the county are primarily a function of elevation, slope and aspect. Since there is a broad range in elevation and topography from north to south, the vegetative characteristics are quite variable. The northern portion of the county consists of higher elevations, steeper mountain slopes, and more densely forested ecosystems of pinion-juniper, ponderosa pine, and mixed conifer. The southern portion consists primarily of prairie grass, shrubland, and pinion-juniper ecosystems on rolling topography (Geery et al. 2008).

In a similar fashion, Santa Fe County supports a variable and diverse range of communities. The City of Santa Fe is the New Mexico state capital and a historic, eclectic city that is perennially ranked as one the nation's top tourist destinations. The county is also home to isolated, traditional, and rural Hispanic communities, ranches, widely dispersed housing tracts, and four Native American Pueblos.

In 2006, the population estimate of Santa Fe County was 142,407, an increase of 10.1% from the 2000 census figures. The median income for households in 2006 was estimated at $50,437, and the median income for families was estimated at $61,355. The percentage of families whose income was below the poverty line was 5.8%, substantially lower than the 13.8% of New Mexico families below the poverty line for the same year (Census, 2006). The Social Capacity Index (SCI), a method of determining wildfire risk based on socio-economic data such as income and other factors has been applied to Santa Fe County by the Forest Guild, a non-profit organization of foresters and land stewards. The SCI is based on the theory that "wildfires have a disproportionately negative impact on those households and communities lacking adequate resources to prepare for, respond to, and recover from catastrophic events" (Geery et al. 2008, p.126). The Forest Guild has assessed all of the census designated communities in Santa Fe County, with results ranging from 3 (low capacity) for Agua Fria, Espanola, and Cerrillos, to a 10 (high capacity) for Eldorado and Sandia Park.

Santa Fe County Fire Department has also completed an assessment of the WUI. In February 2001 the WUI Area Inventory Assessment looked at over 100,000 acres and identified 43 communities at risk within the county. This project was initiated after the Cerro Grande Fire in 2000 devastated Los Alamos County, which is directly adjacent to the northwestern boundary of Santa Fe County. Each area was assigned a hazard rating based on fuel conditions, access, building materials, quality of defensible space, water availability, terrain, housing density, proximity to the nearest fire station, and special hazards. Fourteen areas were rated as Moderate (30,060 acres), twenty were rated as High (35,600 acres), eight were rated as Very High (32, 130 acres), and one was rated as Extreme (2,650 acres). The purpose of the assessment was to provide a quantitatively based hazard ranking and to highlight significant community values at risk (Lightfoot, Blackwell, McSweeney, Gallegos, 2001).

A follow up assessment was performed in 2007 in preparation for the development of the Santa Fe County Community Wildfire Protection Plan (CWPP). The 2007 assessment attempted to quantify changes during the period from 2001 through 2007 that may have affected risk levels in those previously rated areas. The 2007 WUI Assessment used a landscape approach as opposed to the direct observation approach used previously. However, a comparison of the two separate assessment studies reveals a close correlation. The 2007 WUI Assessment identified one community as Extreme, seven as Very High, and nineteen communities as High (Geery et al. 2008). In addition, the 2007 Assessment used a public meeting process and community surveys

to identify those community values deemed to be most at risk from wildfire and worth protecting. The Community Values at Risk (CVAR) list includes housing, businesses, infrastructure, natural resources, cultural resources, tribal concerns, recreation and open spaces, scenic resources, and water resources.

These WUI areas are protected by the Santa Fe County Fire Department (SFCFD). The department was created in 1997 by the Santa Fe Board of County Commissioners (BCC). County Ordinance 1997-11 consolidated the fifteen existing volunteer county fire districts and the office of the County Fire Marshal into one entity. Ordinance 1997-11 provided the organizational framework for the new department, and the BCC appointed a Fire Chief responsible for the "staffing, recruitment, training, budgeting and all other administrative matters for the department and for the development and improvement of the department to meet local, state and federal standards" (Santa Fe County Ordinance 1997-11).

During the past decade a strong effort has been made to organize the delivery of services provided by the department on a regional basis, retaining the individual fire districts but insuring that those districts in each geographic region of the county (north, south, east, and west) cooperate and share resources as needed. The original paid staff members in the Fire Marshal's Office have been supplemented with additional career firefighters and emergency medical technicians in an effort to provide more reliable services in each region. Policies,

procedures, and District By-Laws have been formulated in a coordinated effort to build consistency in fire suppression and emergency medical service training and operations (5 Year Plan, 2009).

The SFCFD currently fields 63 cross-trained Firefighter/Emergency Medical Technicians organized on three shifts. Each shift, supervised by a Battalion Chief, provides daily staffing of 20 firefighters in four regional main stations and two sub-stations. These career personnel supplement and assist the 343 volunteer firefighters who operate out of 28 additional volunteer stations throughout the 15 fire districts (5 Year Plan, 2009).

In 2008 the county fire department responded to 6575 emergency calls for assistance. Approximately 80% of these responses were for emergency medical services and 2.4% were for wildland fires (SFCFD, 2009). This call volume has placed a strain the volunteer fire districts and career responders. According to the department's Response Improvement and Implementation Committee (RIIC), a survey of volunteer district chiefs completed in 2007 reveals that the average number of volunteers responding to emergency and non-emergency requests for service is diminishing (RIIC Recommendations, 2007).

SFCFD also supports a Wildland Section in the Prevention Division. The Section is staffed by a career Captain and a volunteer Lieutenant charged with directing and coordinating the daily activities of a four person wildland crew. These crew

members fill term, grant funded positions; they are responsible for wildfire prevention and public education activities, as well as fuel mitigation projects throughout the county. They are tasked with providing and coordinating wildfire training activities for the fire districts and paid staff. They are also skilled, certified wildland firefighters and are subject to emergency deployment to wildland fires anywhere in the county, region, or nation.

The Wildland Section is committed to implementing the recommendations set forth in the CWPP. A primary component of these recommendations is public education and outreach directed at homeowners in those WUI areas at greatest risk as listed in the 2001 and 2007 WUI Assessments. Effectively communicating with the very diverse groups of property owners in the 27 communities identified as Extreme, Very High, and High is a daunting task for this small group of employees and the volunteer district personnel. The success of their endeavor, to educate property owners on ways to reduce risk on their private lands and throughout their community at large, and to create measureable, sustained actions toward this end, requires that the Wildland Section be strategic, innovative, and highly efficient in the development and delivery of information (5 year Plan, 2009).

For the last ten years, the fire department, using personnel from the volunteer districts as well as career employees, has tried a number of traditional methods to communicate information to the WUI property owners, including meetings organized through community and neighborhood

associations, direct delivery of information on creating defensible space to individual land owners, public service advertisements, and the creation of defensible space demonstration areas so that the stakeholders can visualize the recommended results from various fuel mitigation processes. Wildland Section employees have also successfully assessed hundreds of individual sites, providing the owners with tailored recommendations for property protection. Despite these efforts, the department recognizes, as was revealed in the 2007 WUI Assessment, that there has been little improvement in the level of risk in most areas (5 Year Plan, 2009).

In 2003, fire and law enforcement personnel in the City of Santa Fe began investigating wildfire and its potential impact on citizen evacuation routes in the WUI areas of the city. Collaboration was initiated with the agent-based modelers and visualization scientists at Redfish Group in Santa Fe and the fire scientists at Anchor Point Group in Boulder, Colorado. The intent was to develop models of the interaction between realistic wildfires and traffic as they would exist during an evacuation from certain areas of the city. The collaborators hoped that the ability to visualize a fast moving fire and the dramatic impact on traffic and evacuation would serve as an effective educational tool. And, in fact, their work did have an impact. Prior to viewing the visualizations many citizens assumed they could outrun a fire. Following the visualization, people began to realize that preparing their home to survive a wildfire was less about saving a structure and more about potentially saving their own life (Thorp et al. 2005).

Following the success of this wildfire evacuation model, Redfish Group began working to make the simulations more accessible to emergency planners and educators. Development began on "augmented-reality" tabletops where simulations could be projected down onto tables and participants could then manipulate life-like toy models like fire trucks and fire attack aircraft in a manner similar to a sand table. Sand tables, which have a long history of military training applications, are widely used throughout the wildland industry to train firefighters.

A further refinement of this augmented, agent-based modeling technology, along with further extensive research and development, has led to the recent (2009) rollout of the Simtable. The Simtable from the Redfish Group is an interactive, three dimensional simulation device that is intended to replace the traditional sand table in wildland training and education applications. Simtable is specifically designed for firefighter education, firefighter training, and public outreach (Simtable, 2009). This dynamic device, which is lightweight and portable, provides a three dimensional map of any local neighborhood projected onto a bed of sand. The sand is formed by participants to replicate local terrain and provide a 3D surface, while current satellite imagery of local structures and roads is displayed along with overlays of wildland fuel types. Finally, the moderator can "start" a simulated wildland fire and

participants can watch the progression of the fire through their neighborhood; they actually witness simulated fire behavior in real time in a model of their own community. The fire behaves in accordance with the area's actual slope, terrain, fuel type, density, and weather conditions. Wind speed and direction can be changed by the moderator to reflect common conditions during different times of the year or even different times of the day. Participants watch in amazement as the fire cuts off community roads and escape routes and homes are quickly consumed. The Simtable provides the promise of a dramatic breakthrough in bringing wildfire presentations to life for educators and property owners alike.

Enhancing the traditional approach to WUI public education efforts will assist the department in meeting its mission. Understanding how and why the Simtable can greatly assist in this effort relates to and supports the United States Fire Administration (USFA) operational objective to "appropriately respond in a timely manner to emergent issues" (USFA, 2007). This research will accomplish this objective by analyzing the effectiveness of the Simtable as a dynamic tool for wildfire prevention educators in areas of the county where the hazards are not fully understood or appreciated by many property owners. The completion of this project and the implementation of the recommendations are consistent with the goal of the National Fire Academy Executive Analysis of Community Risk Reduction (EACRR) program "to empower the Executive Fire Officer with the ability to lead community risk reduction is a strategic manner" (EACRR Manual, 2009). The necessity to provide an enhanced and more effective communications strategy for WUI educators

requires the leadership, skills and knowledge gleaned from the EACRR class.

Literature Review

A literature review was completed using the Internet, and this review was supplemented with personal observations, discussions, interviews and questionnaires. This section will review the body of knowledge uncovered regarding the development and use of the Simtable and its applicability in a wildfire prevention program.

The Simtable has its roots in the traditional sand table, a generic term for using constrained sand for modeling or educational purposes. The sand table concept, offering a representation of the physical world in miniature, has been in use for hundreds of years. The earliest known version of a sand table, called the Abax, was used by early Greek students to perform studies in writing and geometry, and it is considered the predecessor to the abacus and a variety of board games (Wikipedia, 2009).

The sand table also has a long history in the military. Commanders as far back as the Roman Empire used sand tables to visualize and manipulate a small physical copy of the battlefield. It allowed them to display and try a variety of different strategies. This evolved into scenarios during which multiple commanders or "players" competed against each other or

against historical records (Smith, 2007). Sand tables are also used in today's military for training purposes. Even the Marine Corps, which has access to some of the most advanced training systems in the world, makes extensive use of sand tables to teach decision making and tactics to entry level officers (Sutton, n.d.).

There was a concerted effort to incorporate sand tables into wildfire training after 2000, and currently sand tables are used extensively in the fire service, primarily to train wildland firefighters and commanders. For instance, the (New Mexico) East Mountain Interagency Fire Protection Association (EMIFPA) used sand tables during their two-day March 2009 training on initial attack, extended attack, unified command and a host of other topics for their Federal, State and local partners (EMIFPA, 2009). In some ways, sand tables are ideal; they are simple, adaptable, and inexpensive to build, requiring only a box of sand, some toy figures of people and fire apparatus, cotton for smoke, and string or yarn to outline fire perimeters and roads. They provide effective training and are considered to be valuable in delivering experience and situational awareness to students in a field where mistakes can be tragically unforgiving. An infinite number of wildfire scenarios can be created on a sand table, limited only by the trainer's imagination. Each scenario adds to the collective experience of those sharing in the training (National Interagency Fire Center, 2005).

However, there are a number of limitations to sand tables. For instance, while sand tables are used first and foremost for firefighter training, and occasionally to deliver fire related briefings, the literature does not indicate they are used for public education purposes and wildfire prevention. The larger tables that show more detail and terrain, and may be better suited to wildfire prevention discussions, are not mobile and require long setup times. A 12’ by 12’ sand table generally requires a dedicated classroom space. Even a 4’ by 8’ table requires a pickup truck to move from one site to another. In addition, sand tables are "low tech" simulations that require the very active involvement of experienced trainers with certain skills. These individuals must make adjustments as trainees interact with the scenarios or make decisions that alter the course of the simulation (Sutton, n.d.). These adjustments may not conform to actual fire behavior principles. In fact, the military has documented that the individual student may not benefit from a sand table exercise unless a highly trained instructor is present (Abramson, Thornton, Dees, 2001). Finally, sand tables provide crude representations of actual terrain, and they lack readily available gaming technology that may commonly be expected by today’s younger generation of learners (Sutton, 2006).

Recent computer based simulators for military and wildfire training that incorporate the principles of sand table training with gaming technologies strive to eliminate the limitations of traditional sand tables. For instance, the military has developed intelligent tutoring system called the Virtual Sand Table (VST). It is a learner-centric system that is less

dependent on experienced instructors (Abramson et al. 2001). The VST is aimed toward the training of skills that are more complex in nature, and the device can provide critique and feedback throughout the course of the exercise without the direct interaction of an instructor. Simulators that incorporate gaming technologies have also allowed the user to customize their scenarios. Prior to the availability of these tools, instructors using a relatively static sand table environment would determine how the scenario might evolve, often based on their own experience and knowledge. It was just too complicated for players to modify the environment themselves (Smith, 2007).

In a similar way, wildfire simulators have evolved from the sand table. For example, firefighter training in the Cleveland National Forest now uses four overhead projectors to produce realistic images of the landscape, smoke, and fire (Sutton, n.d.). A number of CD-ROM based simulations have also been developed and marketed to the wildland fire community. In addition, the USFS, in conjunction with a private vendor, has developed the 3-D Virtual Wildland Fire Simulator. The system provides a "realistic fire propagation model based on fuel types, various environmental conditions and topography" (Sutton, n.d.). Unlike the CD-ROM simulations, students using the virtual simulator don’t sit in front of a computer screen. Instead, they sit in a room with a large monitor, interacting with the instructor as the fire spreads in "real time." Building the 3-D

Fire Simulator was not cheap or quick: almost $1.4 million was spent on the project over a period of six years. The author did locate one example of a simulator used during community outreach: educators used a fire behavior computer program to create a hypothetical wildfire scenario in Incline Village, Nevada. However, nothing else was found during the course of research to indicate that simulators are commonly used for wildfire prevention and public education purposes (Kruger et al. 2002).

The development of simulators for wildfire training has not occurred without a good deal of consternation in the wildfire community, and these developments have stoked a debate regarding high tech versus low tech. While high tech applications add exciting new dimensions to training, there are several disadvantages. Simulators often require one or more computers to operate, as well as a skilled technician to keep things running smoothly. And cost is also a significant deterrent. In general, the more highly technical the program, the more expensive it is to purchase and operate. The learning curve for instructors can also be extended. Finally, there is little evidence supporting the notion that more expensive training solutions are more effective (Sutton, n.d.).

In developing the Simtable, the Redfish Group has overcome many of the limitations of sand tables and simulators. While the Simtable is directly based on the traditional sand table, the differences are more obvious than the similarities. The entire package, without the sand, folds into a suitcase that can be

easily moved from one location to the next. It incorporates a 3’ by 3’ (or larger) wooden frame that can be set on a table and filled with several inches of sand. A simple projector and camera are positioned over the sand on a metal support pole. The hardware is connected to a laptop computer which has been loaded with the simulator software and connected to the internet. Actual terrain maps of an area of study, as well as inputs of local road, housing data, and wildland fuel types from other sources such as Farsite, are downloaded and then the Simtable software takes over from there. The overhead unit clearly indicates how the sand should be molded by participants to create an accurate 3-dimensional landscape over which the terrain layer is projected. What results is a highly realistic model of the study area, such as a neighborhood or community. Participants can then start a virtual wildland fire by directing a laser pointer at any desired location on the surface. The virtual fire progresses in real time across the surface of the sand as though it was moving across the actual terrain in accordance with the inputs. Wind speed and direction can be easily manipulated at any time. Resources such as fire attack aircraft, engines, and hand crews can be deployed from a drop down menu projected onto the sand with the same lazar pointer. These resources, if properly placed, will realistically mitigate the advance of the fire. Previous fuel mitigation project data, if input, will also slow the advance of the fire, clearly demonstrating the benefits of local fuel reduction efforts. All of this is accomplished with minimal setup and preparation time, and without technical expertise or experience. The Simtable

provides accurate and real time feedback to students and instructors alike, feedback that is consistent with actual fire behavior and terrain conditions (Simtable, 2009). According to Steve Mullis, a wildland firefighter and educator with 16 years of experience, "the Simtable represents an amazing jump in technology, and I can’t imagine that it won’t replace many of the old training tools, including the sand table" (Mullis, personal communication, November 19, 2008).

Encouraging the public to take actions that can reduce the likelihood of a wildfire destroying their home or community is a common approach in wildfire education. In many areas, including Santa Fe County, public outreach campaigns are the primary means to increase wildfire safety. These campaigns generally incorporate instructional materials intended to guide residents on selecting fire safe landscaping and construction materials, creating and maintaining defensible spaces around the home, and learning what to do if a wildfire approaches (Bright et al. 2006). One or two public kick-off meetings may be held to initiate a campaign and to generate enthusiasm. These meetings often use the systems for distributing information that exist in most areas, incorporating groups such as landowner associations, Scouts, and the PTA (Kruger et al. 2002).

At the core of this approach is the belief that property owners, if properly informed, can take steps to reduce their risk (Kruger et al. 2002). It is clear, however, that no single method reaches everyone in a community. "Population demographics are constantly changing and the public education methods used to

reach baby boomers are not what you would use to reach today's new millennium generation" (Porter, n.d.). And if an education program is to be effective, it must be relevant to the local target audience. According to Kruger et al in a piece on community preparedness, local knowledge and skills must be utilized in developing site specific educational materials. These materials must reflect the intended audience and the conditions of the community in order to involve citizens in taking action. Educators and community members must understand the ecological factors that make a particular community vulnerable so that strategies can be developed and deployed to decrease that vulnerability within the given landscape.

A key to effective wildfire public education is to engage the community at the individual member level with a message that is direct, clear, and relevant. These factors have a significant impact on eliciting desired behaviors related to wildland fire prevention (Bright et al. 2006). It is also important to highlight more community based action strategies. In a study on the obstacles to implementation of Firewise principles, James Absher concludes that a great need also exists to more directly involve homeowner associations and landlords, and to enact community based regulations (Absher, Vaske, Don Carlos, Bright, 2007).

Applications are being developed to meet these needs. For instance, The Center for Fire Research and Outreach at the

University of California at Berkeley has developed a web-based tool, the Fire Information Engine Toolkit (FIET). The FIET is intended to meet the needs of diverse user groups at a variety of scales, such as individual, community, and regional levels. During the initial phase of FIET, the focus was on presenting pre-fire tools for homeowners and local decision makers. A number of innovative web-based systems have also been developed, including an interface to display results from structural vulnerability assessments conducted at the local level. It is interesting to note that the most recent work concentrates on depicting fire behavior and evacuation modeling scenarios (Kearns, Goldstein, Pedersen, Moritz, 2007).

This evolution in technology coincides with the results of the prevention work conducted locally by the fire department. According to Tom Chilton, a structural and wildland firefighter and educator with SFCFD, an educator needs to establish a scenario depicting the fire situation as it exists in a particular area. This includes incorporating local information on climate, fuel type, insect infestation, slope, aspect, and other factors. What is effective is to create scenarios to show how fires work given local conditions (Agar, 2005). Visualization technology fits this goal; it is effective at raising public awareness and serves as a foundation for decisions involving creating defensible space on one's own property as well as community evacuation and fuel reduction projects (Thorp et al, 2006). In addition, visualization is an important means to provide a realistic idea of the response, and limitations, of fire equipment and firefighters in the event of

a local wildfire. According to Chilton the Simtable allows property owners to see the fire from point of ignition, and observe the fire as it grows in scale, advancing through their neighborhood to the point where lives and property are at risk (Agar, 2005).

Procedures

This author has previous experience with the Redfish Group, having been involved with the original Redfish wildfire and evacuation modeling project conducted for the City of Santa Fe. In his capacity as a Chief Officer with the Santa Fe Fire Department, and more recently with the Santa Fe County Fire Department, the author has observed the development of the Simtable from 2007 until the present. A specific review of existing materials to evaluate previous research on this topic started with several personal visits to the Santa Fe Complex, home of Redfish Group, during 2008 and 2009. The Complex, located in the Rail Yard District of the City of Santa Fe, brings together diverse experts in virtual and physical sciences in an effort to blend different perspectives and approaches to address real world problems through education, outreach, and the development of innovative technologies (Santa Fe Complex, 2009). The Simtable is prominently displayed in the public space and demonstrations of the technology are readily provided by Stephen Guerin, Chas Curtis, and the staff. During these visits the author was a participant in a number of conversations about the Simtable and the continuing innovations for training and

education purposes that would be useful for end users of the technology. These discussions and personal observations were useful in developing an understanding of the Simtable and its potential as a training and education tool, as well as delineating the differences between the Simtable, the traditional sand table, and other fire simulators.

A selective review of research materials and historical background information was initiated using the internet. The search was useful in providing background information on the history of sand tables, their current uses in military and wildfire training applications, and their limitations. Materials obtained during the internet search provided valuable insight into the current use of technical training simulators for wildfire training and the debate that has arisen over the benefits and limitations of these high tech solutions. The internet research also provided useful insight into what processes are more effective in educating property owners about wildfire risk. These insights were substantiated by reviewing the research conducted previously during the evacuation modeling project, including the interview with Tom Chilton.

Materials were collected from the Santa Fe County Fire Department, including the 2010-2014 5 Year Plan, the 2007 RIIC report, and the 2008 CWPP. These materials were useful in painting a picture of current conditions in the department and the WUI areas it is charged with protecting. The CWPP was of primary importance in reviewing the history of the department’s

experience in the Wildland Urban Interface, especially previous efforts to analyze and document the risk associated with specific areas of the WUI, and previous efforts to inform property owners. A comparison of the 2001 WUI Assessment and the 2007 assessment revealed the difficulty in motivating enough property owners to make a noticeable difference. This review and recent exposure to the Simtable inspired conversations and hope within the department's Wildland Division that the Simtable may represent a breakthrough in the perennial effort to educate and inform property owners and drive a measureable reduction in risk.

Research into how educators respond to the Simtable and whether they feel it will be useful for prevention purposes was conducted in four separate demonstrations of the Simtable with various groups over a two month period. A questionnaire was delivered to each participant in all 4 venues. A total of 37 questionnaire forms were distributed, completed on site, and returned to the author. This corresponds to a response rate of 100 percent. The author was in attendance and witnessed the demonstrations in three of the four venues. The first demonstration was conducted on October 7, 2009 in Estancia, New Mexico for the East Estancia Soil and Water Conservation District. Eight questionnaires were completed and returned. This was followed by a meeting with EMIFPA on October 10th during which 13 questionnaires were completed and returned. This venue was attended in the author's absence by SFCFD Captain Mike Jaffa, current Chair of the EMIFPA Board, who was subsequently interviewed. The Santa Fe County District Fire Chiefs meeting

held on October 29th provided 12 completed forms. And finally, a meeting was held on November 19th at the Santa Fe Complex for USFS personnel from the Cibola National Forest, New Mexico. Four forms were completed and returned to the author. It is recognized that these four meetings represent a fraction of the organizations that could potentially use the Simtable for education purposes; however, these meetings coincided with the initial rollout of the Simtable, so further opportunities to conduct research were not available. If the technology was more widely distributed, and more research time and resources were available, additional meetings and questionnaires could have been utilized. In addition, a questionnaire instrument designed with a numerical ranking system instead of written comments may have provided an easier way to extrapolate and interpret the results.

The meetings were organized to sample different user groups, from local and federal fire service educators, public school teachers, members of the Soil and Conservation District, and members of the lay public involved in community wildfire prevention education. Eight distinct agencies were respondents as illustrated in Figure 1 (p.42). The agency on one questionnaire form was not recorded by the participant.

The questionnaire consists of five questions (Appendix A, pgs.43-47). Question one seeks the respondent’s overall impression of the Simtable. The purpose of questions two and three is to determine what the respondents see as the primary and secondary use of the Simtable, and if they feel it would be

useful in promoting a wildfire prevention program, with an elaboration on the reasons why. Question four seeks feedback on how respondents feel property owners will respond to the Simtable, and question five asks about the most significant obstacle regarding the adoption of this technology.

These meetings were followed up with an interview with Steve Mullis of the SFCFD Wildland Division in an effort to capture his perspective as a wild land firefighter training instructor and prevention educator for 16 years. His responses helped verify the author's observations during the Simtable meetings and corroborated the results of the questionnaires.

Results

Research Question 1: How do wildfire prevention educators respond to the Simtable?

The results of the Simtable questionnaire are listed in Appendix A. Every one of the 37 respondents to the questionnaire commented at least favorably during the Simtable demonstrations. These results are documented in the written comments collected for question one. Most of the educators were extremely positive, providing comments that ranged from "amazed" to "excellent" and "outstanding". Several educators were more reserved. A closer examination of the comments reveals that 33 prevention educators, or 89% of the total, had an uninhibited and very favorable response; while four educators, or 11%, had a slightly more reserved response to the Simtable. These four educators

documented their feelings with terms such as "useful, favorable, could be used for training", and "appears to be a good tool". However, none of the 37 respondents incorporated negative terminology or documented serious reservations in response to question one.

In response to Question five regarding the greatest obstacle in adopting the Simtable, 20 respondents (54% of the total) listed cost as the greatest obstacle, and five respondents (13.5%) listed funding. Therefore, 67.5% of the educators regard the cost of the Simtable and constraints on their ability to fund the purchase of the device as the greatest obstacle to putting the Simtable to work.

These results are consistent with the comments provided by Lieutenant Steve Mullis, as well as the author’s personal observations during the Simtable demonstrations. "All of the faces of the participants light up," according to Mullis. "The old sand tables are not interactive and couldn’t use real inputs. Nothing was real time. The Simtable is an excellent tool" (Mullis, personal communication, November 19, 2009). However, both Mullis and Captain Mike Jaffa expressed concern about the higher cost to purchase the device in comparison to the sand table, and questioned if agencies would seriously consider the additional cost without verification that improvements in training and prevention education would result.

Research Question 2: What do prevention educators regard as a primary use and a secondary use of the Simtable?

The results are documented in the responses to Question two in Appendix A. In this section, twenty educators, or 54% of the total, clearly listed training as the primary use. One educator listed training as a secondary use. The narrative results for prevention were not as clearly stated. A variety of different terms were used to indicate what broadly amounts to wildfire prevention activities, such as "planning", "demonstrate wildfire potential", "public outreach", and so forth. For the purposes of this research these terms have been assembled under the general category of Prevention Activities. Seventeen (46%) of the educators listed prevention activities as the primary use of the Simtable, with 17 (46%) listing it as a secondary use. Three written comments for secondary uses (hazmat, briefings, and evacuation) that do not fit the two stated categories have been assembled under the category of Other. Sixteen respondents did not list a secondary use. The results are summarized in Figure 2 on page 42.

Research Question 3: Do wildfire prevention educators believe the Simtable will be useful in promoting a prevention program in the WUI?

One hundred percent (100%) of the respondents to the questionnaire stated that the Simtable will be helpful in a wildfire prevention program. These results, as recorded in response to Question three in Appendix A, are consistent with 92% of educators surveyed who stated that a primary or secondary use of the device is promoting wildfire prevention activities. In addition, these results are consistent with the author’s

observations from the Simtable demonstrations, as well as the interview comments from Steve Mullis, who stated the device is "the next thing and will be a primary tool" for prevention (Mullis, personal communication, November 19, 2009). The written comments in Appendix A as to why the device will be helpful, collected from the diverse group of fire prevention educators, appear to substantiate the unanimous approval to use the Simtable as a prevention tool.

The educators were also asked to consider their audience and how that audience might respond to the Simtable in Question four. This question is intended to compliment Question three by requiring educators to speculate on the response of property owners. This question takes them a step beyond their personal feelings; they must make a judgment based on their own insights and experience working with property owners on prevention activities in their jurisdiction. All of the respondents indicate that property owners will respond at least favorably. As with question one, none of the 37 educators recorded serious concerns or negative comments.

Discussion

The Simtable is a new device incorporating new technologies. It has not yet been widely distributed for use in training or education applications; therefore, data regarding the effectiveness of the Simtable in a wildfire prevention program outside of what was collected for this study is in short supply. While is unwise to draw too many conclusions from the

limited scope of what was done for this research, it is clear that dynamic representations of the physical world are useful in a number of fields, including the military, city planning, architecture, entertainment, and education (Smith, 2007). Visualizations of potential wildfire scenarios is an effective tool at raising public awareness and can serve as a backdrop to initiate the hard decisions that face many WUI property owners and communities (Thorp et al, 2006).

Santa Fe County has established a clear need to reduce the risk of uncontrolled wildfire in areas of the Wildland Urban Interface. And despite the work done by SFCFD in identifying the risks and educating the public since the 2001 WUI Area Inventory Assessment, the 2007 CWPP Survey has revealed that very little has changed in the 43 communities previously identified as at risk (Geery et al, 2008). In addition to the negative impact to lives and property from a wildfire, there are also numerous community values at risk in every one of the identified areas. The fire department, which employs the work of volunteers and career staff to provide fire protection and public education services in the WUI, is understaffed and outgunned in relation to these challenges (5 Year Plan, 2010-2014).

Historically, the department has employed the standard methods to educate property owners in the WUI and to gain measureable results. These methods have included public education, assessments, planning, and fuel mitigation work

(SFCFD, 2009). It is apparent that a supplementary method that can bolster previous efforts would be a positive development. A tool that breaks the existing mold and has the potential to create renewed enthusiasm among prevention educators, as well as to motivate residents to take responsibility in reducing the risk of a wildfire and to create survivable space around their residences is clearly needed. And it is appropriate that, given the recent technological developments in many areas including firefighter training, wildfire prevention efforts should also incorporate an eye catching, high tech approach to encourage action by property owners to reduce their risk. The Simtable takes what amounts to a complex wildfire scenario and delivers the message in a clear and unambiguous fashion. Message clarity is critical in a wildfire prevention program and "has a significant impact on one’s ability to consider, or elaborate on, the message, and in turn, affects desired behaviors related to wildland fires" (Bright et al. 2006).

As is apparent from the research, the Simtable is a tool that has great potential in a wildfire prevention program. It incorporates the latest agent-based simulation technologies in an easy to use format. It not only advances the traditional sand table concept, extending the range of the sand table by incorporating technology and other features while retaining the training functions and purpose (54% of the respondents felt that training will be primary use for the device), but also takes the original sand filled box and drives it into the modern day public education arena. Eighty-nine percent of the educators who

participated in the four demonstrations were very impressed with the device, and nearly half (46%) felt that public education will be the primary use for the Simtable. Nearly all of the remaining educators (46%) who were sold on the training possibilities as the primary use selected public education as the secondary use. Therefore, more than nine in ten educators surveyed for this project recognized and acknowledged that the Simtable has a strong public education component.

The Simtable effectively overcomes many of the shortcomings of the sand table, yet retains enough of the sand table format to be recognizable to the firefighting community. This appears to have added a level of comfort and ready acceptance of the device, alleviating some of the high tech concerns associated with other technologies. The device is easy to transport and setup, requiring that participants provide only a table, electrical power, and an internet connection. The Simtable can be taken directly to those areas of greatest concern. It can even be effectively deployed by a non-techie wildfire educator in a participant's living room or den, making it accessible to small gatherings of friends or neighbors. This is especially important in that one of the keys to effective wildfire public education is to engage the community at the local level (Absher et al. 2007). And unlike some wildfire training simulators, the Simtable does not require an IT person to operate or maintain (Simtable, 2009). In addition to the interest generated by a dynamic, real-time wildfire simulation that can be scaled to a specific neighborhood, we can postulate that the ease of use and

accessibility contributed to all thirty-nine respondents (100%) recognizing that the Simtable will be useful in promoting a prevention program in the WUI. The Simtable will not be useful if it is not user friendly. And while ease of use was not a specific question on the questionnaire, only two respondents listed complexity as a major obstacle. It can be postulated from the responses that the effectiveness of this tool is directly related to its ease of use and accessibility.

The questionnaire results do indicate that educators are concerned about the cost of the Simtable. Nearly two-thirds of the respondents indicated that cost is a significant obstacle. This obstacle may have a negative impact on the accessibility of the device, reducing its usefulness in a wildfire prevention program. This response is also consistent with the trend in wildfire management toward an increased reliance on more expensive emerging technologies and the discarding of the more traditional, lower-cost tools for training and assessment. There appears to be no evidence to support the idea that more expensive training solutions are necessarily more effective (Sutton, n.d.). There is also no conclusive evidence to support the idea that a more expensive solution for wildfire public education will create more measureable results. And while additional research will be needed to investigate the effectiveness of a prevention program that uses a Simtable in order to establish a true assessment of the cost versus benefit, we can theorize that the Simtable will raise the overall awareness of property owners and lead to improved decisions and

an increase in prevention related activities.

The research for this project has determined the applicability of using a Simtable to promote wildfire prevention activities in the WUI. The research also reveals that the surveyed educators have a positive response to the Simtable and feel that the device can be used successfully in a wildfire prevention program.

Recommendations

The results indicate that the Simtable can be a positive and effective tool in promoting wildfire prevention activities in the WUI. In addition, the Simtable can be used successfully in a wildfire prevention program. Therefore, it is logical to theorize from the research that the Simtable can help drive the larger process of motivating property owners to take responsibility for choosing to live in fire-prone ecosystems, and can lead to an increase in activities to improve preparedness and reduce risk. This theory should be tested in subsequent research. In addition, the Simtable appears to have a good potential to enhance wildland firefighter training efforts and, according to some, may play a primary role in training applications. This presumption should also be the subject of further research.

It is appropriate to recommend the incorporation of the Simtable into the current prevention program; however, the research does reveal that educators are concerned about the cost

of the Simtable. It is conceivable that a cost sharing arrangement between the multiple partners with a stake in wildfire prevention may help mitigate this issue. It is also acknowledged that additional research will be required to conclusively demonstrate the effectiveness of the device in creating measureable results in a wildfire prevention program, such as an improvement in conditions and a reduction of risk in the 43 WUI communities of Santa Fe County.

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Figure 1

Military Fire Dept	Community Response Team	Soil and Water Conservation District	Municipal Fire Dept	Public Education Teacher	Lay Person	USFS	County Fire Dept
1	1	2	3	4	4	8	13

Figure 2

Question #2	Training	Prevention Activities	Other	None Listed
Primary Use	54%	46%	0%	0%
Secondary Use	3%	46%	8%	43%

Appendix A	
Question #1	**What is your overall impression of the Simtable?**
Affiliation	Written comments
USFS	*Blown away*
USFS	*Impressed*
USFS	*Amazed*
USFS	*Very useful for wildland firefighters and the public – landowners in the WUI*
USFS	*Excellent tool*
USFS	*Incomprehensible potential – far reaching*
USFS	*Very good training tool*
USFS	*Great educational tool*
Public School Teacher	*Awesome*
Public School Teacher	*Great and can be used for educational purposes*
Public School Teacher	*Wow. Very informative educational tool*
Public School Teacher	*Awesome*
Comm Response Team	*Excellent technology – limitless possibilities*
Conservation District	*Great tool to encourage thinning around our forested area*
Conservation District	*Terrific tool*
Military FD	*Great training tool*
Municipal FD	*Very impressive. I liked interactiveness of the program*
Municipal FD	*Will be very useful for public education and responder training*
Municipal FD	*Outstanding – wide variety of uses*
Lay Person	*Very Impressive*
Lay Person	*Great*
Lay Person	*Nice very impressive*
Lay Person	*Very impressed, think it will be a great tool to benefit many people*
County FD	*Excellent Visual tool, great for initial attack training*
County FD	*Useful training device*
County FD	*Could be used for all kinds of training*
County FD	*Favorable*
County FD	*Great tool for training. Better understanding of what can happen using visual tools.*
County FD	*Appears to be a good training tool*
County FD	*Impressed. Great use for IC training and education*
County FD	*Very helpful for training and teaching community awareness*
County FD	*Neato. Very impressive*
County FD	*Excellent*
County FD	*Very interesting*
County FD	*Impressed. Lots of training and tactical possibilities*
County FD	*Great visual demonstration. Quickly demonstrates the power of 3-D*
Unknown	*Wow. It brings all of these concepts about fire in the WUI to life*

Question #2	**What do you see as its primary use? Secondary use?**
Affiliation	Written comments
USFS	*Enhance decision making capabilities. Demonstrate wildfire potential in WUI*
USFS	*Training, fire planning, structural triage, values at risk*
USFS	*(1)Training (2) Planning*
USFS	*(1)Training (2) Public outreach*
USFS	*Show how quickly a wildfire can overtake a neighborhood*
USFS	*(1)Incident Management training (2) Community Outreach*
USFS	*(1)Type 3 Team training (2) Other training*
USFS	*Firewise Education*
Public School Teacher	*Teaching topography and how fires spread*
Public School Teacher	*Teach about different topics studied in class*
Public School Teacher	*Education to students and community about fire, topography, risk*
Public School Teacher	*Determine best building locations and materials to use*
Comm Response Team	*(1)Training/lessons learned (2) Real time – What if*
Conservation District	*(1)Educate staff and community (2) Educate youth*
Conservation District	*Education*
Military FD	*(1)Command and fire behavior (2) Public Outreach*
Municipal FD	*(1)Community outreach on fire behavior (2) Train fire crews with actual fire behavior*
Municipal FD	*(1)Responder training (2) Public education*
Municipal FD	*(1)Training (2) Public outreach*
Lay Person	*(1)Training (2) Community education*
Lay Person	*(1)Training (2) Community education*
Lay Person	*Showing what can happen*
Lay Person	*Train fire managers*
County FD	*(1)Training (2) Homeowner visual tool*
County FD	*Planning*
County FD	*Modeling wildfire behavior and evacuations*
County FD	*(1)Training and debriefing fire personnel (2) Education for the public*
County FD	*Training*
County FD	*(1)Training (2) Community awareness*
County FD	*Training*
County FD	*(1)Training (2) Community awareness*
County FD	*(1)WUI (2) Hazmat response*
County FD	*(1)Training (2) Prevention with neighborhood associations*
County FD	*(1)Preplanning (2)Evacuation*
County FD	*(1)Training (2) Public education*
County FD	*(1)Prevention, Firewise activities, fuel reduction (2) Briefings*
Unknown	*Public education*

Question #3	**Would it be helpful in a wildfire prevention program? Why?**
Affiliation	Written comments
USFS	*Yes. Current programs need reinforcement to impact the community*
USFS	*Yes. Civilians and firefighters learn more by watching a simulation*
USFS	*Yes. It will bring it home to the public*
USFS	*Yes. More visual and engaging to the public*
USFS	*Yes. A picture is worth a 1,000 bureaucrats blowing hot air*
USFS	*Yes. Colors, 3-D, engaging*
USFS	*Yes. Visual aid*
USFS	*Yes. Residents can see fire potential in their neighborhood*
Public School Teacher	*Yes. Can increase awareness and prevention*
Public School Teacher	*Yes. Hands on opportunity and can visualize what is happening*
Public School Teacher	*Yes. Fires are unpredictable and people need to be aware*
Public School Teacher	*Yes. Families will be able to determine preventive measures*
Comm Response Team	*Yes. Community education, preparedness, prevention, training*
Conservation District	*Yes.*
Conservation District	*Yes. It brings the fire to your neighborhood*
Military FD	*Yes. Allows public to see fire, it's impact, and evacuation routes*
Municipal FD	*Yes. Help community see how a fire progresses*
Municipal FD	*Yes. Allows public to visualize what we see when doing site evals and planning*
Municipal FD	*Yes. May motivate homeowners to thin property*
Lay Person	*Yes. Great simulation of how a fire can impact community*
Lay Person	*Yes. Can wake up community about risk*
Lay Person	*Yes.*
Lay Person	*Yes. Will help eliminate the attitude that it will never happen to me*
County FD	*Yes. People need to see effects, not what ifs.*
County FD	*Yes. It is site specific to how fire can occur and evacuation needs*
County FD	*Yes. But must get people to the presentation first*
County FD	*Yes. It's a simple concept for most people to grasp*
County FD	*Yes.*
County FD	*Yes. Graphically displays how fire will affect neighborhood*
County FD	*Yes. Visual techniques much more effective*
County FD	*Yes. Real time*
County FD	*Yes. Public awareness greatly enhanced with topography and other overlays*
County FD	*Yes. Can relate to it.*
County FD	*Yes. Education for department and community*
County FD	*Yes. Good public education tool*
County FD	*Yes. Homeowners will perk up when they see their home in path of fire*
Unknown	*Yes. Education and public outreach is very difficult*

Question #4	**How do you think property owners will respond to the Simtable?**
Affiliation	Written comments
USFS	*Great for community to know how it has been rated*
USFS	*Wake up call, very eye opening*
USFS	*In many ways*
USFS	*Engage them and prompt more thinning activities*
USFS	*Some it get on board, some will blow it off as propaganda*
USFS	*Engage community and bring reality home*
USFS	*More favorably than in the past*
USFS	*There will be a great response*
Public School Teacher	*Will be very interested*
Public School Teacher	*Interested*
Public School Teacher	*Interested*
Public School Teacher	*Valuable asset*
Comm Response Team	*Easier to understand concepts with visualizations and interactivity*
Conservation District	*Well*
Conservation District	*Positively*
Military FD	*Not applicable*
Municipal FD	*Very, very well. Will appreciate the program*
Municipal FD	*We have limited WUI area*
Municipal FD	*Will be shocked at rate of fire spread*
Lay Person	*Will like bells and whistles presentation rather than mundane stuff*
Lay Person	*Some will be responsive, some will not*
Lay Person	*Some will see problems, others will put their heads in the sand and ignore facts*
Lay Person	*Many will respond well with a few naysayers*
County FD	*Very well*
County FD	*Expect low turn out*
County FD	*Will appreciate seeing realistic scenarios*
County FD	*Will be helpful*
County FD	*Very favorably, at least for those who care*
County FD	*Very positive. Will open some eyes*
County FD	*With awe*
County FD	*Response will be eye opening. Will do what Firewise could not, real time fire*
County FD	*Very impressed*
County FD	*Favorably*
County FD	*Favorably, good education tool*
County FD	*Positively. Knowledge of fire not necessary to get point across*
County FD	*Like it*
Unknown	*Will help them get more involved*

Question #5	**What is your greatest obstacle in adopting this technology?**
Affiliation	Written comments
USFS	*Cost and facilitating data input*
USFS	*Cost*
USFS	*Cost*
USFS	*Obtain authorization to purchase*
USFS	*Cost*
USFS	*Cost but we will figure it out*
USFS	*Cost*
USFS	*Cost*
Public School Teacher	*None recorded*
Public School Teacher	*Practice on equipment*
Public School Teacher	*Cost*
Public School Teacher	*None recorded*
Comm Response Team	*Funding*
Conservation District	*Learning how to use and update the device*
Conservation District	*No obstacle*
Military FD	*Cost; training of operators; data base maintenance*
Municipal FD	*No obstacle*
Municipal FD	*Funding*
Municipal FD	*Cost*
Lay Person	*Cost and funding source*
Lay Person	*Cost*
Lay Person	*Cost*
Lay Person	*Cost and funding source*
County FD	*Cost; training*
County FD	*Too complicated to operate or keep software operating as intended*
County FD	*Learn its capabilities*
County FD	*Availability*
County FD	*Funding source*
County FD	*Cost*
County FD	*Operation of the device*
County FD	*Personnel*
County FD	*Cost*
County FD	*Durability*
County FD	*Cost; training*
County FD	*Cost; technical complexity*
County FD	*Cost*
Unknown	*Familiarity*