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Information Technology Research (ITR): Responding to the Unexpected
&

IIS-0331690

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Information Technology Research (ITR): Responding to the Unexpected

Response to the Report prepared by the RESCUE site visit team
NSF SITE VISIT June 1-3, 2005

We sincerely thank the site-visit team for their insightful suggestions both during the visit as well as in the report. In the following, we have addressed specific concerns by the site visit team by augmenting the report with our responses at appropriate places. We felt that two issues that arose at multiple places within the report (and were also emphasized during the site visit) required additional elaboration. We therefore address those issues separately first prior to providing responses to specific concerns/recommendations expressed in the report.

1. *The recommendation by the site visit team for RESCUE research to move away from large number of small contributions to the next level where we address a few challenges that have a potential of large impact to both science and to the response community.*

Response: The RESCUE team welcomes this suggestion from the site visit team. We also strongly believe that it is now time for us to identify a few integrative major efforts that can serve as legacy of our project and provides us an opportunity to make big impact. Indeed, our internal plans (as evidenced by incorporation of the concept of systems artifacts in year 2) is aligned and consistent with this recommendation. One of our major goals over summer leading up to the next PI meeting in November is to identify on a handful of integrative research challenges/artifacts that both help focus as well as highlight the ongoing research. The artifacts will provide focus and context as well as expose new research challenges at interdisciplinary boundaries but are not expected to cause dramatic changes to the individual research plans of PIs since ongoing research by RESCUE PIs is largely already aligned with the artifacts we are considering. We note that selecting artifacts requires us to work closely with our community advisory board to identify how and where research can be incorporated in the emergency operations. We will also be working towards building a consensus within the RESCUE team on the artifacts to ensure that there is strong support within the team maximizing our potential to deliver on what we identify as significant artifacts.

Not

consensus now?

Doubts on delivery
What is delivery

schedule
dissemination
emergency operation
research

2. *Recommendation by the site visit team for RESCUE to undertake a more holistic approach to studying privacy that includes privacy not only from a technological perspective but also from legal and policy perspective exploring the theoretical basis or appropriate uses of technology in security policy and practice.*

Response: While, in general, this is an excellent suggestion incorporating this recommendation into RESCUE research in its full intent (as the site visit team articulated) requires us to resolve a few significant issues.

First, we observe that privacy, policy and legal issues arise in RESCUE research in three different contexts. Such issues arise in designing solutions for human sensors, in designing solutions for information sharing, and finally, in the context of privacy preserving pervasive spaces (focusing on surveillance technologies) which we have undertaken in RESCUE. We note that our team has already made significant investments in understanding the policies, the security & trust impediments as well as understanding issues related to misuse in the context of data sharing across response organizations. Our primary efforts have been in the form of questionnaires and interviews of emergency organizations in LA city (interviews conducted by Jeannette Sutton – a social science postdoctoral researcher working with Dr. Kathleen Tierney) and also by participating in the BIONET pilot project that was tasked to building a data sharing architecture for public health organizations for San Diego.

We agree with the evaluation of the site visit team that our efforts on considering the potential for misuse of tools we are developing to enable human sensors and also privacy implications of technology failures in the context of video surveillance are not as concrete. There are two reasons for this. First, the technological barriers to surmount in meeting either of the above challenges are so immense; our focus has been on conducting research from a feasibility perspective. With some more maturity in our research when we are at the stage of developing tools based on the research, the socio-technical aspects as suggested by the site visit team would become very critical. Participation and/or help from policy and legal experts would significantly enhance both our research as well as its impact. To facilitate such efforts within RESCUE, we need to resolve two issues: (1) we need to identify a set of experts who have the required expertise that can complement the strengths of the RESCUE researchers in areas of policy and law; (2) we need to identify sources of funding that can be used to facilitate such an interaction. We have begun efforts along both these fronts since the site visit and we list these efforts below:

1. We have initiated conversations with some faculty / researchers in the Schools of Social Science, Social Ecology, and graduate School of Management at UCI who work in related areas with the hope of finding researchers who would complement our efforts.

= challenge
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deterrent

WHEN?

Plan
now

STREAMLINE
select
CORE
problems

2. We have planned contact with researchers working on NSF funded Portia project at Stanford and Yale. We note that Portia is looking into privacy from technological, policy and legal perspective but they view privacy at a broader level. We intend to explore if ongoing Portia research could be leveraged in a more vertical (application-based) setting of RESCUE. We intend to explore if a collaborative effort between Portia and RESCUE can be established at some point. The Cyber Trust PI meeting in Sept. 2005 being organized at Irvine (funded as a subcontract of RESCUE) provides one such opportunity to explore possibilities of interaction with Portia.
3. At UCI, we have a Center for Unconventional Security Affairs (CUSA) the main focus of which is to address the security challenges of the twenty-first century brought on by technological innovations, economic globalization, and the spread of democracy. CUSA has pioneered a collaborative, interdisciplinary structure that draws on the best resources available from UCI, the policy community, and the public and private sectors. The Center's director, Dr. Richard Matthew, is a professor for the Departments of Planning, Policy and Design and Political Science, and has worked closely with a number of government departments and agencies including the Departments of Defense and State. Prof. Matthew has worked closely with RESCUE in the past (e.g., on a proposal to DHS for a center of excellence for homeland security on crisis response). The RESCUE team is exploring possibilities of collaboration with CUSA in the specific aspects of law and policy implications of privacy. To begin such a dialogue and explore possibilities, we have invited Prof. Matthew to address RESCUE researchers in one of our monthly meetings. Another organization with which RESCUE team intends to establish a connection is the Center of Information Policy at the University of Maryland which is a multidisciplinary research center that plays an active role in facilitating and providing solutions to current policy issues surrounding the convergence of information and technology. The center is jointly sponsored by the College of Information Studies and the School of Public Affairs at University of Maryland.
4. Since the site visit, the RESCUE team has established a relationship with researchers at IBM Yorktown (specifically, Gopal Pingali and Arun Hampapur) in the context of privacy preserving video surveillance. The RESCUE team (in collaboration with Prof. Ramesh Jain) has a planned meeting on August 22nd with the IBM researchers at Irvine with the objective of forming a national level team exploring related technologies.
5. RESCUE researchers at UCSD are a month away from moving into a new research facility that will allow them to interact more closely amongst themselves and also with policy and legal experts. A new research neighborhood has been created within this facility to draw out the synergies amongst engineers, computer scientists, medical practitioners, policy and legal experts working on a variety of projects (including but not limited to RESCUE). In particular, they will be colocated with Erin

Interim
Report

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Kenneally a forensic analyst and attorney who focuses on research on cyberlaw issues related to computer forensics, electronic evidence, and computer security. Additionally, RESCUE researchers will also initiate collaborations with the University of California Institute on Global Conflict and Cooperation. In particular we plan to engage with IGCC through its new Public Policy and Biological Threats (PPBT) program which focuses on policy responses to the threat of bioterrorism. Topics include the science of biological weapons and threats, the history of bioterrorism and weaponization, verification and monitoring, response mechanisms, scenario building, national security decision making, and industry protocols and incentives. Michael J. Kleeman, one of the speakers in the PPBT program will also be co-located with RESCUE researchers in this new research neighborhood..

We do recognize that creating and sustaining such new activities will require additional resources. We hope to receive some support or guidance from NSF to help with this but will also pursue independent lines of support to help with this broadening of the effort.

ALREADY REQUESTED IN 187
REVIEW

NO - FOCUSING

NSF SITE VISIT June 1-3, 2005 :: (Response Mark-up)

Project: RESCUE

1. Introduction

The University of California, Irvine (UCI) and the University of California, San Diego (UCSD) were awarded a Large Information Technology Research grant, now referred to as RESCUE, in September 2003 by the National Science Foundation (NSF). The RESCUE team recently completed the second year report that describes the progress made to date. NSF conducted a formal site visit to UCI as indicated in the cooperative agreement with a review team consisting of seven members from academia and industry on June 1-3, 2005. The site team analyzed the progress of the project under the following categories:

- Research Plan
- Research Accomplishments
- Education and Outreach
- Project Management
- Future Goals and Activities

The team arrived at the following conclusion:

Research Output is of high quality; state of the art IT research is being conducted; some anticipated outcomes are already being achieved.

The analysis for each category is given below together with some major recommendations.

2. Project Analysis

2.1 Research Plan

On the whole, the project has followed the tasks and activities listed in the proposal. However, for some tasks, the project has yet to meet the objectives. The project has investigated additional topics, such as privacy, that were not listed in the proposal. It is commendable that the project team addressed the comments of the reviewers of the proposal

and included an investigation of privacy in their research because it is critical to this project. Below is a discussion of each task listed in the proposal and an analysis as to whether the project is meeting the objectives.

Information Collection:

Dynamic Data Collection: The proposal states that the RESCUE team will develop a robust data collection system architecture that can handle dynamic situations. It also states that the system will handle conflicts between security, integrity, data quality, and fault tolerance. However, while the RESCUE team is developing a data collection system, it was inconclusive from the presentations or from the annual report that the conflicts are handled. There are features, such as privacy, that were not mentioned in the proposal, but have been incorporated into the research plan based on the comments of the reviewers of the proposal. The NSF review team identified some inadequacies on their approach to privacy and advised them to include policy experts in the project and examine realistic policy rules.

WHY?

RESULT?

Response: The RESCUE researchers have explored issues related to conflicting requirements during data collection in dynamic situations. For instance, the following publications address tradeoffs in timeliness, performance, reliability and quality for dynamic data collection:

1. Sensor Data Collection with Expected Reliability Guarantee, Qi Han; Iosif Lazaridis; Sharad Mehrotra; Nalini Venkatasubramanian; The First International Workshop on Sensor Networks and Systems for Pervasive Computing (PerSeNS), (in conjunction with PerCom), Kauai Island, Hawaii, 2005-03-08
2. Real-time Collection of Dynamic Data with Quality Guarantees, Qi Han; Nalini Venkatasubramanian; IEEE Tran. Parallel and Distributed Systems, in revision, 2005
3. Time-sensitive Computation of Aggregate Functions over Distributed Imprecise Data Qi Han; Matthew Nguyen; Sandy Irani; Nalini Venkatasubramanian; 12th IEEE International Workshop on Parallel and Distributed Real-time Systems (WPDRTS) (In conjunction with IPDPS 2004), Santa Fe, New Mexico, 2004-04
4. Fault-Tolerant Evaluation of Continuous Selection Queries over Sensor-Generated Data Iosif Lazaridis; Qi Han; S. Mehrotra; Nalini Venkatasubramanian; Technical Report, 2004-03
5. Energy Efficient Data Collection in Distributed Sensor Environments, Qi Han; Sharad Mehrotra; Nalini Venkatasubramanian; 24th IEEE International Conference on Distributed Computing Systems (ICDCS), Tokyo, Japan, 2004-03
6. Approximate Selection Queries over Imprecise Data Iosif Lazaridis; Sharad Mehrotra; International Conference on Data Engineering (ICDE 2004), Boston, 2004-03
7. QUASAR: Quality Aware Sensing Architecture, Iosif Lazaridis; Qi Han; Xingbo Yu; Sharad Mehrotra; Nalini Venkatasubramanian; Dmitri Kalashnikov; Weiwen Yang; ACM SIGMOD Record, March 2004, 2004-03
8. Addressing Timeliness/Accuracy/Cost Tradeoffs in Information Collection for Dynamic Environments Qi Han; Nalini Venkatasubramanian; The 24th IEEE International Real-time Systems Symposium (RTSS), Cancun, Mexico, 2003

SUMMARIZE, not
references

During the site visit, given time constraints, we had to choose only a few of our achievements to highlight. We primarily chose talks that reflected new research that began after the start of RESCUE. Since our adaptive data collection builds on our ongoing research in this area which predated RESCUE, we decided not to highlight it during the site visit. We are currently working on tying the adaptive techniques to more specific requirements enforced by RESCUE (e.g., reflective cellular architecture) and we expect major achievements over the coming years. *HOW MANY?*

Rendering Multimodal Data: The RESCUE team had proposed to develop a distributed novel speech recognition system and address the challenges of background noise and low power devices. It also proposed several techniques such as speech enhancements, blind source separation, and advanced feature extraction. Based on the presentations and the annual report, it appears the team has implemented the advanced feature extraction component of the system. It has also implemented some techniques such as the beam forming algorithm. The review team feels that it may not be possible to implement all of the features proposed during the next three years as the team will have to carry out additional data collection, and building a new speech recognition system is a very complex task. As part of this task, the RESCUE team had proposed to integrate audio and video data. It appears that it is yet to start this task.

W/4?

Response: The RESCUE team has already initiated work and made progress in this area. The work presented at the site visit focused on our initial work on speech recognition. We intend to incorporate video and other cues to enhance the efficacy of speech recognition as originally proposed. In fact, we have recently recruited a new post doctoral researcher, Dr. Rajesh Hegde, to work on exactly this topic.

=> INTERIM REPORT

Reliable Knowledge from Unreliable Informants: While the NSF site visitors appreciated the importance of information in disaster situations, there was significant concern about the societal impact of using humans as sensors. The site visitors recommend that the RESCUE team revisits the potential for abuse, and builds in appropriate safeguards.

Response: This is a valuable recommendation. The RESCUE team will explore possibilities of incorporating safeguards against abuse as design criteria for human as sensor technologies.

PI meeting, => interim report: WHO, how?

Information Analysis

Event Extraction from Multimodal Data Streams: The RESCUE team has carried out most of the techniques proposed on event extraction. It has also demonstrated two scenarios; one is based on the world trade center attacks and the other on the Tsunami response. It had proposed to develop an architecture that would take as input multimodal data streams and carry out an analysis. At present the system can handle only text data. However, the team has plans to handle other data types.

Results?

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Response: Our experience with first responders over the past two years has reiterated the importance of text modality in crisis response. This was amongst the reasons for a focus on text. We do intend to explore other modalities and work in that direction has been initiated.

Adaptive Filtering of Event Streams: The RESCUE team had proposed innovative techniques for adaptive filtering. At present it has not yet started on this task. However, based on what was presented, it is likely that the team will achieve the goals of the task.

Response: The RESCUE team has done prior research on adaptive filtering of multi-modal streams. The approach to filtering we intend to pursue in the context of RESCUE is filtering of events. For this, work in event extraction and representation is required to reach some level of maturity, as such the event filtering work is still in its early stages.

Damage and Impact Assessment: This is also another task that is yet to be addressed by the RESCUE team. The project will have to develop the system before the team can do such an assessment. Based on the progress, the team should be able to meet the goals of this task.

Response: Tasks related to damage and impact assessment have been ongoing from the onset of the RESCUE project. The ImageCat team has been working on quantification schemes for four types of damage/impacts: building damage, transportation system damage, hazardous materials release and its impact on affected populations, and casualty estimation based on a) building damage, b) bridge damage, and c) hazardous materials release. All of these impacts will be modeled in INLET (Internet-based Loss Estimation Tool) and will be accessible by all RESCUE researchers and some government partners. As specified in the timeline presented during the site visit, we expect a proto-type of this system to be up and running by the end of this year.

INTERIM:

Dec. 2005?

Information Sharing:

Optimizing Organizational Structure: The RESCUE team proposed to develop an organizational structure that would be adaptable to normal and crisis operations. In the presentations the team mentioned the workshops and the talks given on DEVO (Dynamic and Evolving Virtual Organizations). However it appears that while the team has developed some high level concepts, it is yet to work out the details. Based on the discussions, it appears that the team should be able to meet the goals of the task.

Response: Team agrees with the observations. This is an active area of current research. Several points warrant emphasis here. Governmental agencies, including the federal government, have now universally adopted specific organizational forms for managing crisis responses—the Incident Command System (ICS) and the National Incident Management System (NIMS). (California was an early adopter of this management model, which was

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known as the Standardized Emergency Management System, or SEMS.) These recommended organizing strategies form the core of the nation's disaster management system. However, these management arrangements are used only in emergencies and disasters, not during normal times, and many organizations that respond to disasters are unfamiliar with ICS/NIMS or choose to organize in different ways. This is particularly true for organizations that become involved on an emergent (unplanned) basis. It is also still true for federal agencies involved in disaster response, since they were only recently required by Presidential Homeland Security Directive 5 to employ NIMS. Moreover, ICS and NIMS do not, in and of themselves, solve the challenges associated with organization and communication within DEVOS. A significant portion of our work will focus on information sharing, both among agencies employing ICS/NIMS and those that operate according to other principles. We will also continue to engage in fundamental research on the structural characteristics of emergent multi-organizational networks and the manner in which those networks evolve over time.

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Open Distributed Computing Support: The team had proposed to develop a distributed computing environment based on various concepts including XML and Mediation. While it has not addressed this task yet, it appears that the team should not have any problem provided the approach to develop DEVO is completed.

Response: This is another of the research areas where significant progress has been made but given time constraints we were unable to highlight achievements during the site visit. Our primary contributions has been towards a peer based data sharing architecture as represented by the following publications:

1. Supporting Approximate Similarity Queries with Quality Guarantees in P2P Systems Qi Zhong, Iosif Lazaridis, Mayur Deshpande, Chen Li, Sharad Mehrotra, Hal Stern UCI Technical Report, February 2005.
2. Achieving Communication Efficiency through Push-Pull Partitioning of Semantic Spaces in Client-Server Architectures. Amitabha Bagchi, Amitabh Chaudhary, Michael T. Goodrich, Chen Li, and Michal Shmueli-Scheuer. UCI Technical Report, February 2005.
3. XGuard: A System for Publishing XML Documents without Information Leakage in the Presence of Data Inference. Xiaochun Yang, Chen Li, Ge Yu, and Lei Shi. Proc. of ICDE'2005, demo track, Tokyo, Japan, March 2005.
4. Answering Queries Using Materialized Views with Minimum Size. Rada Chirkova, Chen Li, and Jia Li. To appear in VLDB Journal, 2005.
5. Secure XML Publishing without Information Leakage in the Presence of Data Inference. Xiaochun Yang and Chen Li. Very Large Databases (VLDB), Toronto, Canada, August 29 September 3, 2004.
6. On Containment of Conjunctive Queries with Arithmetic Comparisons. Foto Afrati, Chen Li, Prasenjit Mitra. EDBT 2004.
7. RACCOON: A Peer-Based System for Data Integration and Sharing. Chen Li, Jia Li, Qi Zhong. ICDE'2004, demo track.
8. Describing and Utilizing Constraints to Answer Queries in Data-Integration Systems.

Succinct Summary

Chen Li. IJCAI 2003 workshop on Information Integration on the Web, August 2003, Acapulco, Mexico.

Besides the above mentioned research publications, many investigators from RESCUE participated in a complementary effort called BIONET which was entrusted with developing a data sharing architecture for multiple public health related data sources in the San Diego area. Lessons learnt from the BIONET exercise have strongly influenced our research direction and we expect major advances over the next two years.

HIGHLIGHT

Trust Management in DEVOs: The team has carried out research on trust management that extends its previous work on TrustBuilder. In fact it has developed an approach for not only checking the credentials of the client, but also checking the credentials of the server. However it is not clear whether the team has developed trust management for the DEVO environment.

Response: The RESCUE trust management research is indeed targeted for DEVOs, and we look forward to deploying it in all the testbeds that include a DEVO component.

Security and Privacy Concerns in Information Sharing: This is an area that was not mentioned in the proposal. However the team carried out some work in this area and has also demonstrated an early version of a privacy preserving surveillance system. The site visit team pointed out the policy issues that need to be addressed.

Response: Issues of security and privacy are extremely important for our society and will likely continue to grow in importance in light of the July 7 London transportation system attacks and newly-developing efforts here in the U. S. to improve security on public transportation. Only one day after the London attacks, safety and security experts are already commenting on the need to balance homeland security concerns with individual privacy rights for those who use public transportation. The RESCUE team agrees with suggestions made by the site visit team, particularly comments that emphasized the need for integrating security and privacy concerns during all phases of RESCUE's research and development efforts. The feedback is useful to us and hopefully will be reflected in our future work in this area.

WHO, WHEN, HOW

Information Dissemination

A structured approach to disseminating Information: In the proposal the team mentioned that it will develop technical solutions as well as examine the cognitive aspects to information dissemination. In the presentations, the team discussed some interesting approaches to the cognitive aspect. That is, it presented the approach to customizing information delivery for different user groups. The project has also developed technical solutions to information dissemination.

Emergent Social Behavior within the Context of a Disaster: The team proposed to study how user groups respond to disasters. Some work has been carried out on this task.

BUT IN
REVIEWS

2.2. Research Accomplishments

The RESCUE team has assembled a portfolio of research that encompasses a broad spectrum of the IT and social science challenges facing systems for first responders. The team has created a nice framework to place their work in context: the four categories of problems are intuitive and map nicely into the overall problem that the RESCUE project is addressing. This helped the visitors clearly understand the breadth of the project overall, and place each piece of work in context.

The demonstrations and posters were well done, and conveyed the actual state of the various projects, as well as the extent to which collaborations have been successful. The students seemed to be aware of the overall goals of this rather large project, of their role in the project, and how their piece of research could potentially integrate with other pieces. The PIs should get credit for bringing about this level of cohesion.

The RESCUE team has established workable mechanisms for multi-site collaboration that could be extended. While there are interactions between Colorado, UCI and UCSD and between BYU and UIUC, most of the frequent interactions and publications are among UCI, UCSD and ImageCat.

The visitors were impressed with the effort taken by the RESCUE team to get field experience with disaster recovery situations. In particular, the participation of students in various drills is commendable. We encourage the team to continue and strengthen this field work component, since for this project, such work is vital for making significant impact and for understanding the problems.

The overall research output reported by the RESCUE team (36 journal publications, 140 peer reviewed conference publications) is substantial. Furthermore, the research output is well-structured, in that the PIs have put effort into articulating the interesting challenges underlying each of the four areas.

WHO, HOW, WHEN
However, one over-arching impression was that, while the team has identified excellent topics and problems to work on (the project on interoperability across different wireless systems is particularly notable), the results to date can be characterized as "early". For example, the idea of using visual cues (e.g., lip movement) to improve the accuracy of speech recognition is promising, but the team's work in this area has been limited to using well-known, standard techniques. As another example, the application of peer-to-peer systems to the flash dissemination problem in disaster recovery is interesting, but the contribution of this work beyond other work (e.g. Bit Torrent, Bullet, Splitstream) doesn't appear to be substantial. As yet another example, the multi-modal speech recognition work could have been subjected to audio and video datasets closely related to the disaster response scenario. Similarly, in the sensitive areas of data collection and sharing, the team's work has not yet taken into account crucial policy and legal considerations.

doesn't show MAJOR NEW results

Response: The overall view of "early stage" is warranted since during the site visit we focused on few new research themes that have emerged as a result of RESCUE. Many RESCUE research areas in which PIs were previously engaged prior to RESCUE initiation, our team has made significant advances as evidenced by a large number of conference and journal publications. We expect significant advances along the research themes we presented during the site visit over the coming years.

WHEN?

▽ conference
do work

We understand that there may be legitimate reasons for this---identifying deep technical, yet relevant problems is difficult and takes time. However, we encourage the team to continue on its current trajectory, but push harder to articulate deeper technical solutions

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Response: The team agrees and considers this a good suggestion.

Focus, e.g., privacy

The visitors were pleased by the team's efforts towards establishing several testbeds. These testbeds are clearly central to the project's success and eventual impact. The INLET demonstration was very interesting, and the ability to visualize transportation conditions and resources during disasters is a crucial capability. However, this tool currently appears to be a standalone project. The value of this (and other testbeds) will multiply when they are strongly integrated with the rest of RESCUE project and make use of the results. Similarly, RESCUE research will immensely benefit from the problems identified in using the technologies on the testbed.

Response: As outlined in our cooperative agreement with NSF, the development of tools to implement the various testbeds was planned for the first year and half of the project. For the most part, all testbed development is on schedule. With respect to the transportation testbed (INLET), the following collaborations are planned in the next several years:

WHO, HOW uses them?

- Testing the efficacy of smart sensors on bridges to assess immediate post-disaster disaster performance of key transportation elements (P. Chang, University of Maryland). The damage assessment part of INLET will be used to perform this evaluation.
- Evaluating innovative origin-destination modeling techniques using Bayesian analysis (R. Dechter, UCI). This research will help to improve both pre- and post-disaster transportation modeling in large urban settings.
- Evaluating occupancy modeling to better quantify exposed populations in regional incidents, such as earthquakes (P. Smyth, UCI). This research will help to improve our ability to determine how many people in an area need to be evacuated in a large disaster.

EXCEPTIONS

- Testing vision-based recognition algorithms to distinguish different modes of traffic, e.g., passenger vs. commercial (M. Trivedi, UCSD). Will help to calibrate transportation (traffic) models.
 - Testing mobile-based applications for customized messaging during disasters (Rao and Zhu, UCSD). This research will be key in determining whether advanced telecommunication technologies (wireless) are a viable solution to efficient evacuation in large, unexpected disasters.
 - Evaluating decision-support technologies for optimized routing of emergency acute care vehicles (M. Shinozuka, UCI). This research will help to enhance the applicability of INLET to other emergency response incidents, e.g., transport of injured after a disaster.
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Finally, the site visit team had four comments regarding the RESCUE's team responses to the questions the team had posed. First, the RESCUE team could have more precisely addressed the question regarding the contributions by unfunded partners. Second, the project milestones could have been better documented, and changes to the milestones better highlighted. Third, it is imperative that the RESCUE project embrace a shift in thinking towards articulating and producing a small number of major accomplishments, be they intellectual or systems artifacts. Finally it is now the time to articulate clearly the emphasis and deliverables and systematically execute them.

Response:

1. During the site visit, the question asked of us was "what are the major contributions that you could clearly attribute to RESCUE (i.e., ITR) as distinct from the work of collaborators or your previous/concurrent work". We addressed the question at two levels. First, we identified a list of projects and accomplishments that we could clearly attribute to RESCUE funding. These included our efforts on wireless mesh networking, a system for situational awareness (SAMI), a multiagent simulator (DrillSim), the INLET tool, privacy preserving pervasive spaces, multi-microphone speech recognition, emergent multiorganizational networks, reflective cellular architecture etc. These projects were not those that any of the PIs had been previously working on prior to RESCUE funding and much of this work has not been a result of ongoing collaborations outside of the RESCUE team. While we consider the established connections/relationships RESCUE researchers have with other research groups both in industry and academia as a significant benefit to the RESCUE project, we also realize the sensitivity and importance of the question being raised. Going forward, we intend to be more careful in gathering information from the PIs about their RESCUE research. Specifically, as part of the annual report contributions, henceforth, the PIs will be asked to clearly identify activities funded by RESCUE and activities which are collaborative partnerships between RESCUE and other initiatives.

2., 3, & 4. We consider the recommendation by the site visit team (both during the site visit as well as in the report) that it is time for RESCUE to focus onto a small number of substantive research accomplishments as extremely important – one which will have profound impact on RESCUE as we move to the next stage of our project. In the first two years, our research was to a degree exploratory where we were determining the fundamental challenges, learning to work with each other, and learning to conduct multidisciplinary research. We believe that the past two years has given our team unique insights and moving forward we will be able to consolidate our research into a small number of substantive research projects that we can explore together. Indeed, this very thought of consolidation of efforts was the driving force behind instituting the concept of system artifact in year 2. Our plans are to come up with a broad agreement on the set of artifacts we will explore as part of RESCUE by the next PI meeting scheduled for November. We will then be in a much better stage of renegotiating and tracking specific milestones with NSF.

HALF-LIFE₆

2.3. Assessment of Education and Outreach Activities

The majority of the education and outreach activities take place at the University of California Irvine (UCI) and the University of California San Diego (UCSD). Current accomplishments include:

1. Summer internship by a UCI student with the City of Los Angeles during 2004
2. Field study based on interviews and discussions with Los Angeles emergency officials. The purpose of this study was to provide feedback on how this research could be adapted and applied effectively in the emergency management domain and provide their government partners with new enabling technologies and potential tools.
3. Programs for student and faculty exchange
 - a. Visits between UCI and UCSD team members
 - b. UCI student and faculty visits to Boulder for interactions at the University of Colorado Natural Hazards Center
 - c. Visit to UCI by Professor Seamons and his students from Brigham Young University (BYU)
 - d. Visit to UCI by Professor Kathleen Tierney and Postdoc Jeannette Sutton from Colorado
4. Outreach to local community
 - a. K-12 outreach
 - b. Local minority universities
 - c. Interfaces for the disabled community

Research Integration with Education

The research has impacted 11 courses across the UCI and UCSD campus. UCI has implemented 4 new courses, including a 3-course series. 10 students attended all courses in the series. There are no prerequisites and the courses are offered to all graduate students.

The course impact is most prevalent at the UCI campus. The impact at UCSD appears to be limited to augmenting existing coursework. BYU provides opportunities for interdisciplinary coursework through their multidisciplinary security lab. The other distant partner universities (Maryland, Colorado and Illinois) have not demonstrated research integration into education or outreach.

Response: University of Colorado researchers have and will continue to engage in a variety of educational and outreach activities. Kathleen Tierney is currently co-editing the second edition of the International City and County Management Associations "Green Book" volume entitled *Emergency Management: Principles and Practice for Local Government*. In addition to being used extensively by government officials across the country, the volume is expected to be adopted as a standard text in many emergency management and homeland security college and university programs. The book will include a chapter on advances in technology for emergency management, which will be co-authored by RESCUE PI Ronald Eguchi and University of South Carolina professor of geography Susan Cutter.

RESCUE-supported students will be attending the annual Hazards Workshop in Boulder, which begins on July 10th. The 2005 Hazards Workshop has attracted approximately 400 researchers, students, government agency officials, and emergency management practitioners. Workshops held in subsequent years will provide RESCUE PIs and students with opportunities to make presentations and submit posters based on RESCUE research.

To further RESCUE's interdisciplinary education and training mission, the University of Colorado Hazards Center has increased its collaboration with the CU Computer Science Department. The Center has hired a female computer science graduate student (with an interdisciplinary undergraduate degree in social sciences from UC Irvine) who specializes in human computer interaction and computer supported collaborative work, to work on the RESCUE project. The Center is also working closely with CU computer science faculty who are interested in conducting research on information sharing and dissemination in disasters.

With respect to outreach, Kathleen Tierney has also given a number of presentations focusing on such topics as public responses to warnings and crisis-related collective behavior. For example, in February, she was invited to present a seminar on those topics at the Office of Science and Technology policy, which was attended by Science Advisor John Marburger. She is scheduled to take part in a Congressional seminar on July 21, 2005 which will again focus on public responses to crises.

BYU has also augmented existing coursework by incorporating the study of access control in open systems into an existing graduate security course. In the near future, BYU will look for opportunities for interdisciplinary coursework through their new multidisciplinary security lab that spans several campus departments.

Finally, the Champaign Testbed and the RESCUE partnership with the City of Champaign demonstrate substantial outreach efforts from RESCUE to the local community, with benefits also flowing in the reverse direction.

MORE EFFORT IN ALL SITES: ALL underrepresented groups
not books, meeting on, but actions WITH

Correlation to Original Proposal

The implementation of education outreach does not differ significantly from the original plan. The research team has successfully implemented a visitor exchange program and impact course offerings at the UCI campus.

The proposed activities in community and minority institution outreach were not detailed in the original proposal. The contributions in community outreach are limited to campus-wide activities at UCI. There has been no outreach to the minority institutions (Cal State Fullerton and Cal Poly Pomona) as mentioned in the original proposal.

Response: Our specific plans for community outreach have adapted as more opportunities came up. For instance, members of the RESCUE team have met several times during the past year with EduDyne Foundation, an Orange County-based non-profit entity that creates and operates after-school programs. This organization was created to facilitate a collaboration and cooperation between various organizations in the community including education, industry, church, private foundations and government. Their work is primarily focused on minority and underprivileged students in Orange County. We plan further engagement with EduDyne during the coming year. As another effort, in conjunction with Bob Welty, A RESCUE consultant and CAB member, we will contribute to the curriculum on the Interdisciplinary Master's Degree in Homeland Security at the San Diego State University. Outreach activities involving Cal State Fullerton and Cal Poly Pomona are also being developed.

YOO?

How about INreach?

Relevance of Project Goals to Education and Outreach

The education goals address obstacles in student and faculty exchange, curriculum improvement and community outreach. The majority of this work takes place at the UCI campus. The team mentioned future plans to create a repository of course materials related to crisis response at the UCI campus for dissemination to all partner universities. To increase education and outreach among the other institutions, the review team recommends the following:

Improve connections and linkages between distant universities

1. Increase and emphasize participation by distant universities in monthly meetings. earlier than NOVEMBER!
2. Increase cross-university publications beyond UCI and UCSD.
3. Share lessons learned from multidisciplinary curricula development. Promote activities with multidisciplinary security lab at BYU.

Improve undergraduate research participation

1. Increase the number of undergraduates from UCSD, BYU, Illinois, Colorado and Maryland

Goal

2. Create synergies and partnerships between graduate and undergraduate students at all universities : *goal*

The RESCUE research would benefit from increasing the number of social science researchers. The social science students are often required to cover specialty areas not related to their core expertise. The RESCUE team is encouraged to recruit more graduate students and faculty with social science expertise in law and public policy.

Response: We agree (particularly based on the input from and interactions with the site visit team) that RESCUE would benefit with more expertise in the areas related to law and public policy and we intend to explore some avenues to step up our activities to fill in this deficiency. We provide details of the steps we have already taken since the site visit as well as steps that are planned in the overview response.

We would, however, like to point out that our commitment to and our ongoing current efforts in the broader area of social science as related to responding to crisis are quite substantive. Our team consists of two eminent social scientists – Prof. Kathleen Tierney who heads the Hazard center at Colorado, and Prof. Butts who is a mathematical sociologist at UCI. RESCUE is currently supporting 2 dedicated students working with Prof. Butts and a postdoctoral student working with Prof. Tierney. Prof. Tierney has recently also hired three new graduate students – all women – one of whom also has a substantial computing background as well who, prior to joining Colorado, had an undergraduate degree from ICS at UCI.

In the RESCUE project, as we emphasized during the site visit, instead of dividing up the research funds amongst the PIs (as is sometimes done with large grants), we have created a central facility that includes both hardware and software infrastructures, as well as, a common pool of programmers, project scientists, project managers, work studies, and undergraduate researchers. These are shared common resources accessible to which all RESCUE researchers. For instance, Prof. Butts has extensively worked with Amnon Myers and Chris Davison in variety of data collection, drill instrumentation, data analysis tasks. Furthermore, in RESCUE, we have substantially encouraged interdisciplinary collaborations amongst students in computer science and social science. For instance, Prof. Butts is actively engaged in research with CS students working on DrillSim (a multi-agent crisis response simulator), SAMI (a system for situational awareness), and PADO (a privacy preserving video surveillance system). Prof. Tierney and her postdoctoral student Jeannette Sutton have initiated research collaboration and come up with a joint research plan with the RESCUE IT researchers on customized dissemination.

MORE VISIBILITY FOR RESEARCHERS & ROLES

The RESCUE team community outreach is limited to existing K-12 outreach programs at UCI and UCSD with local schools and community organizations. This was limited to two sessions for middle school and high school students that already visit multiple departments on the UCI campus. The review team encourages more systematic involvement in community outreach activities.

We encourage systematic recruitment of women and disadvantaged minority researchers at all levels. We also encourage increased collaboration with local organizations at UCI and the other partner institutions.

Response: The team agrees and will increase efforts for the recruitment of women and disadvantaged minority researchers as well as well increase collaborations with local organizations at UCI and the other partner institutions. The team has already stepped up its efforts to increase diversity. For example, in addition to the female postdoctoral researcher and female graduate student who are currently affiliated with RESCUE, Kathleen Tierney has hired 3 graduate women researchers who will work on the RESCUE project at CU Boulder. Further, at UCI subsequent to the site visit, we have hired Alonzo Garcia a first year undergraduate student from the California Alliance for Minority Participation (CAMP McNair). Alonso is the second such student to be hired into RESCUE from the program. In addition, RESCUE participation in a high school program for native American (6 to 12 graders) is being planned in collaboration with the outreach efforts of the School of ICS, UCI. *WUEN?*

The review team notes that the researchers have established beneficial partnerships with local First Responders. They have developed a strong research plan for product deployment throughout the remainder of the project.

2.4. Project Management

Is there a clear management structure?

The RESCUE project does have a well articulated management structure, with a project director, two principal investigators and an executive committee. The project appears strongly centered at UCI and UCSD, with the other four institutions not as closely integrated into project activities. This may be a factor of geographical location, but efforts to integrate all six university research teams more closely in joint projects and publications would strengthen the project. The “all hands” project meeting brings all members of the RESCUE team together once a year, and an effort to conduct monthly virtual meetings in this past year has increased communication among the six campus research teams. This is an area that needs continual attention and effort in a large, complex project. The risk is that the six campuses would lapse into separate teams, and the process of integration needs steady monitoring, review, and reflection.

We miss, however, stronger participation from a wider Advisory Council of experienced community, government, and industry leaders that would advise the project team on the design, development, and evaluation of research projects. We encourage the urgent formation and involvement of a strong advisory council.

Response: Our effort in forming an advisory team had indeed begun prior to the site visit. For instance, we had invited Prof. Ramesh Jain – a well renowned researcher in areas related to RESCUE to chair the committee and with his help we are selecting other members of the committee. We chose not to highlight our efforts since the committee had not yet been fixed. With the benefit of the recommendations from the site visit team, we are currently rethinking the constitution of such a committee. For instance, we are actively trying to identify a member who can bring in the public policy perspective into RESCUE. Likewise, we intend to invite another researcher who has had substantial success in technology transfer to first responder organizations. We intend to form the complete committee and convene it by the time of our annual PI meeting.

*large-scale
team management*

Is the project being managed most effectively to achieve the project's goals?

In general, the project is managed effectively and after two years, it has achieved a significant number of publications, collaborative partnerships, and visibility in their respective communities. A major issue, however, is the increasing responsibility for management as the project moves into its last three years. The current teaching load for the project manager of three courses appears heavy for the range of responsibilities that he is expected to manage. The Site Visit Team recommends that this teaching load be reduced by one course to enable him to manage these increasing managerial responsibilities effectively. For example, the project will need to develop a coherent strategy for translating their research findings into products that can be delivered to their community partners

Response: The Dean of ICS at UCI – Debra Richardson -- is in principle supportive of an additional course release for the PI for RESCUE. She has two concerns both of which are surmountable – 1) availability of the teaching staff to cover the courses required to meet the academic needs of the school, and 2) the impact of course reduction to the academic evaluation of the PI. At UCI, the academic evaluation consists of three components: teaching, research, and service and it is considered vital to retain a balance in all three. While the first obstacle can be overcome by finding a replacement instructor for courses, the second obstacle requires proper explanation of the benefit and usefulness of RESCUE to the broad scientific community and to the university. Dean Richardson intends to make such a case for the PI of RESCUE to all the levels of academic evaluation.

*not and
problem!*

Does the current project organization and management actively support collaboration across sites and disciplines? What types of coordination mechanisms are being used to encourage collaboration?

*and his/her role as
an educator.*

The current project organization and management clearly supports collaboration across sites and disciplines in principle, but the effort to integrate the geographically distant campuses into the larger center needs more effort.

The principal coordination mechanism is the "all hands" project meeting, but other mechanisms of student internships and faculty/student exchanges have been recently initiated among the six participating institutions. These mechanisms are obviously fruitful, and the Site Visit Team encourages the project managers to continue and expand these changes to support the vital goal of integrating research and practice. This collaboration appears vital and strong between UCI and UCSD, and this may clearly be facilitated by proximity. More use of virtual meetings and "peer2peer" exchange among students, researchers, and faculty in other departments would likely strengthen this continuing process of integration.

goals
Response: These are valuable suggestions which the team agrees with and intends to pursue. For instance, this year, further student exchanges between partnering sites are being implemented with some UCSD students visiting Colorado and UCI student visiting ImageCat. With the adoption of system artifacts as an integration mechanism amongst the RESCUE team, such interactions will substantially increase over the coming years.

A valuable opportunity in this project is the potential for different types of 'living laboratories' in different settings across the country. Using these laboratories for evaluating their technologies and getting feedback from different sets of first responders confronting different types of risk is an important potential to be exploited more fully. and research engagement would strengthen collaboration among the more distant institutions.

Going forward, what organization and management challenges, if any, does this project face? How appropriate are the project plans to address them?

This project has a major opportunity to contribute substantively to the development of a coherent theoretical perspective for the design and implementation of security in a democratic society. The goals, functions, and limits of security are not well explicated in current policy and practice. This project represents a major investment by the NSF into developing a clear socio-technical foundation for security policy and practice for the US society. As noted earlier, systematically exploring limits and boundaries for using technology in a democratic society is a crucial responsibility of the project. Although project researchers acknowledge the need to address questions of privacy, there appears to be no concrete plan yet to explore a theoretical basis for the limits or appropriate uses of technology in security policy and practice. This is a fundamental challenge, and one that the project still needs to address. //

Response: The RESCUE team considered this to be among the most important recommendations/concerns. We have specified our plans regarding incorporating policy aspects of privacy into RESCUE in the response overview at the beginning of the response.

Not as
TIMELINE

2.5 Future Research Goals and Activities

The following future research directions and activities have been proposed by the RESCUE team for the next three years:

1. The RESCUE team plans to continue to pursue their research goal of "transforming the ability to collect, analyze, share, and disseminate information within the responding organizations and the public" based on the four research thrust areas of information collection, analysis, sharing, and dissemination.
2. Research goals in each of the thrust area will include: (1) information collection: developing robust and adaptive infrastructure to meet surge capacity needs; (2) information analysis: developing situational awareness from humans and about humans; (3) information sharing: developing scalable data sharing architecture for heterogeneous and autonomous environments; and (4) information dissemination: developing customizable dissemination of crisis information and assessing its impact.
3. Major novel research directions to be pursued will include: reflective cellular systems, privacy concerns in collection, event data management, and cross-layer adaptation in IT infrastructure.
4. Future RESCUE research activities will include: (1) advances in basic research focusing on collaboration opportunities identified and the primary goals of the project; (2) integrative system artifacts that highlight primary achievements and that serve as project legacy; (3) validating RESCUE research using crisis metrics; and (4) technology transfer, new research areas, and education.

General observations of the site visit team about the RESCUE team's future research plans are listed below:

2. The site visit team commends the RESCUE team for adopting an interdisciplinary and multi-thrust approach to pursuing their stated research goal of "transforming the ability to collect, analyze, share, and disseminate information within the responding organizations and the public."
3. Many ongoing research projects suggested under the four research thrust areas are relevant and interesting. The four suggested novel research directions (reflective cellular systems, privacy concerns in collection, event data management, and cross-layer adaptation in IT infrastructure) seem appropriate and are achievable in the next three years.
4. The Site Visit Team commends the RESCUE team for their four-layer research activity plan (basic research, integrated artifacts, integrative testbeds, and impact assessment). In particular, highly integrated testbeds will be critical for validating

Missing in plan

basic research and system artifacts generated from the project for the target response organizations and users.

The site visit team also identifies the following research directions and activities for the RESCUE team to consider:

1. Continue to address the legal, ethical, and policy issues of privacy of relevance to the project, and make advances in technologies that embed leading edge knowledge and practices about privacy considerations.
2. Clearly delineate the major contributions that can be attributed to the ITR RESCUE project from the work of collaborators or prior/concurrent work, and clearly identify research milestones for each of the four major thrust areas.
3. Clearly define and articulate a few major research target areas and accomplishments that can be communicated effectively to the funding agency, research partners, community leaders, and the general public.
4. Identify and develop integrated systems from the research components over the next three years that will directly address one or more disaster response scenarios, and make the systems and data sets available to the first-responder community and to researchers.
5. Integrate the security and trust research into a set of integrated products that would support decision making for the first responders.
6. Continue to develop interdisciplinary curricula in the participating universities.
7. Increase its effort in engaging community (i.e., academia, industry, and first-responder) leaders and actively solicit their advice about future research focuses and directions.
8. Develop a proactive plan to increase participation of under-represented groups (e.g., women and disadvantaged groups).

Response: These are valuable recommendations many of which we have (or have plans to) incorporate into RESCUE. Our specific plans are specified in the response overview at the beginning and as markup throughout the site-visit report.

3. Conclusions

not specific

Overall, the visitors applaud the efforts of the RESCUE team. In the future, we hope that the RESCUE team will move from identifying great problems to pushing harder on developing innovative original socio-technical solutions, integrating them into the testbeds, and focusing on making real impacts on the first responders. Given the social importance of the RESCUE work, it is crucial that the team integrates safeguards against the misuse of the technology into every aspect of its design. It is also important for the team to communicate the limits of their technologies and provide tools that enable the users to understand the implications of their choices as they deploy RESCUE technologies. Finally, it behooves the RESCUE team to focus on major contributions that make the difference as opposed to many little advances.