Multi Institutional Semi-Structured Learning Environments

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ABSTRACT

A description of two effective and novel collaborative learning environments that support engineering and technological innovation is provided. While offering great value to systems, and systems of systems, engineering practice, these environments are not adequately described by either of these perspectives. Instead these multi-institutional semi-structured learning environments are best described using an informing sciences perspective. Evidence is presented that these environments not only fulfill the definition of an informing system but may represent two of the more complete and dynamic instances of such systems with each simultaneously informing practice, research and teaching in a substantive manner that also produces engineering and technological innovation. The potential for these environments to serve as laboratories for both traditional and participatory research for those studying informing systems is suggested.

Keywords: informing systems, trans-discipline, collaborative learning, system of systems, and systems engineering.

1. INTRODUCTION

This paper describes a novel informing system, the multi-institutional semi-structured learning environment (MISSLE). Two examples of these entities are currently in existence with plans for a third instance under serious consideration. Products from these MISSLE systems have been credited with improving research efficiencies [1] and with improving disaster relief efforts in Haiti [2].

Since 2002 the Naval Postgraduate School has been conducting field experiments in support of the special operations community. These experiments began with a relatively narrow focus on a single technical challenge using a typical approach to experimental design and evolved into an ongoing series of complex events involving dozens of experiments, hundreds of participants and a unique business process [3]. The key stakeholders in these events, recognizing their value to the academic, government and industrial communities associated with the special operations community began to formalize processes, structure and funding in 2009. The series of events, and the individual events each quarter, are collectively known as "TNT" after the venue where most events occur, the Naval Postgraduate School's Tactical Network Testbed north of Paso Robles, California.

In 2009 TNT's emergent collaborative learning processes and its success in informing requirements generation, creating innovative solutions and decreasing time from the laboratory to the field led to an attempt to establish a second MISSLE environment. This MISSLE focused on a different community of participants, the humanitarian assistance and disaster relief community. This second series, Research and Experimentation for Local and International Emergency and First-responders (RELIEF), attempted to intentionally replicate the processes that had evolved into TNT. RELIEF has slowly grown in scope and has become successful enough to indicate that the success of TNT is not accidental and is a result of the environment and its emphasis on collaborative learning.

Each of these environments can be described using the same generic characteristics. To begin with, they are multi-institutional. Each has participants from government, industry and non-governmental/non-profit organizations (NGO/NPO) to include academia. Each has multiple individual experiments occurring simultaneously. For each experiment the specific organizations that predominate varies. TNT is more institutionally aligned in that the special operations community that it serves is generally centered on the United States Department of Defense (DoD) and even more so on a special segment of the DoD, the Special Forces Command. RELIEF is less aligned, with government participation, for example, ranging from cities and counties within the United States up to the United Nations. Similarly, the nature of industry and NGO/NPO participants is less homogenous for RELIEF than it is for TNT and RELIEF has more participation by citizens of countries other than the United States.

Secondly, the activities are semi-structured. There is just enough structure to be safe, secure and legal while optimizing the potential for collaboration. These events feature dozens of technical activities (experiments) that are conducted by different organizations from different institutions that may not collaborate with one another routinely. The semi-structured approach seeks to balance the benefits of both structured and unstructured collaboration [4].

Finally, each MISSLE is treated as a learning environment. Any entity that has a proposed solution can submit their capability for consideration and any

government entity can apply to attend. Invitations to participate emphasize that these events are intended to explore applications of technology within the subject domains and that this is not a sales event. Engineers and scientists, not sales personnel, are the intended audience on the technology side. The morning safety and coordination brief each day emphasizes that these are learning events with failure not only accepted but actually encouraged due to the learning involved.

The multi-disciplinary aspects of MISSLEs and the emphasis on seeking knowledge regarding potential solutions associated with the challenges of a problem domain make MISSLEs difficult to classify. While they may have a role to play in addressing the challenges associated with systems of systems [5] engineering a MISSLE lack the level of requirement specificity to be considered a systems engineering, or even a systems of systems engineering, construct or process.

Instead, Nadler's industrial engineering terminology [6] and Gackowski's [7] application of this terminology such that "informing systems are a class of work systems whose basic output is information that affects recipients' actions" may offer a potential framework for describing the MISSLE construct as an informing system.

While most of the foundational work on informing systems has been related to information systems and business schools, the view of informing as a discipline has been used to examine socio-technical organizational constructs such as the Informing Science Institute. [11]

The informing science approach is generally attributed to Eli Cohen [8], and was later applied to business schools by T. Gill [9]. Gackowski has also described this approach as a transdiscipline. [10] This approach may offer a useful perspective for examining MISSLEs as informing systems.

For the informing science approach to be considered appropriate three components must be present: 1) a client/receiver with a problem or problems that need to be addressed, 2) an informer/sender with appropriate expertise to address problems if additional resources are provided, and 3) a channel for communications exists or can be provided. [8] MISSLEs contain these components.

2. A MISSLE AS A COMMUNICATIONS CHANNEL

MISSLE events are part of an ongoing learning process in which clients with problems identify their problem domain and solicit the assistance of government, industry and academic experts that may have knowledge regarding potential solutions to these problems. This solicitation is done in the form of a Request for Information posted on the FedBizOps.gov website. A panel of client stakeholders reviews white papers describing the proposed solutions and invites participation in a quarterly MISSLE field event based on the panel's assessment of the potential solution described. At this point the MISSLE construct has already created bi-directional communications regarding the problem domain and potential solutions between the client and informer.

The stakeholders develop a list of activities, designated "experiments" to reflect the failure tolerant learning centric nature of the event, to explore the potential of the proposed solutions. These experiments can vary from a narrow and isolated proof of concept to a complex scenario incorporating moving vehicles, complex communications and active adversaries. An example of a current list of experiments is available at http://www.nps.edu/Academics/Schools/GSOIS/Departments/IS/Research/TNT/Upcoming-Events/Events.html.
More than 100 companies will typically participate in a MISSLE event. Industry participants are permitted only for actual experimentation and even those groups are composed of engineers and scientist with the attendance of marketing personnel (or marketing activity) prohibited.

These experiments tend to be focused on new technologies but it should be noted that this is not an acquisition activity but rather a learning activity. The stakeholder clients are focused on learning about potential capability solutions and not the purchase of any particular widget. The conduct of the experiments serves as another channel for communications between the client and informer.

In addition, the MISSLE events are open for all United States government employees and a typical event has more than 50 government agencies, not part of the stakeholder/client group, that attend to be informed regarding the state of technologies that may be useful to them as well. The social networking and transactive memory enhancement that one would normally see at a conference or trade show also takes place at these events.

Finally the events produce a variety of written reports to include a stakeholder's assessment, specialized reports (such as cyber security assessments) and a formal after action report. [12] The later can exceed 300 pages in length and represents a participant provided, stakeholder edited, record of each experiment.

3. INFORMERS AND CLIENTS

As noted above each MISSLE engages dozens of entities from both the government and commercial sphere. MISSLE events generally include university participation as well with participants from both private and public universities at each event. As one would expect, the roles of informer and client are not static with the client often informing the informer regarding specific aspects of the problem domain in addition to the designed direction of information flow. This access to objective end user feedback is the primary reason that commercial entities

participate since it represents vital information for systems engineers and designers. It should be noted that all participants are completely self-funded. The other major resource provided by the clients is access to military assets (UAVs, HMMWVs, weapons ranges, etc.) that are not normally available to most commercial entities.

One of the more interesting phenomena observed is the degree to which the informers, often commercial companies, will exchange and share information (and sometimes equipment) with one another in their attempts to address the client's problem set. An area for potential exploration by sociologists and organizational scientists would be the reasons for this cooperation between normally competitive entities. An untested hypothesis is that the engineers and scientist that make up the typical MISSLE participant team are more collaborative by nature than their marketing counterparts in the respective organizations.

Also participating are dozens of students and faculty from academic institutions, with the NPS, as one would expect, having the largest contingent of students. In the case of TNT these events align well with the unique nature of the NPS student body where 90% of the students are military officers.

4. METHODS OF INFORMING

MISSLEs have been shown to use three primary means of informing. They inform via research, they inform via practice and they inform via teaching.

Research products produced by scholars participating in (and utilizing experimental data obtained at) TNT have included dozens of conference and journal articles, both masters theses and doctoral dissertations, and follow on proposals for new work.

Contributions to informing practice have led to new capabilities reaching the battlefield in an accelerated manner, the development of two frameworks for including field experimentation as an explorative pre-acquisition process by two government agencies, and numerous examples of improved technologies. The MISSLE construct has proven so successful that the Office of the Secretary of Defense commissioned the Institute for Defense Analysis to conduct an independent assessment of the potential application of the construct across for the larger military and interagency communities.

Finally, educational informing products have included the pilot for a new hybrid masters degree program with an intensive field residency element, a short course for program managers, hands on theory-to-practice activities for students taking technology courses and, of course, increased currency for scientists and scholars participating in these events.

5. CONCLUSIONS

The MISSLE construct has been described using informing systems science and shown to meet the criteria for applying this transdiscipline perspective. Additionally MISSLEs appear to be robust examples of informing systems that simultaneously inform along the three main paths associated with informing science: research, education and practice.

The existence of two (TNT and RELIEF) structurally similar MISSLE instances, each executed by the same host educational organization but focused on different client/informer communities, may offer a unique opportunity for scholars of the emerging informing science transdiscipline to test hypotheses and develop corresponding theory. The MISSLE construct may become a community asset in the way that particle accelerators are to the high energy physics community.

The opportunity to use both traditional and participatory research methods to explore process improvement both in the design and operation of these informing systems and in the practice, education and research associated with the selected domain of interest may represent a leap forward for scholars engaged in the description of the emerging transdiscipline of informing science.

The intent of this paper has been to introduce the MISSLE construct and to initiate a dialogue regarding the applicability of, and value to, informing systems scholarship of this construct. Detailed case studies of the TNT and RELIEF MISSLE constructs are being prepared for submission to forthcoming IIS and IEEE conferences.

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