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Non-Tactical Infrastructure Education to Support Special Operations (In-Progress)

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Introduction

Army operations are executed across multiple domains and in complex environments. The complexity is partially due to the societal systems inherent to any operating environment (OE). Leaders must consider all factors that make up the OE, including social factors initiating and sustaining a conflict. Collecting information to facilitate understanding of an OE provides the basis for operational assessments, including military aspects and the population's influence. Civil Affairs (CA) forces conduct Civil Affairs Operations (CAO), which includes liaisons with civilian populations in the OE to address issues like infrastructure that may impact mitigation of civil interference and restoration of essential services [1]. CA forces have varying backgrounds which often do not include technical assessment and analysis of infrastructure.

The need for continued learning is inherent in any profession and a common goal of institutions of higher education. At the United States Military Academy (USMA) at West Point, the Strategic Goal #3 (Develop and Provide Intellectual Capital) [2] states the following:

- [USMA] will… seek opportunities for faculty and staff to assist Army units in a variety of operational environments.

- …leverage USMA's research, analysis, and education capacities to solve problems and enhance the creation of knowledge across the Army.

Inherent in this Strategic Goal is the duty to foster continued learning by identifying opportunities to support Army units and develop/provide learning opportunities to those units using the engineering education routinely taught at USMA. To support this Strategic Goal, a portion of the existing Infrastructure Engineering course currently taught at USMA was adopted into a three-day short to teach infrastructure assessment and analysis to two Civil Affairs Teams (CAT) companies of the Joint Special Operations Command 98th Battalion. The first offering of the short course was delivered virtually in December 2020, and the second offering was delivered virtually in January 2021. There were 35 participants during two sessions. More specifically, the course focused on four infrastructure assessment and analysis components: Critical Infrastructure and Key Resources, Stakeholder Analysis, the Infrastructure Component Model, and Infrastructure Assessment Model [3].

Course Design

The short course content and structure is heavily based on the existing Infrastructure Engineering course content and structure taught in the Civil Engineering Division at USMA. The Infrastructure Engineering course is offered to CE majors as part of the standard CE curriculum, and also to non-majors as part of the Infrastructure Track available to all USMA students. Thus, the Infrastructure Engineering course has been designed to educate students with technical and

non-technical backgrounds in order to achieve the desired learning objectives. The course content is reviewed and updated at the end of every semester.

The composition of the CAT members is similar to the composition of the USMA cadets in terms of technical background- the CAT members had limited technical training or life experience assessing infrastructure. CAT members ranged in age from approximately 22-32 years old, with varying levels of education beyond high school.

A Study Guide was developed and distributed to the participants approximately one week prior to the short course. The Study Guide is based on the engineering education materials taught at USMA and was modified to make the engineering-based content appropriate for the participants, who had a non-engineering (and generally non-technical) background. Prior to the short course, participants completed an anonymous Knowledge Assessment Survey to gauge their current knowledge level of infrastructure and assessment/analysis techniques. The findings of this Knowledge Assessment Survey are further described below in "Assessment".

The short course was conducted over three consecutive days. Due to travel restrictions associated with COVID-19, Day 1 and Day 3 classroom activities were conducted remotely. The first day was conducted in a classroom and includes one- hour long modules on 1) Critical Infrastructure and Key Resources (CIKR) as defined by the Department of Homeland Security (DHS), including an interactive exercise; 2) Stakeholder Analysis, including a desktop exercise; 3) the Infrastructure Component Model, including a desktop exercise; 4) the Infrastructure Assessment Model, including a desktop analysis; and 5) the Infrastructure Resilience Model, including a team exercise. The interactive and desktop exercises include individual and team activities. The participants were also given assignments to complete on Day 2, which were based on the information learned on Day 1. On Day 2, the participants conducted site visits to infrastructure systems located on Fort Bragg. On Day 3, the participants returned to the classroom to present their assessment and analysis of the infrastructure systems seen on Day 2. The participants analyzed effects on infrastructure, stakeholders, and mission objectives relative to several non-tactical scenarios including flooding, mudslides, forest fires, severe weather, and a biological pandemic.

Classroom instruction (Day 1):

- CIKRs- this module discussed the multiple definitions "critical infrastructure" and "key resources" and how those definitions change based on the organization writing the definitions. The definitions were then focused on those used by DHS. The interactive exercise required the participants to research the 16 DHS CIKRs [4] and rank them into three tiers based on the tiering system developed at USMA.

- Stakeholder Analysis- this module discussed the characteristics used to identify and classify stakeholders involved in an infrastructure related issue; and appropriate engagement strategies for each classification. This is particularly relevant to the CAT as their missions typically involve engagement with a multitude of potential stakeholders. The desktop exercise required reading a recent article on the increased presence of a foreign government

in the 98th Battalion area of operations, identifying stakeholders, and developing appropriate engagement techniques for those stakeholders.

- Infrastructure Component Model- this model was developed at USMA to supplement the engineering education curriculum on infrastructure prior to being written into TR-14-14 and is used in several Army officer education courses. The Component Model focuses on the following six elements to describe various stages of infrastructure systems.

  1. GENERATE: processes needed to create a resource in bulk.
  2. BULK TRANSMISSION: move large quantities of the resource over long distances.
  3. DISTRIBUTION: Move smaller quantities of the resource over smaller distances to a user.
  4. USE: consumption of the resource.
  5. WASTE MANAGEMENT: manage the waste associated with generating or moving the resource.
  6. COORDINATION: mechanisms to ensure smooth function of the resource production and transport.

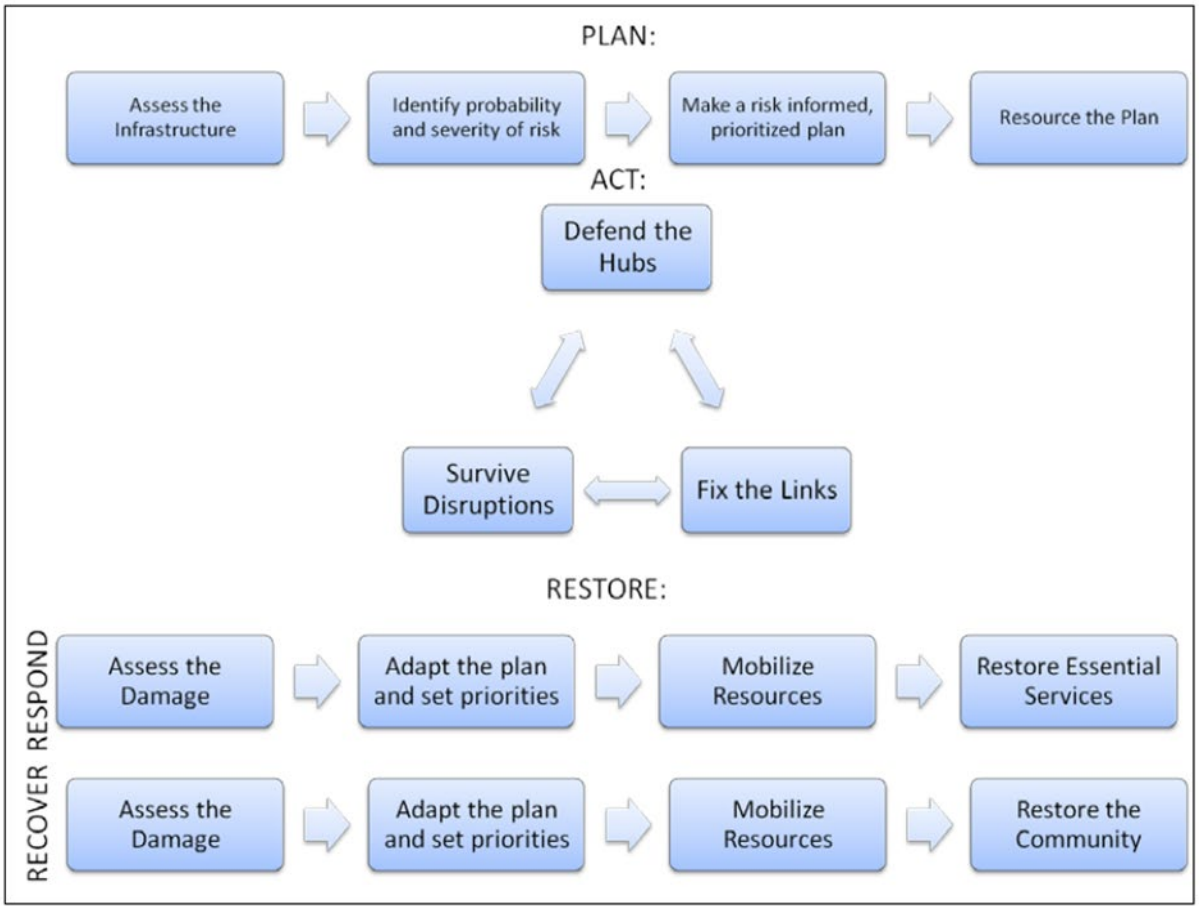
  The desktop analysis included showing the participants a water and wastewater system and having them classify the various stages according to the Component Model elements.

- Infrastructure Assessment Model- this model was developed at USMA to supplement the engineering education curriculum on infrastructure prior to being written into TR-14-14 and has been used in several Army officer education courses. The Assessment Model focuses on the following six prompts to rapidly assess and describe the status of infrastructure components and systems.

  1. REQUIRED – What's needed?
  2. READY – What's present?
  3. ORGANIZED – How is the system coordinated?
  4. REDUNDANT – Is there a spare?
  5. PREPARED – Is there a plan for disruptions?
  6. TOUGH – Is it reliable?

  This model is particularly useful in post-disaster and conflict zones. The desktop analysis included application of the Assessment Model to the electrical infrastructure in Puerto Rico following Hurricane Maria.

- Infrastructure Resilience Model- this model was developed at USMA to supplement the engineering education curriculum on infrastructure prior to being written into TR-14-14 and has been used in several Army officer education courses. The Resilience Model focuses on the three overarching prompts of the Plan, Act, and Restore phases to identify resiliencies and deficiencies in infrastructure systems as shown below. This model also introduces the concept that some systems must operate while others must fail. The team exercise required the participants to evaluate the US Health Care infrastructure response to the COVID-19 environment.



The participants were given assignments to complete during their site visits on Day 2.

Site Visits (Day 2):

The participants went to several infrastructure systems located on Fort Bragg to meet with the operators and subject matter experts to better understand the infrastructure systems. The sites included the water treatment plant, wastewater treatment plant, railyard, solid waste facilities, electricity facilities, and the airfield. During these site visits, they took photographs and interviewed the operators to understand the infrastructure systems in terms of the assessment and analysis models presented on Day 1. The participants compiled their information into presentation to be delivered on Day 3.

Classroom instruction (Day 3):

On Day 3, the participants, in their CA teams, met virtually with the instructor to present their findings on the infrastructure assessment and analysis tasks. The format of the presentation was open-ended, with most participants using the quad-chart format familiar to the Army. Presentations lasted approximately 30 minutes and included questions from the instructor and discussion with the participants on the applicability of the models, deficiencies in applying some parts of the models to various infrastructure systems, and how to facilitate use of the models when deployed.

Assessment

An anonymous Knowledge Assessment Survey was issued electronically to the participants approximately four days prior to the start of the short course. The purpose of the Knowledge Assessment was to assess the participants knowledge of infrastructure and assessment/analysis techniques prior to the short course. Participants were instructed not to use the internet or any other resources to answer these questions and use the knowledge in their head. The response rate for the Knowledge Assessment Survey is 86% (30/35). The Knowledge Assessment Survey included the following questions and response method:

1. Describe "infrastructure" in your own words. (Short Answer)
2. How do you determine "critical infrastructure". (Short Answer)
3. How accurately can you describe how a life service (e.g. water, electricity, etc.) is delivered from source to user? (Likert Scale)
4. How confident are you in rapidly assessing infrastructure components and systems? (Likert Scale)
5. How do you define "Resilience" with respect to infrastructure? (Short Answer)
6. Are "resilient" and "sustainable" the same? (Yes/No)
7. Are infrastructure components typically stand-alone, part of a system, or part of a system of systems? (Radio Button)
8. In your deployment experience, how have you dealt with infrastructure? (Short Answer)
9. Your team arrives in XXXX with the task of Nation Assistance following a natural disaster… Your team can only effectively manage assessment and action at one of the three sites until additional support arrives- which site do you go to first and why? (Short Answer)

In response to Knowledge Assessment Question #7, all participants stated that they considered individual infrastructure components as part of a system, which fits with the definition of infrastructure used in this course that states "Infrastructure components are part of a system of systems, or metasystem".

An anonymous Course Assessment Survey was issued electronically to the participants immediately following the short course. The purpose of the Course Assessment was to assess the participants knowledge of infrastructure and assessment/analysis techniques gained during the short course. The response rate for the Course Assessment Survey is 66% (23/35). The Course Assessment Survey included the following questions and response method:

1. How accurately can you describe how a life service (e.g. water, electricity, etc.) is delivered from source to user? (Likert Scale)
2. How confident are you in rapidly assessing infrastructure components and systems? (Likert Scale)
3. This course increased my understanding of infrastructure in my operational environment. (Likert Scale)
4. What were the most useful parts/models of this course? (Short Answer)
5. What were the least useful parts/models of this course? (Short Answer)

6. Your team arrives in XXXX with the task of Nation Assistance following a natural disaster… Your team can only effectively manage assessment and action at one of the three sites until additional support arrives- which site do you go to first and why? (Short Answer)
7. List any additional sustains/improves. (Short Answer)

To assess the effectiveness of this short course, the responses to the following Knowledge Assessment and Course Assessment questions were compared:

1. Knowledge Assessment #3 and Course Assessment #1
2. Knowledge Assessment #4 and Course Assessment #2
3. Knowledge Assessment #9 and Course Assessment #6

Figure 1: Results of Knowledge Assessment #3

Figure 1 indicates that the participants were not confident in their ability to describe these services accurately prior to this short course, with only one participant reporting "Very Accurately", eight reporting "Somewhat accurately", 12 reporting "Neutral", seven reporting "Somewhat Inaccurately", and two reporting "Not at all!".

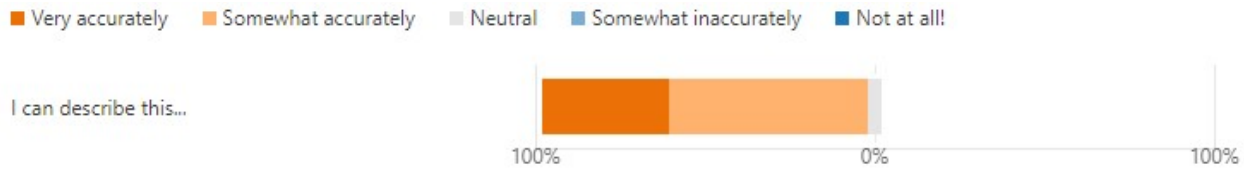


Figure 2: Results of Course Assessment #1

Figure 2 indicates that the participants confidence in their ability to describe these services accurately increased dramatically following the short course, with nine participants reporting "Very Accurately", 14 reporting "Somewhat Accurately, only one participant reporting "Neutral" and no participants reporting "Somewhat Inaccurately" or "Not at all!".

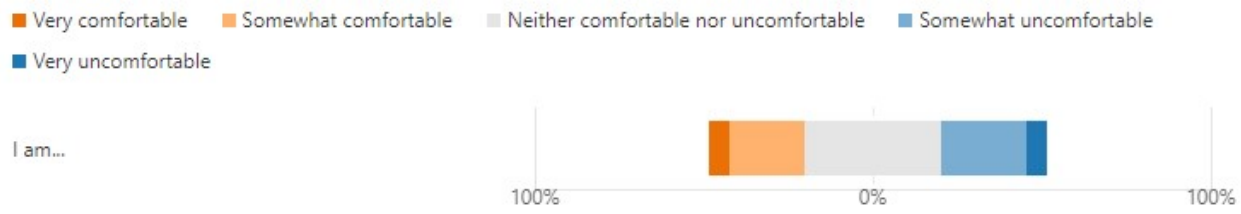


Figure 3: Results of Knowledge Assessment #4

Figure 3 indicates that the participants were not confident in their ability to rapidly assess infrastructure components and systems prior to the short course, with only one participant reporting "Very Comfortable", seven reporting "Somewhat Comfortable, 13 reporting "Neutral", eight reporting "Somewhat Uncomfortable", and one reporting "Very Uncomfortable".

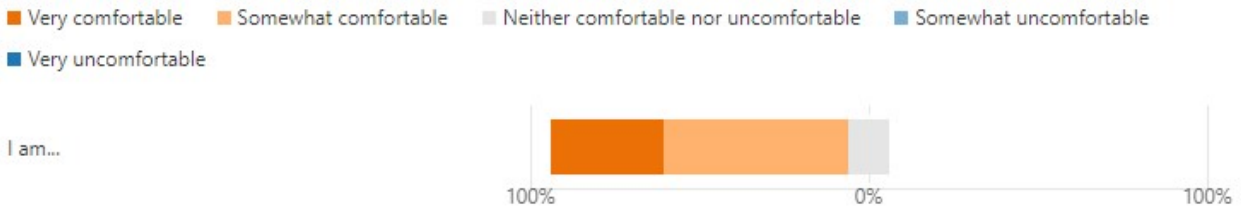


Figure 4: Results of Course Assessment #2

Figure 4 indicates that the participants confidence in their ability to rapidly assess infrastructure components and systems increased dramatically following to the short course, with eight reporting "Very Comfortable", 12 reporting "Somewhat Comfortable", five reporting "Neutral" and no participants reporting "Somewhat Inaccurately" or "Not at all!".

These results indicate that the content of the short course met the overall objective of increasing the participants knowledge and confidence in applying the infrastructure assessment and analysis models.

The scenario presented in Knowledge Assessment #9 and Course Assessment #6 asked the participants to choose between responding to (e.g., assessment and action) either a hydroelectric dam, police station, or regional hospital. These questions were developed to assess the effectiveness of the CIKR and Stakeholder Analysis modules. The responses to Knowledge Assessment #9 and Course Assessment #6 were provided in short answer form where participants were asked to select one building and explain their selection.

In the Knowledge Assessment, 18/30 indicated they would select the hydroelectric dam, 7/30 indicated they would select the police station, and 5/30 indicated they would select the hospital. Explanations generally stated that: the dam was selected as it provides water and power to the other buildings; the police station was selected as establishing security is priority; and the hospital was selected as several participants are medics and "are most familiar with this". These results match the participants descriptions of the types of infrastructure systems they initially encountered on their deployments asked in Knowledge Assessment #9

In the Course Assessment, 18/23 indicated they would select the hydroelectric dam, 4/23 indicated they would select the police station, and 1/23 indicated they would select the hospital. Explanations generally stated that the participants made these selections based on their understanding of the water and power provided by the dam as Tier 1 infrastructure. Three participants continued to indicate that they selected the police station as the prioritized security. Zero participants selected the hospital, indicating they understood that Healthcare is a Tier 2 infrastructure.

Conclusions

This paper describes the development and delivery of an infrastructure assessment and analysis short course, and the college-level engineering education course it is based on. The educational curriculum developed for the Infrastructure Engineering course required very little modification to develop the short course for CAT soldiers, most of whom do not have a technical background. Based on responses received during the Day 3 discussion and comparison of the Knowledge Assessment Survey questions and Course Assessment Survey questions, this short course substantially increased the confidence of the participants to assess and analyze infrastructure systems, and action responses based on their understanding of CIKRs and Stakeholder Analysis. Other comments received from the participants indicate the course was very well received and beneficial to their jobs, and they provided very few suggestions for improvements. The second iteration of the short course, delivered in January 2021, was revised to increase focus on the materials more relevant to the CAT mission and reduce focus on the education they have previously received elsewhere in their careers. The short course provided the learning objectives sought by the participants, thus providing intellectual capital to the Army and achieved USMA Strategic Goal #3. This short course will continue to be delivered as needed and will be revised to include current information and learning assessments.

References

1. *Civil Affairs Operations*, FM 3-57, Department of the Army, Washington, DC, 2019

2. United States Military Academy Strategic Plan 2017-2022

3. Hart, Klosky, Katalenich, Spittka, Wright, “Infrastructure and the Operational Art” *ERDC/CERL TR-14-14*, September 2014

4. Presidential Policy Directive 21 (PPD-21): Critical Infrastructure Security and Resilience