

Undergraduate Thesis Prospectus

Capacity Planning and Electrification of the Port of Virginia  
(technical research project in Systems Engineering)

Insurgency, Independence, and Identity: Ukraine's Digital Warpath  
(sociotechnical research project)

by

Ekaterina Forkin

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technical project collaborators:

Timothy Costello

Carter Paulen

Tanushri Roy

Matthew Swierczewski

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

*Ekaterina Forkin*

*Technical advisor:* James H. Lambert, Department of Engineering Systems and Environment

*STS advisor:* Peter Norton, Department of Engineering and Society

## **General research problem**

*How does real-time data sharing improve system communications and operations?*

The principal step forwards towards improved net carbon emissions compels the use of “monitoring and real-time reporting systems” (Sifakis & Tsoutsos, 2020). To improve energy consumption at ports, “fast response time” of equipment operations and their storage systems will inevitably be required (Kermani et al., 2022). Forecasts and plans created from outdated information may be inaccurate and harmful when not validated by present knowledge.

Synchronized management is the emergent mechanism to bolster “operation and energy performance” at ports (Kermani et al., 2022). Instant feedback can be used for strategic planning in both social media politics and in cyber physical spaces – in fact, “among 2.2 million politically engaged [Twitter] users,” digital communication strengthened similar ideologies, leading to more efficient political mobilization (Zhuravskaya, Petrova, & Enikolopov, 2020). Instantaneous digital data can assemble collective groups in the context of politics, such as increased voter turnout (Zhuravskaya, Petrova, & Enikolopov, 2020). To boost resiliency against unprecedented events, current informatics provides the adaptivity for existing plans, in the scope of both industrial functions and geopolitics.

## **Capacity planning and electrification of port operations**

*How can electric equipment be implemented across the Port of Virginia?*

The goal is to model port electrification and expansion via Simio use case simulations and visualize carbon emissions via PowerBI. Professor James Lambert of the Department of Engineering Systems and Environment is the technical advisor of this Capstone. The student team comprises: Ekaterina Forkin, Tanushri Roy, Carter Paulen, Matthew Swierczewski, and

Timothy Costello. At the Port, real-time data sharing through the use of RFID-tagged trucks has already improved efficiency and trucking metrics. Such data sharing supports truck reservations, transits, “advanced knowledge” of arrivals, and improved security measures via “automatic... identification” of vehicles (POV, 2016).

Year-round port operations maintain a steep energy demand. The “acquisition of a detailed, long-term database enables the proper establishment of an energy profile” (Sifakis & Tsoutsos, 2020). The term “nearly Zero Energy Ports” covers the systemic state-of-the-art transition from diesel-based operations to hybrid and electrified methods (Sifakis & Tsoutsos, 2020). These methods include shared power grids and “high power lithium batter[ies]” (Kusakana, 2021). Local electricity production in several international ports is sourced through “photovoltaic solar power” (Hansson & Wall, 2022). Though electrification through hydrogen fuel cells and liquified natural gas exists, research suggests that port equipment is quite fit for batteries. Such apparatuses operate within a fixed vicinity and will be “close to charging stations” (Hansson & Wall, 2022). Impacts of cargo-handling equipment electrification have been analyzed through forecasts, cost approximations, and CO<sub>2</sub> reduction estimates in case studies, as well as simulation software (Schenk et al., 2020).

Technical methods include discrete-event simulation, model verification and validation, and experiments conducted through Simio. Necessary data will be sourced from 1) the Port of Virginia when available and 2) existing literature, case studies, and reasonable assumptions. A successful project entails presenting the client with multiple use cases for electrified equipment implementation, disruption resiliency, economic trajectory on investments, and benchmarking against other ports. Financial projections and cost-benefit analysis are of prime regard to the port

as well. This will assist in developing the port's electrification plans, which function to curtail CO<sub>2</sub> emissions, reduce costs, and improve time savings.

### **Insurgency, independence, and identity: Ukraine's digital warpath**

*Since 2014, how have defenders of Ukrainian independence advanced their agendas through use of social media?*

Following Russia's annexation of Crimea, conflicts over Ukrainian land manifested through protests and political shifts. In March 2022, the Russo-Ukrainian War erupted as a struggle for territorial freedom and independent existence. The impacts are global: climbing gas prices, a potential third world war on the horizon, supply chain shortages, and a "massive increase in the rate of inflation" (Reynolds, 2022; Cordesman, 2022). War operations are not limited to their regional scope. As fighting persists, "North Korea, Pakistan and India, Iran and the Arab states, Turkey, and other major regional powers" stand to be involved with transfers of weapons, national economies, and trade pacts (Cordesman, 2022). Within the digital space, researchers have theorized that few media topics garner enough attention to "translate into political change" (Schroeder, 2018). The crossover of entertainment and economic matters into social justice and geopolitics on social media platforms, where the latest HBO shows, cryptocurrency crashes, or upcoming NATO summits trend simultaneously, may sever audiences' attention.

Participants include the Ministry of Defence of Ukraine, a government agency at the forefront of daily statuses. Their agenda is to mobilize armed forces and unite Ukrainians on the "path to victory" (Ministry of Defence, 2022). This group is led by President Volodymyr Zelensky as Supreme Commander-in-Chief, who exposes the reality of live combat through

videos of conflict zones (Зеленський, 2022). The Ministry's shared values include the projection of authenticity and a federation of military and civilian support. A key technique employed by the Ministry and Zelensky is the distinction of Ukrainian ethnic identity as separate from other Eastern European states. This is accomplished through salient heritage symbols posted on their Twitter (fig. 1). This differentiation of national identity is one way they encourage separateness.



Figure 1. A tank amidst a sunflower field, the national flower of Ukraine (DefenceU, 2022).

Another technique is the use of native Ukrainian as opposed to Russian for all official communications on social media. In the rising “use [of] Ukrainian in protest against Russian interventions”, the speech distinction is a display of state and individual insurgence (Mankoff, 2022).

A category of unorganized participants includes survivors whose cities were attacked. Their agenda is to inform relatives of their status by posting live updates (Specia, 2022). Though their primary agenda is to let relatives know of their safety and location, such posts often spread virally on social media networks as primary evidence of the violence justified by war, and are frequently cited by news sources and reporting media. Additionally, such posts are a means to spread information and awareness to call international crowds to action. A method to implore

viewers' pathos is tweeting videos of children's artifacts (Scherba, 2022). The disjunction between a toy and burning buildings conveys the shared interest to cease fire on residential areas and reestablish a sense of normality for civilians.

Another participant group is Airbnb.org. The subsidiary nonprofit declared an offer for "free, short-term housing to up to 100,000 refugees fleeing" warzones (Airbnb, 2022). Cheng (2022) found that Airbnb.org's measures to support Ukraine's effort for independence circulated through Twitter and reached "charities, politicians, and... mainstream media". Airbnb's technique of "connecting people with emotions" bolstered Airbnb user support and activism (Cheng, 2022). Specifically, channeling tourism and travel into a deeper motivation to understand spatial context and promote cross-border support uniquely enhanced Airbnb's status as a hospitality platform while gaining them a philanthropic face. This ultimately advances their main corporation's agenda of global inclusivity and financial profit from the tourism marketplace.

Next, participants include Russian artists who protest via demonstration and photography, such as the Party of the Dead. Their overarching agenda is to advise Russians of the "dehumaniz[ation] by the big things like war, money, oil, corporations, parliament, [and] wage labour" (Kirillova, 2019). To accomplish this, the Party informs fellow citizens of the "destruction and death" created by the Russian regime by creating performance art and silently demonstrating (Dixon, Ilyushina, & Abbakumova, 2022). Though their primary interest is not necessarily social media signaling, such performance art and physical installation media inevitably gets videotaped and/or photographed. Thus, social media functions to share messages that would otherwise be considered temporary, and transforms the landscape from local advocacy to global outreach. To convey their anti-war message, members of the Party held

demonstrations at a cemetery (POTD, 2022). In response to criticism and possible political threats, Party members don skeletal masks to preserve anonymity (fig. 2).



Figure 2: Messages express “Are there not enough corpses” and “The dead don’t need war” (POTD, 2022).

Finally, participants include United24, a foundation that serves as the “main venue for collecting charitable donations in support of Ukraine” (United24, 2022). Their plan includes the provision of medical aid, rebuilding infrastructure, and military support. Agenda advancement techniques include warzone photography and quantification of donor-funded purchases. The emphasis on defensive utilization, by using words such as “demining”, “humanitarian”, and “rebuild”, function to preserve the sentiment of unprovoked attack (United24, 2022). Amongst the serious pleas for drone support, United24 utilizes a sense of humor as a technique to gain favor amongst viewer eyes and display an amiable quality. For example, the use of meme format to wish President Putin a happy birthday and “congratulate him with drones for the Armed Forces of Ukraine” provides a sense of conviviality and lightheartedness amongst more serious posts, while propagating their need for gadget fundraising (u24.gov.ua, 2022).

Researchers have investigated war through the lens of social media. For example, Hauter (2021) found that opposing sides “try to give credence to their narrative and discredit the narrative of their opponents”. The result is often an environment of disinformation and compounding data whose truth is difficult to validate. Through social media’s provision of “unprecedented access to information from conflict zones”, faster on-ground physical support to armed groups is provided, and publicly shared support is made more visible (Hauter, 2021). Penn State researchers found that social media usage by advocacy groups “enable[s] engaging feedback loops” and “strengthen[s] collective action efforts” (Obar, Zube, & Lampe, 2012). The awareness garnered by spreading agendas via social media platforms promoted outreach and solidarity amongst their audiences. The rate of information dissemination and depth of audience reached demonstrated the ability of social media to “mobilize” and encourage action (Obar, Zube, & Lampe, 2012). Both online and offline activism was boosted.

In relevance to geopolitical regions, the speed of circulation is dependent upon the popularity of various platforms across the world. For example in Russia, VKontakte and Odnoklassniki are as commonname as Facebook and Twitter in the U.S. (Thussu & Nordenstreng, 2020). In conjunction, researchers have investigated how identity through “linguistic, familial, and cultural ties” lays the foundation for a murky atmosphere over geopolitical disputes (ICG, 2020). Such cultural similarity is often used as reasoning against Ukrainian nationalism and regional independence. Though both countries have intertwined alphabets, folklore, and Slavic customs, their economic and political goals are evidently divided. Unsettled exploration in the context of social media’s role includes the utilization of civilian- and advocacy-sourced data on military operations.



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