User Experience Design as a Framework for Environmental and Political Negotiation in Decision-Making about Wind Energy

Daniel P. Richards

Department of English, Old Dominion University, Norfolk, VA, United States
dprichar@odu.edu

Jennifer L. Whytlaw

Department of Political Science & Geography, Old Dominion University, Norfolk, VA, United States
jwhytlaw@odu.edu

Thomas R. Allen

Department of Political Science & Geography, Old Dominion University, Norfolk, VA, United States
tallen@odu.edu

Jonathan J. Miles

School of Integrated Sciences, James Madison University, Harrisonburg, VA, United States
milesjj@jmu.edu

George Mcleod

Department of Ocean & Earth Sciences, Old Dominion University, Norfolk, VA, United States
gmcleod@odu.edu

Jeremiah J. A. Cronin

Institute for Innovation & Entrepreneurship, Old Dominion University, Norfolk, VA, United States
jcronin@odu.edu

ABSTRACT

This case study outlines a user experience design approach, with specific emphasis on persona building, of a web-based mapping and information tool aimed at helping developers site wind energy projects. Relying on philosophies of user experience in the field of technical communication, particularly ones that focus on usefulness, problem solving, and political participation, the authors of this paper present how user experience design was used as a framework for negotiating political differences between stakeholders in wind energy, namely the military and energy developers but also municipal permitting offices and state agencies overseeing energy regulation. In doing so, the authors speculate about the possibility of implementing user experience design as a method for political negotiation, particularly as it pertains to environmental regulation and communication.

CCS CONCEPTS

• **Human-centered computing** → Interaction design; Interaction design process and methods; User centered design.

KEYWORDS

User experience design, environmental communication, risk communication, renewable energy development

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1 INTRODUCTION

Wind energy recently surpassed hydroelectric power as the largest renewable energy source generated in the U.S., with wind energy itself currently providing 8.42% of all electrical energy generated in the year 2020 (U.S. Dept. of Energy, 2021). This percentage has tripled over the last decade or so, spurred in large part from the American Recovery and Reinvestment Act signed by the Obama Administration in 2009, which allocated \$90B of the total \$787B stimulus package for creating “green jobs” in both solar and wind energy. With President Biden and his administration recently signing a stimulus package in 2021 with even more earmarking for renewable energy [1], specifically offshore wind development,¹ and with concrete goals for employment numbers and energy generation [2], we can only assume that wind energy will continue to grow at a similar rate, if not more, in the next decade in the United States.

One of the core challenges for wind energy development is perhaps the most obvious one: Where should the turbines go? Or, in energy discourse, where should they be “sited”? Turbines on the scale of wind farms for utility-based usage are generally located where the strongest wind patterns are. Developers might use a geospatial resource, such as the data provided by the National Renewable Energy Laboratory (nrel.gov/wind), to identify ideal locations for a wind farm. From there, developers work with local, regional, state, and/or federal permitting and regulatory agencies to ensure that the wind turbines are zoned appropriately and do not disrupt environmental or historical protections already in place. The regulatory procedures vary by state for onshore wind development as well as for offshore wind if in state waters. (If it is in federal waters, the process, run by the Bureau of Ocean Energy Management [BOEM], is a bit more straightforward and government-led in terms of policy and siting decisions.) In all, siting wind turbines is not just a matter of finding where the wind blows and sticking a turbine in the ground. Agencies ranging from the Federal Aviation Administration (FAA) to the Department of Defense (DoD) to the Department of Environmental Quality (DEQ) to the business

¹The Biden Administration designated a new wind energy area of the Department of Interior within their Bureau of Ocean Energy Management (BOEM).

divisions of states all have a say in where wind turbines should or should not be sited.

There are layers upon layers of permitting and regulatory authorities, of course, on most any energy development project; but what is unique about wind energy is the third dimension of height (not sprawl for solar or depth for oil), which brings into the regulatory fray anything from Navy helicopter training routes to peregrine falcons to shadow flicker. And given the relative newness of this branch of renewable energy there is still some regulatory decentralization and even a lack of clarity of who has the authority to grant or restrict development of a wind farm or even a single wind turbine on a personal property. Some states, like Texas, California, and Oklahoma, have thrived during this boon despite varying political colorations in some part due to flat topography and in some part to streamlining a state-driven process of permitting and siting wind farms. Others, like Virginia, are pushing politically and economically towards a cleaner energy network but are facing obstacles relating to challenging topography, military installations, and regulatory decentralization.² So, even with a positive rhetorical environmental disposition towards renewable energy, there exist literal layers of complexity that need peeling back if wind energy is to really take off. What is needed is a solution-based tool that allows developers to site turbines, yes, but also better understand the meandering and at times *ad hoc* regulatory frameworks and processes in place that will facilitate or flounder their wind projects. It is our contention that the field of technical communication and its approaches to user experience design has much to contribute to just such a project and, indeed, this paper details just such an attempt at designing such a solution-based tool.

This paper shares the preliminary design of a GIS-based mapping and information tool aimed at helping developers site wind energy projects in the state of Virginia. The goal of the project—executed through Old Dominion University’s OpenSeas Technology Innovation Hub, and funded through an Office of Economic Adjustment and Department of Defense (DoD) grant sponsored by the Virginia Department of Mines, Minerals, and Energy (DMME)—was to design a mapping tool to help energy developers locate spaces for wind turbines that would not affect military operations and to help the DoD receive early notification about potential wind projects submitted through local permitting offices and other state agencies to facilitate quicker development of wind energy. It is part of a larger push by the state’s DMME to centralize the process of wind energy siting and development, in essence modeling the state-led permitting process currently in place in many other states that have developed wind energy quickly and efficiently. At its core, then, the design of this wind energy siting tool is imbued with a sense of negotiation, of shared future, and of holding both military and renewable energy operations accountable for the lands they lay claim over and how those lands are used to protect and nourish the communities within and around them.

²The state of Virginia is home to the world’s largest naval base as well as a variety of other military installations serving multiple branches of the military. As such, one of the key conflicts for wind energy development in Virginia is disruption with air space for onshore projects and maritime routes for offshore projects. The unique aspect of wind energy development is the potential interference with military operations. To be sure, there are myriad other aspects of wind turbine interference, such as migratory bird patterns, ecosystem disruption, shadow flicker, tourism sight lines, and continued studies on the effects of noise on sleep patterns.

2 THE EXIGENCE OF WIND ENERGY SITING TOOLS

Our tool, when complete, will not be the first to exist, nor will it be the last. As with most any environmental problem to solve, there exists an array of GIS-based tools that leverage the latest geospatial technology to facilitate a specific purpose. In the case of wind energy, this array of tools is generally characterized by the use of points or polygons to either see the current locations of wind turbines or learn more about potential conflicts about siting a wind turbine in a specific, pre-determined location. The tools are also generally state-based, as the entirety of onshore wind energy permitting and regulation operates on the state or county/municipal level. As such, there is no standard tool across the nation; each state has their own project (or projects) funded by various agencies, mostly military ones, to help “deconflict” (military discourse, mainly) wind energy development with military operations and readiness. But there are distinct differences between each tool. They exist as a genre, like other environmental-focused interactive tools [3], with enough similarities in exigence, audience, and function but enough differences in emphasis and focus.

Take for example the Texas Early Notification Tool, or TENT (Figure 1). As per its user guide, “the tool allows users to create custom queries based on their area of interest. If the area selected overlaps a military asset notification area which warrants early notification, the tool will generate an output with the notification areas and associated point of contact information. These data are displayed through interactive mapping and general text” [4]. The main function of TENT is not to find strong wind patterns in the state of Texas but to identify the points of contact the developer would need to initiate and engage with if seeking to construct a wind turbine or wind farm. As the user can plainly see, the layers of military land usage, ranging from installation and base properties to training routes, are quite vast. But plotting a wind turbine within these areas is not impossible; as the user can also see, there are many turbines currently running within these zones. The interface here is not then about immediate negation of space but about generating points of contact based on certain locations (i.e., each installation as its own commanding officer or other point of contact specifically for energy development). The “early notification” theme of the tool is precisely about this point: wind energy developers—who are the primary users of the tool and these types of tools, generally—should engage military stakeholders early and often to ensure that their project is not quashed later on in the process due to interference with military readiness, broadly defined. An overlap with military assets isn’t an immediate “no” but instead early notification (for all parties) that mitigation measures may be needed before the project can proceed. The TENT tool helps scratch the surface of political negotiation.

The TENT application is impressive in its focus on establishing effective communications between the stakeholders who need to interact (namely, wind energy developers and military personnel). Other tools, such as the California Military Land Use Compatibility Analyst (Figure 2), are less impressive in this regard. The California tool affords users the ability to place a single dot on the map and then receive a series of “is/is not” results about proximity to bases, training routes, and special use airspaces. This places more

Figure 1: Cropped screenshot of Texas Early Notification Tool, main page (<http://tent.nri.tamu.edu>)

Figure 2: Cropped screenshot of California Military Land Use Compatibility Analyst tool interface (<https://cmluca.gis.ca.gov>)

communicative onus on the user (likely a developer) and also fails to communicate that the turbines *can* exist within military spaces; nor does it facilitate communication between different user groups or stakeholders.

Some tools go even further in using the full affordance of the GIS graphical interfaces, choosing to bring in more factors of permitting and regulations. For example, a third application, the Southern New Mexico – El Paso Joint Land Use Study tool (Figure 3), includes military base layers but also highlights other geographical and political layers, such as environmental and public lands (including national monuments) and other ecological information. This tool includes a third dimension, height, in revealing various FAA constructions, such as radio towers, and even transmission lines below ground. This tool is far more comprehensive in the broader sense of

what is meant by “compatibility.” It uses military deconfliction as its premise but brings in concerns of other environmental and political stakeholders by including more categories of potential conflict.

The thread weaving these tools together is military support. TENT was funded by the DoD, as was the New Mexico tool. The California tool was developed with support from military affairs of their state. This is not a coincidence, as the reader might imagine. Given the height of turbines and the potential for radar interference, the military has great interest in overseeing the development of wind energy pretty much anywhere in any state. However, as an “environmental” area of work, many states have developers go through permitting processes with environmental or conservation agencies. Military readiness was not foregrounded in the permitting processes in many states, including the focus of our project in

Figure 3: Screenshot of interface for the Southern New Mexico – El Paso, Joint Land Use Study (JLUS) project (<https://map.snmepjointlanduse.org>)

Virginia. Many municipalities, counties, and states have regulatory frameworks and processes in place from years past (or that build off solar regulatory language) that did not have the foresight to include the military. With the sudden and expansive increase in wind energy, the military wants to know about any and all wind turbine development that might impede effective training or that might cause radar interference. The aforementioned tools, while functioning differently in varied state regulatory contexts, all “fill this gap” in the process by moving the military contacts up to the “front of the line” even if there exists no regulatory authority on their behalf at that moment in the project. “Filling this gap” is a big part of our own project, seeing as our main source of funding also comes from the military, but it is not the only part, as another partial sponsor and substantial supporter of the project is the Department of Mines Minerals and Energy (DMME).

Put frankly: the current permitting processes for onshore wind generally starts with the Department of Environmental Quality (DEQ) on a local level and move up from there. There is an explicit political push from both military and state authorities to improve coordination of the associated processes. There is perceived value in engaging the state’s department focused on energy (the DMME) to support this function. Our tool, then, must mirror this political push and we of course must meet the functional requirements laid out before us by our grant sponsors, which in part centers around early and often communication amongst stakeholders.

Given this political enmeshment, we are sympathetic to Rebecca Zantjer and Laura Gonzalez’s thinking on not establishing a set definition of “user experience” [5]. For them, trying to find or give a stable definition takes researchers in an unproductive essentialist direction, and instead it might be more productive to proffer what *is meant* by user experience when researchers and practitioners describe their work. For our team, and for this project as a whole, user experience refers to the ways in which the various stakeholders in

wind energy use our tool to help their individual needs and support inquiries. The three main stakeholder groups (and user groups are governmental permitting officials, wind energy developers, and military personnel). The experience of the tool must be productive, always pointing the user—be it a military, state, or developer user—towards the continued development of wind energy and not indicate an immediate conflict that will not be resolved through the process. This productivity can range anywhere from regulatory education to fulfilling a data inquiry to guiding a developer through the complex siting and construction process.

But, for our project, we wanted to do more than just fill this gap in early military intervention or interfacing. We believed in the centralizing process of wind energy siting and its benefits. We envisioned a tool that was as useful to any and all stakeholders as possible while still retaining ease of use. Our task was then to have the GIS elements that allowed for deconflicting in siting but that also walked a user through the complex regulatory processes and brought together all the elements a developer would need to go through from beginning to end. We needed to think of this tool as helpful in bringing users through the process of how to locate turbines in the state by breaking down and streamlining the process, often visually, for them, but we also needed to think about how this tool might anticipate changes in energy regulation through the development of a more centralized model. In doing so, we would bring together the three major stakeholders—military, wind energy developers, and state and local permitting offices—in a more expansive vision of “usefulness” [6, 7] in user experience design.

3 STAKEHOLDER ENGAGEMENT AND PERSONA DEVELOPMENT

The DoD would have been content if we just recreated existing tools but for Virginia. Their main desire was to be included earlier on the

process. As of right now, the permitting process for onshore wind in Virginia goes through the Department of Environmental Quality (DEQ) and/or the State Corporation Commission (SCC), depending on the nature of the installation. Both agencies are concerned with different aspects of projects. There is an explicit political push to coordinate these processes, with the state department focused on energy (the DMME), in the position to facilitate and track the status of energy projects of all types in the Commonwealth and adjacent waters. It is *suggested* they receive informal reviews from the FAA, Navy, DoD, and the Coast Guard (for offshore), but it is not required to receive a permit to build. The pressure the military can apply to restrict the development of a wind project in our state is not official at the permitting level but later on if the military wishes to raise concerns about the wind turbine's height, say, and then it would be hard for that developer to get insurance, for example.

We, of course, learned about all these nuances by way of stakeholder engagement, by extending our vision of the tool beyond military deconfliction, essentially asking: What would be the ideal tool to facilitate wind turbine siting and development look like? Specifically, we asked: What would all the various stakeholders envision a more comprehensive tool to look like? What would they use it for? And what goals should it accomplish, beyond mere centralization of information and resources? In all, we conducted 22 interviews of individuals or groups of individuals representing the following sectors and organizations: DoD; DEQ; Navy Fleet Forces; domestic and international energy companies (including Dominion Energy, US Wind Inc., and Ørsted); Virginia's State Corporation Commission (SCC); Naval Facilities Engineering Systems Command (NAVFAC); Naval Seafloor Cable Protection Office (NSCPO); FAA; US Coast Guard; American Wind Energy Association (AWEA); and the Department of Mines, Minerals, and Energy (DMME). At first, we had categorized these stakeholders into the following four categories: energy developers, DoD, military installations, and permitting agencies (including state and local governments). These would change slightly once we started developing our personas.

All interviews were conducted over phone or video call. The questions we asked to all were presented as such:

- **Processes:** What are your processes or procedures from the start of a project to its finish? What needs would you want to have addressed? Who do you contact for specific steps in the process?
- **Tools:** How are tools used throughout the process, and what are the tools you are currently using? Are outside data needed to run certain tools? Are there specific data specifications for developers to submit for review?
- **Policies:** What are the relevant policies for your work? What restrictions do you have, and which specific regulations guide your actions?

Once the interviews were complete, we were able to categorize the feedback we received into the following four areas (Table 1), thinking about the work of Carol Barnum during this phase, who notes that personas ought to represent “specific people with particular needs, wants, desires, skill levels, and contexts of use” [8]. We also strived to make the user personas, as Lisa Melonçon [9] might put it, “three-dimensional,” using the interview data we had

accumulated to develop each persona rather than demographic information about each group.

Right away we noticed that the DoD and military installations had the same preferences of use and the same conflicts. We also learned that, more than data layers, communicative pathways between and across agencies and sectors was paramount. Many of the frustrations we heard had to do with not knowing who to communicate with or hearing dissonant messages from different stakeholders. We also heard a good amount of the need to demystify the regulatory process, especially for onshore wind siting. While we assumed this would be a data-centered tool, we were hearing that there was still a great need for establishing communicative pathways (often by providing updated contact information) and for providing education for those in need. Given what we learned, we developed the following developer (Figure 4), permitting authorities (Figure 5), and military (Figure 6) personas, narrowing down the user categories and focusing on desired purpose, frustrations or points of friction, and of course the technical requirements of our tool to help it be as useful as possible for them. Eva Brumberger and Claire Lauer's recent work on persona development was most instructive for us. For in addition to using personas to “tell a story” of fictionalized but data-supported user identities, they note that “research-based personas can also be used to explore the diversity of work tasks and styles that encompass a field” [10]. Our focus on tasks and requirements is clear in the below personas, tailored as PowerPoint slides included in a verbal progress report presentation to our grant sponsors and supporters. The quotes in the top right-hand corner are meant to characterize the sentiment displayed by each user group during our interviews.

Taken together, the development of these three personas pushes our tool beyond what the existing tools have done in the past by using military deconflicting as an exigence but then extending the tool to include military personnel users themselves as well as government workers in local and regional permitting and regulatory bodies. These points are expanded in the following section.

4 DESIGNING FOR DECONFLICTION AND BEYOND

We fully realize that user experience design is invariably political [11] and inherently ideological [12], so attention was paid specifically to where points of difference arose and how the tool could help move towards resolution or at least productivity in more communication. User experience design is at its core about decreasing the friction between the user and the technology, but in this case, we also attended to how the technology itself could decrease political friction between different user groups. We see this is not an insignificant distinction. Even designing a single tool that stakeholders from various groups would use at the same time is itself a participatory design act—let alone what they do when they get there.

In all, we identified three points of “deconfliction” where a user experience design approach intersected with political conflicts:

- **Early notification.** As stated above, early notification of the military of wind energy projects is the underlying exigence of so many of these siting tools. Ours, given our funding source, also needed to meet this functional requirement. At

Table 1: First iteration of persona development

Organizational Needs	Energy Developers Contact information for military. Data layers for transmission cables for offshore projects. The developers have processes, tools, and contractors in place (though these do vary by the size of each company). Our tool is complementary, and we need to persuade them to see its value by providing certain data (transmission cables) and regulatory clarity. Smaller developers will more readily see its value.	Dept. of Defense Early notification. Better understanding of the early steps wind developers are taking.	Military Installations Early notification to ensure no radar interference.	Permitting Agencies Broader perspective on wind energy is needed. Coordination between economic resource development versus environmental review and regulation. Education on existing cases in similar counties or cities.
User Goals	Site and develop wind projects. Receive early notifications of policy changes. Developers are avid users of tools and spatial data.	Ensure military readiness. Identify conflicting uses and cumulative impacts.	Ensure military readiness and base security while reducing radar interference.	Learn more about the regulatory processes before and after their permitting work.
Conflicts of Use	Military restrictions. Fishing communities.	Feel “out of the loop” when it comes to early development and discussions of siting. Consistent contact with energy developers.	Disruptions in everyday trainings. Compatibility of regional missions between bases	Coordination of a variety of state agencies.
Key Struggles	Required to submit multiple technical and environmental reports as part of the siting and development process. Developers interested in having the most recent data and information available to them. Offshore developers mentioned lacking easy way to get access to specific datasets such as AIS (vessel traffic) and identifying where transmission lines would approach and connect land. Sometimes feel disassociated from early intervention with important stakeholders such as military radar and Coast Guard.		Personnel changeover on installations and with energy project leads.	Staffing and resources.

Figure 4: Persona slide depicting wind energy developers

Figure 5: Persona slide depicting state and local permitting authorities

one of our earliest meetings, representatives of the DoD gave us the clear impression that they felt “left out of the loop,” with DEQ and other, small agencies knowing and circulating information about potential projects without notifying the military. The DEQ is not responsible for doing so, but the military wants to know as soon as possible not only to save

face should they quash an already-developed project but also because they see military readiness as the number one concern in land and water development. To address this concern, we included the DoD’s informal review early in the process outlined by our tool to let developers know that it is best practice to notify the military of their plans, even

Figure 6: Persona slide depicting military stakeholders

though it is not required by law or regulation to do so at that stage, if at all.

- Environmental vs. military concerns.** There is a palpable sense of conflict between the energy community and the military. Both are vying for limited space, and both seem to think the other should have less authority than they do. This should not come as a surprise, of course, but our design team will need to be sensitive about how we communicate the order of operations. We also fully realize, and also pick up on the fact, that when interviewing energy companies there was at times a sense of distrust of what we were doing—again, understandable, given our funding source. We needed to be sure that we were designing a tool that was highlighting military deconfliction but that was also of great value to energy developers, so they would see more the compatibility of the two sectors. This is where most of the work went above and beyond, as we painstakingly broke down the regulatory frameworks, including all the documents, contacts, and data needed to site a successful project, to produce a procedural design approach to the tool, helping assuage their biggest concern that their project would face resistance or get quashed late in the game. This work of unpacking the regulatory part will hopefully give the tool a sufficient level of usefulness to put military users and wind energy developer uses in the same space for a common goal.
- Educate local permitting offices.** There are very rural parts of our state where wind energy isn't exactly the talk of the town. There is real political resistance to any energy source that might continue to take away jobs in other energy sources and there is an inherent resistance to any out of state energy company coming in and changing, literally, the

landscape of a town or county (aesthetic effects on tourism in the mountainous regions are also a point of resistance). While there is a standard “permit by rule” process set up in the state to allow developers to receive a local permit to site turbines before moving to the next step, many local offices are understaffed and ill-equipped to handle questions about policy. To supplement this, we have included a third section of the tool that allows state, local, and tribal authorities to learn more about the regulatory framework and learn from the few successful examples currently in place.

These points of conflict to certain degree are not fully resolvable, and especially not so through a modest web-based geospatial tool. But we do believe that our approach to user centered design, focused specifically on persona building, usefulness, and participation, can operate to some degree in facilitating political-environmental negotiations between stakeholders by putting them in contact with each other at times of critical development and by centralizing the regulatory writing, data, and other helpful tools to bring these vastly different users together in a common mission.

5 CONCLUSION

We hope that readers of this paper take away both (1) a case study example of how the research team of technical communicators, geographers, and geospatial specialists designed an interactive tool that met the mapping (GIS data) and information (policy exposition) needs of a variety of stakeholders involved in wind energy development and (2) an expanded vision for user experience design as itself a tool for political negotiation in environmental contexts.

Our tool is not complete, and the complex problem-solving based work on siting wind turbines will only increase, rather exponentially. We hope our approach will encourage others to focus on

more than just data layers in environmental problem solving and for UX practitioners and researchers to continue to think about how the facets of user experience design—while seemingly so obvious and neutral in their make-up—might actually serve as frameworks for political reconciliation on grander scales.

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