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Table A1.1: Interview guide for ethnography phase.

1. What is your position? What is the purpose of your organization/agency?
2. Who do you work with most closely in your position (external to your organization)?
3. What was the process by which you became involved in the Deepwater Horizon spill response? Who contacted you? What was the turnaround time for engagement?
4. During the spill, what did a typical day look like for you? Who were you interacting with most frequently? What types of decisions did you have to make?
5. Can you tell us about a time during the DWH when you had to make a decision but you weren't sure what to do? How did you go about making that decision?
6. We are particularly interested in how information and ideas were communicated during the spill. Did you receive or request information during the spill from outside your department or division? If so, what types of information and who did you receive it from?
7. We have heard from other people we've talked to about spill response that who people already knew and worked with closely before the spill happened greatly impacted what their response effort look like and what they were able to get done. Does that resonate with you?
8. What role do you think trust played in the structure and effectiveness of the response?
9. Who do you wish you had known/had in your network to draw on during to the spill?
10. In the ideal future, what would that relationship look like before another large-scale spill happens?
11. Do you think that we are more, less, or equally prepared for quickly and effectively responding to a large oil spill crisis now, as compared with before the Deepwater Horizon oil spill?
12. DWH was obviously a very stressful experience for everyone involved. What was an example of success, when you felt proud of your work?
13. How and when were you recognized or rewarded for your work?
14. Are you working with new people or organizations now as a result of the spill?
15. Did your job responsibilities or expectations change as a result of DWH?
16. In your position, how did you utilize science during the spill? Did you interact with scientists directly? If so, what was that experience like? If not, how did you receive the information you needed?
17. How did you sort through or make sense of all the information you received?
18. Were there times when you couldn't get the information, data, or scientific advice that you needed?
19. This project is based on the assumption that finding a way to rapidly and efficiently integrate new science with response decisions will dramatically improve the speed and effectiveness of large oil spill management. Do you agree with that assumption? Are there other challenges or barriers to effective response that you would place as higher priority?
20. Thinking about the potential to use science in rapid response in the future, what would be your ideal setup?
21. What is preventing that ideal from being a reality?
22. If you had a billion dollars (and the executive power), what are two critical success components that you would focus on to ensure effective response to oil spills in the future?
23. Reflecting on this conversation and your experience, what were some key takeaways that you feel you learned from DWH about seeking guidance from scientists to assist decision-making during crises?

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24. If you were in my position, looking into this challenge of rapidly integrating science into the effective response to large oil spills, what additional questions would you be asking? What are we missing?
25. Anything else you want to say?

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Figure A1.1: Persona profile template used to distill key insights about our four primary stakeholders.

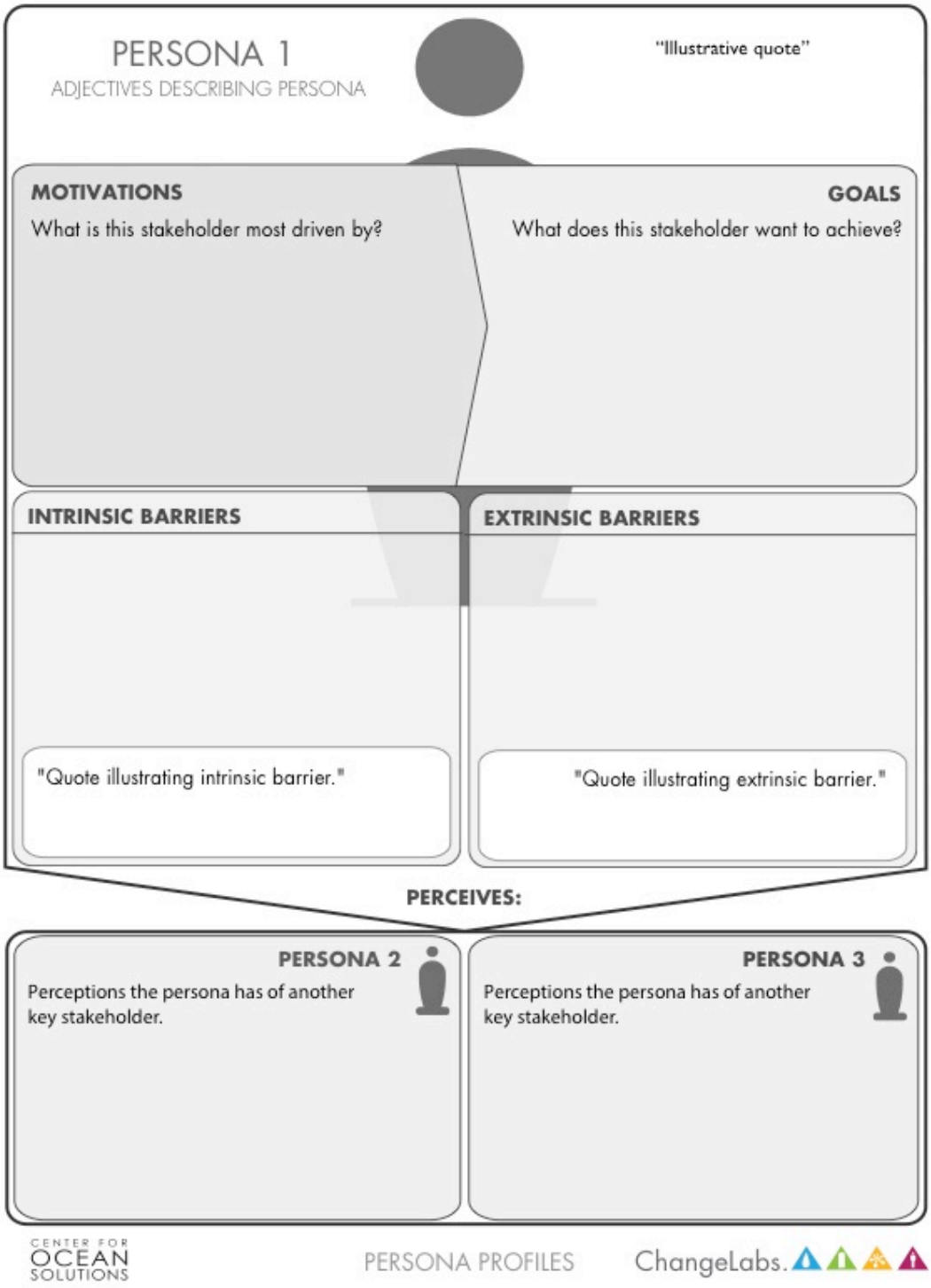

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Table A1.2: Hypothesized leverage points in the system.

Delays & Lag Times in the System
Description: Key time delays before or during the response that were barriers to the desired outcomes.
Theory Of Change: Reducing the lengths of these delays would contribute to target outcomes.

1. The delay in the communication of research needs from responders to academic scientists during oil spills
2. The delay in mobilizing scientific resources (e.g., physical or intellectual) among key institutions to the spill site during oil spills
3. The delay in finalizing scientific products due to QAQC processes during spills
4. The delay in adaptive learning among agencies and non-governmental scientists after response drills
5. The (possible) delay in adaptive learning among agencies and non-governmental scientists after small or large spills
6. The delay in the publication of science conducted before, during, or after spills in academic journals

The Size of Buffers
Description: Buffers, which resist or help to moderate change within a system, maintain system stability and dampen oscillations.
Theory of Change: Depending on your goals, increasing or decreasing the size of current buffers can push system behavior towards desired outcomes.

1. Increased buffers around spill response research between spills (i.e., bolstering research interest between spills, rather than punctuated interest only during spill events)
2. Increased buffers between data collection (and scientific process generally) and media pressure to publish results before adequate QAQC
3. Decreased cultural buffer between political appointees vs. government veterans that have risen through the ranks
4. Decreased physical buffer between local communities and federal responders during spills
5. Decreased buffer between the beginning of the spill and scientific grantmaking (e.g., rapid response grants)
6. Decreased buffer around procedural action during spills (e.g., interagency administration, appropriations, etc.)

Feedback Loops
Description: Positive and negative feedback loops before and during the response that helped or hindered the desired outcomes.
Theory Of Change: Enhancing desirable positive feedback loops will create desired outcomes; minimizing undesired feedback loops will create desired outcomes.

Cycles that reinforce time constraints (*goal would be to slow/reduce these*):

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1. Media pressures on politicians, responders, and academics (i.e., engagement with media takes away time from response and research, but lack of engagement compounds public pressure)
2. Demands or concerns of federal politicians (e.g., limited understanding of the Incident Command System (ICS) structure leads to political demands on response decisionmakers, which in turn reinforces involvement by politicians)
3. Scientists quickly becoming spokespeople on public-facing scientific issues (e.g., once scientists are quoted in an article, the media increasingly identify those scientists as sources willing to speak out, potentially reinforcing particular perspectives and voices)

Cycles that enhance the speed of response activities (*goal would be to amplify these*):

1. Journals create publication addendums to allow data sharing (e.g., Science and Nature allow the release of non-published data, academics are incentivized to collaborate on data analysis)
2. Rapid response grants for academic research were disseminated to scientists, leading to greater scientific understanding and increased capacity to secure funding
3. Some scientists who became involved in the response efforts were able to build long-term relationships with government responders, leading to sustained collaboration
4. Agencies create new communication protocols to streamline intra-agency communications (i.e., mechanisms to transcend bureaucratic hurdles within agencies during crises)
5. Information relevant to human health was efficiently and effectively communicated to decisionmakers

<u>Rules of the System</u>
Description: Governing rules of the system across geographies and time scales.
Theory Of Change: Shifting or tweaking the governing rules has cascading effects on resource allocation and system behavior.

1. The Incident Command System (e.g., designation and role of the Responsible Party)
2. Area, Regional, and National Contingency Plans
3. The National Restoration and Damage Assessment
4. The tenure system as the reward structure for academia (e.g., academics are rewarded individually for their work, publications valued over service)
5. The Oil Pollution Act (e.g., funding mechanisms)
6. The jurisdictional boundaries of U.S. law, which influence spill cleanup and restoration decisions
7. Fishery regulations that influence spill cleanup and restoration decisions
8. Agency staff reward structures (e.g., staff are often rewarded by their length of service, which influences decisionmaking within agencies)
9. The implicit authority federal politicians can exert over agency decisionmaking during crises (e.g., politician interests can trump Incident Commander decisions by intrinsic power structures)
10. The government's annual fiscal cycle, which can influence resource allocation and capacity

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Mindsets and Perceptions

Description: Mindsets held by key stakeholders that deeply inform their behavior.
Theory Of Change: If we can change the defining mindset of a key stakeholder, their behavior in the system will also change (if they have the external agency to make that change).

1. All stakeholders and the public hyperbolically discount disasters
2. All stakeholders often have an assumption of no "unknown unknowns" before or during a response
3. Agency perception that staff know what to do during a response and there is not a role for academics
4. Academic perception that research, if informed by applied needs, is biased
5. Academic perception that their data will be used by decisionmakers if it is produced, and it is not their responsibility to translate it
6. In human-caused disasters, all stakeholders often have a need for a scapegoat (e.g., blame and distrust of government responders due to relationship with R.P.); there is no sense of collective responsibility for an oil spill occurring
7. Agency responders often have multiple objectives (e.g., mitigate oil spill, meet public expectations), whereas academics often have a single objective (e.g., scientific discovery and publication)
8. Agency mindset that disaster planning is not a collective responsibility across agencies
9. Responder mindset of a bias towards action, whereas academics are often biased towards scientific precision
10. Academic mindset and desire for their research to have social relevance

Goals of the System

Description: Intrinsic goals of the system that drive system behavior.
Theory Of Change: If we can change the goals of the system towards our desired outcomes, systemic change will occur.

1. Increase scientific understanding of the human and natural environment
2. Enforce a system of putative accountability
3. Extract oil
4. Maintain human and environmental well-being