A Nuclear Complex? A Network Visualization of Japan’s Nuclear Industry and Regulatory Elite, 2006 to 2012

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Abstract
After the meltdown of the Fukushima Daiichi facility on March 11, 2011, in Japan, attempts by civil society actors to reroute the energy priorities of the country inevitably confronted obstacles in what scholars, activists, and journalists alike termed a nuclear complex. The authors’ original network data identify a dense field of overlapping executives and officials in Japan who forge long-term ties among the nuclear energy industry, the state, the leading business federation in Japan, nuclear scientists, and the national media. The authors use the Fruchterman-Reingold algorithm to present a large-n network visualization of these organizations and their ties in a manner that spatially distributes similar pairs of organizations proximate to one another.

Keywords
Fukushima nuclear power plant disaster, Japan, energy industry networks, nuclear village, network visualization, power elite

In the fall of 2011, seven months after the devastating tsunami and nuclear meltdown in Fukushima, Japan, the New Yorker published an expose on the political “fallout” of the catastrophe, showing how “Japanese nuclear regulators, like their American counterparts, have frequently been criticized for following a revolving door into lucrative jobs in the industries they police, and vice versa” (Osnos 2011:11). Critics and scholars of these revolving doors in Japan have variously depicted this phenomenon as a “nuclear complex” (Funabashi 2012), “atomic circle” (Hasegawa 2012), or “nuclear village” (Kingston 2014). Funabashi (2012) cited a report to show how the widely cited practice of amakudari—“descent from heaven” or “golden parachutes”—placed “at least 50 high-ranking officials from METI [Ministry of Economy, Trade and Industry] . . . in nine major electric power companies in recent years” (p. 68). These personnel interchanges form the structural basis for the power structure that Hasegawa (2012) describes as an “atomic circle” (p. 88). Ours is the first large-n depiction of this energy sector complex.

In this figure, the Fruchterman-Reingold algorithm in NodeXL was used to plot the vertices and edges of the network. Adjustments to the “strength” of repulsion were made and used 50 iterations (Smith et al. 2010). Manual adjustments were made to improve the visibility of some vertices.

In Figure 1, the network visualization depicts institutional connections formed through the career paths and joint board memberships of personnel from nine nuclear utilities and various government ministries to positions in Keidanren-member companies, universities, nonprofits of all types, local governments, media companies, and others between 2006 and 2012. The result is a remarkable dispersion of personnel that connects a wide swath of institutions, ranging from local governments to the country’s most influential corporate boards.

Per the group-level graph on the right, types of organizations are color-coded. The aggregated connections across institution type (top right) reveal the critical role that federations and associations play in bridging personnel flow

1These events culminated in level 7 meltdowns at three nuclear power plants at the Fukushima Daiichi Nuclear Power Plant complex, owned by the Tokyo Electric Power Company, Japan’s largest private utility. More than 140,000 residents within a 20-kilometer (12-mile) radius were evacuated. Most remain evacuated to date.

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between corporate and government bodies. Within this group-aggregated graph, vertex size is scaled by the maximum betweenness centrality score found within each category. The numbers of vertices and edges within each group are also charted on the bottom right. Of note, the nuclear utility corporations (red), by law, cannot share board members; hence they share zero edges within their group.

Within the main panel, there are 619 distinct vertices and 1,283 edges among them. Repeated ties (390) serve as weights and determine the thickness of lines between two entities. The 10 labeled entities are the most central in the larger network, and all vertex sizes are scaled to their betweenness centrality scores. Keidanren, the top corporate federation in Japan, is second in centrality to METI. These two form large cores in the network. During this time frame, METI shared 115 personnel with other entities in the network, notably forging ties to eight of the nine nuclear utilities. Nested between METI and Keidanren are several nuclear industry advocacy groups, some of the largest nuclear utilities, and a number of financial and manufacturing firms. The Tokyo Electric Power Company (TEPCO), like Toshiba and Hitachi, bridges both Keidanren and METI, having shared officials from both institutions over many years. Crucially, as the visualization portrays, the broader partnership between industry and the state is mediated by organizations such as the Japan Atomic Industrial Forum (JAIF), the third most central body in the network, which also maintains expansive ties via personnel exchanges among major universities, media, major corporations, and government officials. JAIF is a decades-old creation of industry and the state designed to promote and develop a world-competitive nuclear power sector. To the left of JAIF, we see close ties to numerous universities, well known for their expertise in nuclear chemistry, denoted in light purple. Japan’s largest corporations (brown) and financial firms (yellow) are proximate to Keidanren at the top right of the graph. At the bottom left, we find a clustering of environmental organizations (green) closely connected to the Ministry of Environment and the Ministry of Land, Infrastructure, and Transport, consistent with accounts that show the state playing an active role in facilitating specific environmental causes (Dreiling, Lougee, and Nakamura 2016). The structure of the network thus reflects the close partnership among the Japanese state, industry, and civil society in the development of nuclear energy capacity since the late 1950s.

**Why Does This Matter?**

As Kingston (2014:470) elaborated, “Japan is at the center of the global nuclear-industrial complex” and outspends all other countries on nuclear development. The hub of this energy industrial complex is composed of some of the world’s largest corporations, including three Japanese corporations engaged in joint ventures to develop and promote
nuclear technology: General Electric with Hitachi, Westinghouse with Toshiba, and AREVA (French) with Mitsubishi (Kingston 2014). Heavy industries, including cement and steel, enjoy lucrative contracts with the utilities, and major financial corporations insure and finance nuclear energy development. In 2011, TEPCO alone had 7 percent of all corporate debt in Japan (Samuels 2013).

In response to critics and public protests about the meltdown, Keidanren defended the utility corporations, and its members poured money into the conservative Liberal Democratic Party (LDP). Kingston’s (2014) work shows how the electoral strategies of the LDP helped set the stage for a “nuclear renaissance” even “after the triple meltdowns, an endless cascade of damning revelations about safety, a bungled clean-up, and overwhelming public support for phasing out nuclear energy” (p. 468). Prior to the 2012 election, the Nuclear Power Renaissance (NPR) was founded to advance the threatened industry. The NPR board includes presidents of electric power companies such as TEPCO, the CEOs of the three nuclear technology manufacturers (Toshiba, Hitachi, and Mitsubishi Heavy Industries) and also the presidents of Nippon Steel Corporation and Toyota Motor Corporation. In our figure, these and many other high-level founders resulted in NPR’s obtaining a very high centrality ranking (ninth on betweenness centrality) in its short existence. The LDP solidly defeated the fractured left-of-center Democratic Party of Japan in December of 2012 and initiated steps to reinstate and expand nuclear power generation (Kingston 2014).

Supplementary Notes on Data

Our data were collected from online and physical archives. Japan’s nuclear industry and regulatory complex is mapped through our measurement of overlapping personnel across a six-year period (2006–2012). Our data were collected with a purposive approach to tracing all recent personnel exchanges from the nine nuclear power–producing utility corporations, the nonprofit nuclear advocacy sphere, the academic and research sphere, and the major ministries of the Japanese government. The procedure began by collecting the names of individuals on the boards of the nine utilities and the top officials from five government ministries over a six-year period. Our data were supplemented by several reports by the Japanese government that explicitly traced ministry officials and their retirements into private, local governmental, and nonprofit sectors.

Because of the long-term influence and close affiliation between TEPCO and Keidanren, we also included all member companies of Keidanren. Not all Keidanren member companies shared a direct connection to the nuclear sector. Our data do, however, map any direct connections between nuclear-related institutions and member companies of Keidanren, as well as the indirect connections through common membership in Japan’s largest business federation.

In the research process, it became apparent that numerous nuclear advocacy or policy-oriented quasi-governmental and nonprofit organizations served as “landing” spots for retired ministry or company officials. The full boards of those organizations were thus also obtained. The process continued until we confidently identified whether an official or a board member from nuclear-affiliated organizations participated on another board or in an official government capacity for those six years. Consequently, we used multiple data sources to construct the affiliation matrices. It was necessary to access numerous government reports and records, annual reports from corporations and nonprofits, academic appointments, and biographical information on highly prominent individuals whose previous affiliations were typically listed at their most current positions.

Acknowledgments

We express deep appreciation for the gracious direction of Socius coeditor Jim Moody. We also thank Kenji Shimizu for his assistance in collecting data and conducting translations on behalf of this project.

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