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State-Making and the Origins of Global Order
in the Long Nineteenth Century and Beyond

Technology and Politics: A Research Agenda

Johannes Lindvall

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Technology and Politics

A Research Agenda

Johannes Lindvall
Professor in Political Science
Lund University

I Technology and Politics

This paper makes a simple point: the great technological revolutions of the past 200 years have had powerful effects on political institutions, political competition, and public policy, but these effects are not well-understood.

In a general sense, it is of course well-known that technological change has transformed politics. For example, Samuel Finer writes in his *History of Government* (1997, Book III) that the development of the modern state in the nineteenth century was only possible because of technological changes associated with the Industrial Revolution, and Michael Mann notes in *The Sources of Social Power* (1993) that the enormous increase in the state's "infrastructural power" in the nineteenth and twentieth centuries was at least indirectly a result of new technologies that allowed the state to penetrate civil society—including new means of transport and communication ("through improved roads, ships, telegraphy") and administrative practices made possible by high levels of literacy ("enabling stabilized messages to be transmitted through the state's territories") (Mann 1984).

Beyond such general observations, however, there are few careful studies, at least in political science, of how specific technologies have produced specific political outcomes. A search in the archives of the *American Political Science Review* reveals, for instance, that over a period of more than one hundred years, the top journal of political science has only published three articles with the word "technology" or variants thereof in the title.

The scarcity of systematic work on the relationship between technology and politics in political science is especially striking when one compares political science with the other social sciences. In economics, it is uncontroversial to argue that technological innovations drive economic change, economic organization, and, in the long term, economic development (see, for example, Landes 1969); indeed, modern theories of economic growth have persuaded economists that cross-country differences in per-capita output are driven mainly by differences in the rate of technology adoption among countries (Acemoglu 2009, 19). It is also widely believed among sociologists and social theorists that social and cultural change can be explained, at least in part, by underlying technological changes (see Bain 1937 for one early example).

In fact, an entire academic discipline, science-and-technology studies, investigates the relationship between technology, society, and culture.

It is time for political scientists to take technology seriously by examining, theoretically and empirically, the relationship between technological changes and changes in political institutions, political competition, and public policy.

II A Simple Example

Let us consider an example of how the nineteenth century's technological revolutions changed the conditions of politics.

The distance between Vienna, the capital of the Austro-Hungarian empire, and Trieste, the empire's main seaport, is approximately 500 kilometers. By the late nineteenth century, thanks to the completion of a railway route between Vienna and Trieste in 1857, it was possible to cover the distance between the two cities in a single day. Cook's Timetable from 1892 tells us, for instance, that a traveller could board a train in Vienna at 7.20 in the morning, have lunch in the dining car as the train pulled into Graz, and arrive in Trieste at 8.42 in the evening. Another, perhaps more civilized, option was the comfort of the sleeper, which departed from Vienna at 8.20 in the evening and arrived in Trieste at 9.28 the following morning.

Before the railway age, the fastest method of transportation was the stagecoach. Stagecoaches had a speed of approximately 13 kilometers per hour (Schivelbusch 2014 [1979], 34*n*). Even if the coach travelled for as long as eight hours per day, it took at least five days for a traveller from Vienna to reach Trieste.

Now, let's imagine that someone only wanted to send a brief message from Vienna to Trieste, as opposed to going there personally. Before the arrival of the electric telegraph — which was established in Austria in the late 1840s and early 1850s (Huurdeeman 2003, 83) — the fastest option was to send the message via courier. But even a courier that was able to change horses regularly could not travel more than 250 kilometers in one day, at most, so before the telegraph, it took at least two days for a message from Vienna to reach Trieste. After the arrival of the telegraph, a message could be relayed in hours or even minutes.

These tremendous changes in the nineteenth century — the “compression” of space and time (Harvey 1990) — are the subject of an enormous literature in cultural history, social history, sociology, and

other disciplines. But political scientists have only begun to understand how the nineteenth century's revolutions in transportation and telecommunications changed the course of *political* history.

Consider education. Ben Ansell and I have recently argued (2013) that many conflicts over education in the nineteenth and early twentieth centuries were about *centralization*: should schools be administered by local or regional authorities (parishes, municipalities, towns, cities, counties, or provinces), or directly by central governments? We also note, however, that conflicts over centralization only began in the second half of the nineteenth century (the first Western European government that sought to establish a centralized education system, a liberal government in Belgium, did so in the 1870s). Until that time, all the school systems in Western Europe were governed locally. The explanation is arguably that before the construction of the railways and the expansion of electric telegraphy, national governments simply could not establish the direct control by the center over the periphery that is required to run a school system.

In other words, technological advances during the period that we now call the First Industrial Revolution allowed governments to do things they had never done before.

The Second Industrial Revolution, in the late nineteenth century, brought more momentous changes. “Modern governments, one would guess, overuse the aeroplane,” Hicks wrote in his *Theory of Economic History*, “but where would they be without the telephone and the typewriter?” He concluded: “The contribution of the computer to this mechanization of government is only beginning to be seen. It is already the case that it would be easier (technically) to govern New Zealand from London than it was to govern Scotland from London in the eighteenth century” (Hicks 1969, 99).

III Three Crucial Periods

These examples lead us to the question of which periods and which specific technologies we need to understand better if we wish to develop theoretical and empirical analyses of the relationship between technology and politics.

Perez (2002, 14) identifies five “technological revolutions” during the past 250 years, defining a “technological revolution” as a “powerful and highly visible cluster of new and dynamic technologies, products and industries, capable of bringing about an upheaval in the whole fabric of the economy”: (1) the Industrial Revolution (Britain, beginning c.1770); (2) the Age of Steam and Railways (Britain, spreading to European Continent and USA, beginning c.1830); (3) the Age of Steel, Electricity, and Heavy Engineering (USA and Germany overtaking Britain, beginning c.1875); (4) the Age of Oil, the Automobile, and Mass Production (USA, spreading to Europe, beginning c.1910); and (5) the Age of Information and Telecommunications (USA, spreading to Europe and Asia, c.1970).

(1) and (2) are often collapsed under the heading “The First Industrial Revolution” and (3) and (4) are often collapsed under the heading “The Second Industrial Revolution.” We can see immediately that these three revolutions were followed by three politically transformative periods: the aftermath of the First Industrial Revolution (the second half of the nineteenth century), the end of the Second Industrial Revolution (the turn of the twentieth century, especially the First World War and the years that followed it), and the Age of Information and Telecommunications (the late twentieth century).

In the first of these periods, the two most important technological developments, from a political point of view, were, as we have already seen, the railroad, which permitted the state’s agents to travel from the metropolitan core to the furthest reaches of the state’s territories, and the telegraph, which was the first technology that allowed the core state administration to communicate remotely with its agents in the periphery in an efficient manner. The first inter-city railway opened in the United Kingdom in the 1830s, and telegraphy was first introduced on a commercial scale in the 1840s. For the first time in the history of government, it became possible, in the middle of the nineteenth century, to develop national political programs that established a direct link between states and masses.

In this first period, it is also important to pay attention to the investments that states made in information-gathering and information-storing political institutions such as censuses and national statistical agencies (an important feature of nineteenth-century politics, as documented by scholars such as Rose 1993 and Randerad 2010; see also Brambor et al. 2016).

In the second period — that is, in the first decades of the twentieth century — these developments accelerated: electrification, the increase in telephone density, and the availability of automobiles provided governments with ever more effective means of communication and information exchange. The Second Industrial Revolution was also the period in which industrialization took off outside the early industrializers, and the period when large, modern corporations developed. There is every reason to believe that all these factors mattered for the political transformations of the time. It is noteworthy that Hicks (1969, 162) identifies the years 1914–1918 as a crucial period in the history of government; he argues that the experience of effective management and political control during the First World War resulted in what he calls the “Administrative Revolution.”

In the third period, the main event of interest was the introduction of the modern computer. The theory of the computer was first developed in the 1930s and 1940s, and computers were first used by governments in the 1950s and 1960s — mainly for military purposes, but also, and increasingly, for non-military ones (for a history of computing, see Campbell-Kelly and Aspray 1996). Vastly increasing the capacity of political authorities to collect and manage detailed and easily accessible information about individuals (and society), computers are essential for contemporary public administration.

IV Gaps in the Literature

There is one field of political science in which technology has been studied more thoroughly than in others: the field of international relations. There is, by now, a vast literature on the relationship between military technology, the nature of warfare, and competition among states. There is also an important literature on the effects of technology on colonization and imperialism (Headrick 1981, Adas 1989; cf. Pacey 1990). Finally, there is an emerging, new literature on the effects of specific technological innovations on the nature of international politics, and on globalization (Nickles 2003; Paterson 2007; Wenzlhuemer 2012).

In comparative politics, all existing studies of the political effects of technology of which I am aware are concerned with the effects of new communication technologies on political engagement and political

mobilization (in other words, with the effects of technology on the *governed*, not on *government*). For example, Bimber (2003) studies the consequences of “information revolutions” for political competition in the United States, Kalathil and Boas (2003) examine the impact of the Internet on authoritarian governments, and Pierskalla and Hollenbach (2013) identify the effects of mobile-phone networks on collective action and political violence in Africa. There is also a large and growing literature on voting technologies. And some studies take the analysis one step further, investigating how technological change, as mediated by political mobilization and competition, influence public policies; see, for instance, Strömberg (2004) on the relationship between the expansion of public radio and the distribution of public spending in New-Deal-era United States.¹

But there are notably few studies of the relationship between technological change and the administrative structures and capabilities of governments, or, in other words, the “output side” of government (as opposed to political communication and competition, the “input side”). What we need, it seems to me, are systematic theoretical and empirical studies of how states have used new technologies to change the way they govern.

The few examples that I have found in this area are single-country case studies from outside of political science, such as Agar’s historical study of the relationship between information technology broadly understood and public administration in Britain (2003), and Medina’s historical study of “cybernetic revolutionaries” in Chile (2011). Agar’s fascinating study of British public administration treats a “file” in Weber’s sense as a “part of a technological system,” noting that a file would not work without “associated devices” such as “ink pens, typewriters, standardized paper, Treasury tags” (12), and he provides a detailed analysis of the development of the “office machinery of government” from the late nineteenth century onward (Chapters 5–8).

¹ There is of course also a vast comparative politics literature on the indirect effects of technology. In fact, since technology is widely understood to be an important driver of economic development, any study of the effects of economic development and modernization on politics is implicitly a study of the relationship between technology and politics. But that literature only deals with technology in an abstract and indirect manner. The importance of technology is often mentioned in the literature on state building and state capacity—for a recent example, see Fukuyama (2011, 150, 172)—but typically only in passing.

Medina's equally fascinating study tells the story of the "Cybersyn" project, an attempt by Salvador Allende's government in Chile in the early 1970s to improve its capacity to steer the Chilean economy by bringing in a team of British cybernetics experts to develop a new economic monitoring-and-control system (the initiative was stopped after the 1973 coup).

But these are isolated examples, and for the most part, scholars of science and technology have studied how states deal with technology ("technology policy") not with how technology affects the ways in which states operate.²

V Conceptual and Theoretical Problems

The term "technology" has several different meanings in the social sciences. *The Oxford English Dictionary* defines technology as a "branch of knowledge dealing with the mechanical arts and applied sciences," the "application of such knowledge for practical purposes," and the "product of such application," including "technological knowledge or know-how" as well as "a technological process, method, or technique." As Orlikowski (1992) notes, however, social scientists have long abandoned this "hardware" view of technology, defining technology more broadly as the "generic tasks, techniques, and knowledge utilized when humans engage in any productive activities" (399).

Orlikowski (1992, 406) proposes a "dual" view of technology, encompassing both of these ideas and recognizing that although technology is "the product of human action," it also "assumes structural properties." Importantly, such a "dual view" is present already in classic studies in the sociology of technology such as Rogers's *Diffusion of Innovations* (Rogers 1962), which defines an innovation as "an idea

² See, for example, the contributions to Jasanoff (2004). The literature on technology policy asks which policies states adopt, or should adopt, to encourage technological innovations and the effective use of new technologies in production and economic life (see, for example, Nelson, Peck, and Kalachek 1967); it also asks how the environmental risks and security risks associated with modern technologies should be evaluated and managed (see, for example, Kraft and Vig 1988).

perceived as new by the individual” (13) and notes that it “matters little, as far as human behavior is concerned, whether or not an idea is ‘objectively’ new,” adding that “even in the case of technological innovations, it is the *idea* about the new material product that is diffused as well as the object itself.”

For the purposes of empirical research in comparative politics, the main drawback of a dual definition of technology is that it makes endogeneity problems more difficult to deal with. The advantage of a narrow “hardware” definition of technology is that the “hardware” is more rarely endogenous to the political process than the various applications of the hardware in the social world. But for many scholarly purposes, a “hardware” definition will make little sense—the social practices are what matter, not the technical object itself.

It seems more important, therefore, to distinguish between the *specific* policy instruments and political resources that states have developed by applying new technologies (which are *always* endogenous to the political process) and the *generic* technologies, including “generic tasks, techniques, and knowledge,” to use Orlikowski’s formulation, that states adapt and apply when they develop their own “political” technologies. The generic technologies can, at times, be treated as exogenous to the political process—particularly when it comes to technologies that were originally developed for more narrowly economic purposes.

Turning from conceptual to theoretical issues, one mistake that one should always endeavor to avoid when studying the application of new technologies in the political domain is making the assumption that the adoption of new technologies is based exclusively, or even primarily, on efficiency considerations. The adoption of a new technology by states and their administrative agencies is a fundamentally *political* choice. If it is not in the interest of the ruling party or faction to use new technologies, it is not likely to happen. In his *The Levers of Riches*, an influential study of innovation and technology since antiquity, Joel Mokyr (1990, 178) notes, regarding technology adoption in the economic domain, that “[a]lthough technological progress is by definition a net improvement to the economy, it is almost always the case that there are some groups whose welfare is reduced because of it.” For similar reasons, political parties and factions may seek to prevent the political use of new technologies if they expect the long-term effects of those technologies to benefit their political opponents (see also Acemoglu and Robinson 2006, but note that Acemoglu and Robinson’s study is

concerned with the *indirect* political effects of technological change, not its *direct* effects).

VI Research Questions

So what is the main advantage of paying closer attention to the role of technology in politics? I believe that there are two types of research questions that an analysis of the relationship between technology and politics would allow us to address.

First, and perhaps most importantly, our analyses of political conflicts over what governments *should* do need to take into account what governments *can* do. To take one prominent example, many of the policies that are most contested politically in the contemporary world — such as income taxes and social benefits — require well-maintained public records and population statistics, and before the middle of the nineteenth century, most countries in the world did not even have a regular census (much less registry-based population statistics) — arguably because a census was very difficult to implement before the advent of modern communication technologies and technologies for information storage (indeed, many countries lack these capabilities today, as the contemporary literature on state building and state capacity attests). If we fail to take these sorts of underlying structural differences between periods and countries into account, we will not understand political conflicts well.

Just as the productivity of workers depend on the technologies that firms adopt in order to turn inputs into outputs, the “productivity” of the state’s personnel — the ability of the state’s agents to use policy instruments effectively to achieve intended policy outcomes — depends on the technologies that states use to develop new policy instruments; to gather, store, and retrieve information; to raise revenue; and to increase its human capital stock by raising the quality of the bureaucracy (cf. Lindvall and Teorell 2016).

Second, I expect that analysis of the relationship between technology and politics will help to explain an important but understudied fact: over the past two centuries, the main political operatives in the advanced states, and, consequently, many members of their political elites, have been recruited from very different professions

clergy, diplomats, lawyers, generals, and economists, to name but a few.

One plausible explanation for this inter-temporal and cross-national variation in elite recruitment is that the demand for political expertise depends on the nature of the technologies are currently used by states and their administrative agencies. For example, Fourcade (2009) argues that the increasing prominence of the economics profession depended crucially on the needs of the modern administrative state, with its reliance on statistics, information processing, and economic projections (although she also identifies differences across countries). It is also likely that the sharp decline in the political importance of the clergy in the nineteenth century was at least partly a result of technological changes, broadly defined, that led to the rise of new professional classes – a key driver in the secularization process in European societies (McLeod 1997; on the crucial relationship between new groups of professionals and the state in the industrial era, see especially Johnson 1982).

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