# Creating Machine Readable Men: Legitimizing the '*Aadhaar*' Mega E-Infrastructure Project in India

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## ABSTRACT

Mega infrastructure projects require considerable financial and human resources. Their costs are hard to justify, especially in low-income countries, and their sustenance depends to a large extent on their success in gaining political and public legitimacy. This paper examines one such project in India – 'Aadhaar' – developed to provide biometric-based identification for the 1.2 billion residents of India. Since its initiation in 2010, the project has issued more than 320 million identification numbers. Aadhaar is India's first state-sponsored e-infrastructure mega project and is unique for its survival in the face of severe opposition. We argue that the project survived because its proponents were able to legitimize it by showcasing its promise of poverty reduction and financial inclusion, and by making it a metaphor for progress and development. We compare the project with two mega projects undertaken earlier in India – the railroad network and a dam project – and find that Aadhaar's digital infrastructure made the use of symbolism harder, thereby requiring different strategies to gain legitimacy.

## Categories and Subject Descriptors

K.4.0. **Computers and Society:** General.

## General Terms

Management, Design, Economics, Human Factors.

## Keywords

ICTD, Mega Infrastructure, Digital Infrastructure, Identification, Historical Analysis.

## 1 INTRODUCTION

In 2009, the government of India launched a large-scale or 'mega' project, to provide a biometric-based 12-digit unique identification number to every resident of India, i.e. to over 1.2 billion people. As of September 1, 2013, over 415 million biometric-based unique identification (also called UID or 'Aadhaar') numbers had been issued to residents in India, in essence making residents 'machine-readable.' The UID database has long crossed the milestone of being the world's largest such database. Currently, about a million new numbers are issued a day and over 100+ million numbers authenticated.[1] Not surprisingly, Indian and international media have by now referred to the Indian UID project as the "World's biggest ID database," "A reform by numbers," a "game changing scheme," a "project of national transformation," and even "the biggest social project on planet" [8],[16],[25],[48].

The UID project comes at a time when 'e-infrastructure' is being recognized as "genuine infrastructure." Edwards argues that digital infrastructure has reached a point where it comprises "robust, reliable, widely accessible systems and services that are beginning to look in form and centrality like the digital equivalents of the canonical infrastructures of telephony, electricity, and the rail network — a resemblance scarcely credible even two decades ago " [17: 365]. It is precisely this argument that Nilekani makes when he refers to a UID system as a "necessity," not a luxury, and as "plumbing" that has far-reaching implications for education, democracy, livelihood, and financial inclusion in India [42]. Despite high praise for e-infrastructure, few digitally-based identity projects of the scale of the Indian UID have been undertaken and where they have, they have been abandoned midway [7]. The current Indian UID project, too has been bitterly opposed, but has continued in spite of consistent criticism from prominent activists and institutions in India since its inception four years ago [22],[26],[31],[41]. Not only has the project survived, it has achieved figures of enrolment that are already unparalleled in the world. What made this possible?

In this paper, we argue that the UID project survived because its proponents successfully championed the project's technological artifacts, promised benefits, and project team to gain legitimacy. They drew heavily on the intangible symbolic value associated with the project, effectively representing the UID as a metaphor for progress and development to a large population of technocrats, politicians and the public. Using symbolic value to gain legitimacy for mega infrastructure projects has a long history in India. We situate the UID project in this historical context and compare its strategies to gain legitimacy with those involved in the building of the Indian railroads (initiated 1850s) and large dam projects (initiated 1950s). The railroads and dams have been


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[1] https://portal.uidai.gov.in/uidwebportal/dashboard.do

among the most prominent and ambitious infrastructural projects of their times in India. They had strong state backing, relied substantially on state funding, and were supposed to reach the entire country, other reasons that make them comparable to the UID project. Furthermore, the distinct periods in Indian political history in which the three projects commenced – under British rule, in a newly independent India and India after economic liberalization – allows us illustrate how their operation was not solely about technology. We show that UID's representation strategy closely resembles that of these earlier infrastructure projects that too could not sustain themselves by highlighting their tangible benefits alone. However, we also find that a project centered on digital infrastructure faces unique challenges. In particular, we find that the absence of a technological artifact with imposing physical form makes it harder to associate symbolic value with the artifact and demands a different strategy than in the earlier cases.

# 2 GAINING LEGITIMACY

Acquiring financial, human, or technical resources is always a challenge for new ventures in their initial stages. Outsiders find it hard to judge possible future performance and quality of a new venture and as a consequence, are reluctant to commit resources [69]. This "liability of newness" [64] is more pronounced for novel and unorthodox ideas as it is even harder to provide evidence of eventual success in such cases [11]. When the new venture is a 'mega' infrastructure project i.e. large and expensive, and particularly when it is also publicly funded or has development goals, garnering financial resources or political support becomes that much more difficult. In these cases, the significant cost of the project has to be justified not only to investors, but also to politicians spanning an ideological spectrum, as well as to the tax-paying population. In recent years, the act of justifying these costs has become more difficult as the cost overrun and underperformance of well-known mega infrastructure projects has generated frequent and significant opposition around the world [4],[20],[60]. Therefore, gaining legitimacy has become more important than ever for mega infrastructure projects today. We see legitimacy as socially constructed and defined as:

> *"a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, beliefs, and definitions" [65: 574].*

From an institutional perspective, legitimacy is obtained through conforming to other similar existing projects or organizations and by upholding established norms and beliefs [38],[50]. The display of culturally accepted symbols too is critical for gaining acceptance, particularly in the absence of tangible predictors of success [24],[62],[68]. Useful symbols for legitimacy may include educational training or the demonstrated caliber of the leader and founding team [18],[45], artifactual displays, props, and other visual symbols (such as large posters/pictures of leaders)[21], and narratives that craft an identity for the project by enumerating its benefits or attributes [36]. We draw on these examples of useful symbols, as well as the components required to present a positive image (how/ by who a project is being built, what is being built, and why) to argue that the process of legitimizing mega infrastructure projects includes showcasing: 1. The personalities of project proponents and all that they represent, 2. The scale and splendor of the technological artifact, and 3. The tangible and symbolic benefits of a project. Depending on the historic moment at which they function and on their audience, projects leverage these aspects to varied extents to gain legitimacy. We elaborate on this framework below and use it to analyze the cases of three Indian mega-infrastructure projects in the rest of the paper.

## 2.1 The Team

The people building or deploying a project are valuable in gaining legitimacy. Whether it is their past experience and the value of their expertise and networks, or the values they symbolize, leveraging the personality of a project's builders is an important strategy in gaining legitimacy for a mega project. Since mega projects tend to be risky ventures, and involve great uncertainty in their working and outcomes, their very association with such a strong leader can be of immense value in the quest for legitimacy.

## 2.2 The Artifact

The awe and almost religious fervor inspired by new technologies has long been acknowledged and also been labeled the 'technological sublime' [39],[44]. In recent times, this concept has been extrapolated to give us the idea of a 'digital sublime,' which refers to similar feelings of awe that are evoked in the context of digital technologies and cyberspace [40]. While the positive perceptions of a technological project is crucially about how the technology has been presented to potential users, at least part of this awe inspired by digital or other technology draws on the form and affordances of the technology itself. This is particularly true of the large-scale artifacts that are involved in mega projects, where form is also leveraged to gain legitimacy.

## 2.3 Benefits

Highlighting the direct or indirect tangible benefits that are visibly performed or achieved by a technology or technological project is the most obvious way to gain legitimacy for a project. However, this is not always possible and it is seldom sufficient to justify the large costs incurred by the project. For one, the precise nature or extent of costs and benefits in a project that has no precedence are hard to calculate. For another, many of these benefits might accrue to some sections of a population, but might not be equally relevant to others. Linking and leveraging "an intangible set of symbolic meanings" such as 'progress' or 'modernization' in relation to the technology can help overcome both these problems [60]. Indeed, the importance of such symbolic meaning has also been examined in ICTD studies to explain the use of computers in rural areas and in low-income communities at a smaller scale [33],[34],[46].

# 3 MEGA E-INFRASTRUCTURE PROJECTS

Historically, the strategy of showcasing the builders, artifact and benefits outlined above has helped mega projects gain legitimacy and sustain themselves. In many cases, projects have not merely gained legitimacy, but gone on to become symbols that provide ideological and domestic political benefits down the road [1],[23],[57],[58][63][67]. As Steinberg [63] notes, once such projects come to be seen as evidence of progress and modernization, they then function as politically neutral and unifying symbols in divisive polity. Although several aspects of how mega infrastructure projects gain legitimacy, including the role of symbolism in the process, have been examined we lack an

understanding of how these strategies have evolved with new regimes and technologies. In particular, how do projects such as UID that deploy relatively "invisible" infrastructure [10] legitimize their work? Further, how do their strategies differ from the processes of legitimation undertaken by earlier infrastructure efforts whose form, scale and working were more visible? Since the literature on mega infrastructure projects focuses on projects of brick, mortar and steel, such as public transit or dam projects, there is little analysis of the use of symbolic meanings by e-infrastructure projects.

If one of our goals is to contribute an analysis of e-infrastructure projects to the mega infrastructure project literature, the other is to bring that literature to the ICTD space. The scale of the UID and its development goals make it a unique case of e-infrastructure to analyze in the ICTD space. ICT-based research has seldom focused on situating ICT-based projects in a longer history of technology in India. The historical lens has only been used, where it has been used at all, to trace the trajectory of individual projects.[2] We suggest that a historical analysis of the kind we propose can bring much value to the domain of ICTD. It will enable us to understand present day ICT projects in light of technologies from before, and help avoid the tendency to see ICT as revolutionary or as having broken away from all that came before. The focus on the symbolic, meanwhile, will help account for the larger meanings attached to ICT-based mega infrastructure projects such as the UID project.

In the rest of the paper, we first briefly outline our methodological approach and then present the three case studies of mega infrastructure projects in chronological order. We start with a case study of Indian railways, go on to the case of a dam project, and finally to the UID project. In a sense, we follow the trajectory that the chairperson of the Unique Identification Authority of India (UIDAI), Nandan Nilekani, laid out when he said that the slogan of "food, clothing, shelter" ("roti, kapda, makaan" in Hindi), long popular in Indian development rhetoric, and had given way to "electricity, roads, water" ("Bijli, sadak, pani") by the 1980s, and had now transformed into "UID, bank account, mobile phone" [51]. In our discussion of each case, we start with a brief history of the building of the project and then examine how an image was built for the project as a way to legitimize and gain support for it. We discuss how the implementation team, material form, and benefits of the project were showcased in each case, using both tangible and associated symbolic meanings. We conclude by examining the similarities and differences across the three cases and discussing the implications of this work.

# 4 DATA SOURCES

Since this paper is a historical analysis we rely significantly on secondary sources. The building of both the Indian railways and dams has been studied extensively and we draw on seminal and supporting texts on each. For the UID project, secondary data consisted of newspapers and magazine articles and the project website, which contains documents and reports, as well as details on enrollment figures, trends in enrollment across states, and technical details of the project. Over a 1000 newspaper articles have been written about the UID project in the English language alone since 2010 and therefore, articles provided an important medium of representation in this period. In addition to secondary data, we collected primary data from several actors associated with the project through interviews. We draw on these interviews as well as resources pointed out to us by the informants.

# 5 THE INDIAN RAILROAD NETWORK[3]

The Indian railroads were the costliest project undertaken by any colonial power in any colony (more than £200 million of British capital invested between the 1850s and 1911). It was also among the most extensive networks in the world at the time (in length, density and reach). Railway enthusiasts in Britain had started clamoring for a railroad network in British India as far back as the 1840s. From there to the building of the railroads was a long drawn out process that involved negotiations in Britain and in India, between governments, private entrepreneurs and railway enthusiasts.

## 5.1 Building the Railroad

In 1841, British engineers and railway enthusiasts suggested to the British East India Company a possibility of government subsidies for building a railway network in India. When the Company showed no inclination to participate, railway promoters gathered supporters in Britain and in India, including members of Parliament, cotton manufacturers and wealthy industrialists among others, and started lobbying the Company. Most of these negotiations occurred over the nature of government subsidies for the project. Railroad projects rely on the scale of their operations to make profits, but building up this scale requires enormous upfront investment. In 1849, the British East India Company's Court of Directors reached an agreement with railway promoters: individual stakeholders were guaranteed a 5% return regardless of how the railways performed, the difference being drawn from the government treasury. With the agreement, two limited liability railway companies were created. Work on the first lines began in 1850-51. The project continued, in spite of several engineering and financial challenges over the next several decades, reaching its peak during World War 1, after which the expansion of the system started to decline.

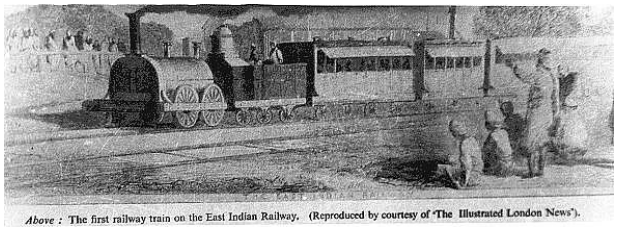


**Figure 1: 1853 – first train on the way to Thane**

## 5.2 An Image for the Railways

In his work on mass-transit systems in recent times, Siemiatycki argues that such systems manage to attract support in spite of their steep costs because of how they are presented to the public and because they are able to convey a positive image that galvanizes public support and attracts patronage [60]. Siemiatycki's analysis is as relevant for the era when the railways were being established

[2] Examples of historical analyses within the ICTD space have focused specifically on ICT policy or ICTD discourse [13],[47].

[3] Our account of the railroads draws on the works of Headrick and McPherson, unless otherwise specified [23],[37].

in India over a century ago, with one significant difference in the context of British rule in India, the audience for this 'image' was restricted mainly to commercial users, investors and policy-makers in Britain and in India. The support of the Indian public was much less important given that India was a colony at the time. Consequently, much of the representation of the railroads and efforts at gaining legitimacy for it happened through Minutes to the East India Company, letters to shareholders, through personal communication and articles in newspapers[4] as discussed below.

### *5.2.1 The Team*

While the railway promoters and the East India Company were negotiating in Britain over subsidies for the railways, the only person who could influence events in India was the Governor-General, Marquis of Dalhousie. Dalhousie (who held this post from 1848-1856) was "the most technocratic among all its governors" [23: 61]. He drew his reputation from his stint as the Head of the Railway Department during the British railway boom. Dalhousie had great ambitions to 'modernize India.'[5] Dalhousie wrote a Railway Minute to the Court of Directors of the East India Company in 1853 and "such was his prestige as a recognized authority on railroad questions, that his Minute formed the basis for the Indian railways for the next 70 years" [23:64]. Given the power of the Governor-General's office, Dalhousie's vision shaped India's railroad network as well as its image among investors and the public. Besides Dalhousie, the enthusiasm and involvement of British engineers, such as Rowland Stephenson in the early stages, also brought around potential investors in Britain and, to a lesser extent, in India, to the idea of building a railroad network in India.

### *5.2.2 The Artifact*

The technological artifacts associated with the railroads were important in gaining support for them. For one, they evoked great enthusiasm among engineers. Headrick points out, for example, that the Victorian perception of railroads as "exciting and ingenious mechanisms that deserved to be built for their own sake," provided a push for setting up a railroad system [23]:58. Besides evoking enthusiasm, the physical artifact was also leveraged in the earlier phases to describe how the natives reacted to the railroads. British engineer John Brunton, for example, described how

> *"the natives had…never seen a Locomotive Engine…During the Mutiny, the mutineers got possession of one of the stations where stood several engines. They did not dare approach them but stood a good way off and threw stones at them" (quoted in [23: 66])*

It was against the backdrop of such images and the need for 'civilizing' the natives that the railways received a strong push.

### *5.2.3 Benefits*

Headrick observes that the impetus to build the Indian railroads, as well as its perceived promise, included material, intangible, direct, and indirect benefits. These goals and benefits were highlighted to attract investors, as well as to put pressure on the government to support the railways. Commercial interests lobbied for the railroads to facilitate the transport of raw materials like cotton to the port for shipping to the British textile mills and for the transport of British manufactured goods from the port to cities. The British also saw a role for the railways in the consolidation of the British Empire and indeed, it proved crucial in curbing the 1857 'Mutiny' against the British in India. The British government also saw a role for the railways in reducing the devastation caused by famines. Headrick points to several indirect benefits that came about in the establishment and operation of the railways: banking and capital markets developed to finance it, engineers and workers were recruited and received training to build and operate the system, and an industrial base was established to supply equipment and fuel.

But both the motivation to build the railways as well its perceived promise had an intangible component. At the simplest, the railroads were seen as "firm and unaltered memorials of British rule." They also symbolized, like no other technology, the material and moral superiority of Western societies in the eyes of European observers [1: 223]. Further, "In the speed of its comings and goings, trains proclaimed the Europeans' mastery of time and space and demonstrated their capacity for precision and discipline"(224). The railways were seen to represent fundamental English values, and its supporters hoped that these would be propagated by the spread of the railways. *The Economist*, for example, noted in 1857 that the railroads would help spread, besides English men, "English art" and "English opinions." Railroads also had other lessons to offer the Indians, including the value of "self-dependence" and that "time is worth money" (226). These 'English' values were posed in opposition to 'native' values, and from the outset, the railways were considered a way to 'uplift' the Indian people. Dalhousie, for instance, described the railways as a great "engine of social improvement" and had expressed hope that a system of railways in India would "surely and rapidly" give rise to an "encouragement of enterprise" and "discovery of latent resource" [23: 64]. Railways were even imagined as an effective tool for breaking down the barriers of caste as individuals of different castes would have to travel side by side and "thirty miles an hour is fatal to the slow deities of paganism" [1: 226]. By 1894, a commentator could marvel at the transformation brought about by the railways and claim it had raised,

> *"a land where the very names of innovation, progress, energy, and the practical arts of life were unknown or were abhorred, and which appeared sunk in a lethargic sleep too profound for any possibility of awakening" to a high level of "power and civilization", bringing about a "wonderful resurrection of a whole people" (quoted in [3: 87]).*

The 5% guaranteed return was enough to convince the investors. However, the symbolic association of the railways with social progress and upliftment, as well as the propagation of English values, powerfully influenced political support for the establishment and operation of the railways. Much later, the British leveraged the railways in their attempts to legitimize British rule, claiming that the railroads had brought "progress and

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[4] Including the *Calcutta Englishman, Friend of India,* the *Times, The Economist* and several railway journals.

[5] Dalhousie was also instrumental in developing the telegraph and postal system during his time in India.

prosperity" and not drained the country of wealth as many claimed, especially with regard to the 5% guaranteed returns that were paid out from tax money.

As the railways got more entrenched in India, it became clear that the promise and expectations associated with them were not always fulfilled. In some ways, expectations were exceeded – the wide adoption of trains by Indians for travel was one that the British did not anticipate.[6] On the other hand, the caste system did not break down, and it is unclear that conceptions of time or punctuality changed drastically as a result of the railways.[7] Finally, it is worth pointing out that while the British found it useful to associate the railways with 'social progress', the organization of the railroad system itself - with Indians employed as workers and the British as better-paid engineers; the 'class' system within trains that allowed only the British to travel first-class; and the trading of railway shares in London, made it virtually impossible for Indians to participate indicating that they subscribed to a very particular definition of 'progress.'

# 6 DAMS

Since its Independence in 1947, India has constructed an astounding 900 large dams, making it one of the top five big-dam-building countries in the world [30: 37],[61: 83]. Dams have held an iconic position in India as symbols of modernity. In this section, we examine one such dam building project – the work of the Damodar Valley Corporation (DVC). DVC was established with the DVC Act, the first major development legislation passed by India's Constituent Assembly in February 1948. The initial plan was for DVC to build eight dams but it has only managed to complete four dams to date. In addition, the overall DVC system comprises several power plants and a flood mitigation and irrigation system [15]. DVC illustrates both the ambitions and struggles faced by early dam builders, as well as their strategies to gain legitimacy.

## 6.1 Building the DVC

DVC was conceptualized in the highly technocratic 'Nehruvian era' of Indian politics. With a Congress-led government at the center, and Jawaharlal Nehru as the Prime Minister, the focus was on developing heavy industries. There was a strong central government and relatively weak financially strapped regional governments. The bureaucracy too was firmly under the control of the governing party. Consequently, the planning and execution of large infrastructure projects was centrally managed and relatively easy to achieve in this period. The decision to set up DVC came in the wake of a flood in July 1943 that created havoc in the Damodar River Valley region in eastern India and severely hindered supplies intended for famine relief in Bengal. A committee appointed in the aftermath of the disaster recommended the Tennessee Valley Authority (TVA) in the United States as a possible model for the DVC and subsequently DVC recruited a TVA engineer to design a plan for the dam.

[6] Time and again, accounts focus on the awe that the railways inspired among the 'natives', but equally expressed surprise that the locals appeared to enjoy traveling by train, and were not as terrorized of it as expected [1: 223], [23].

[7] Headrick describes how passengers would just arrive hours earlier at the platform to be safe, rather than manage their time around the precise arrival times of trains [23].

## 6.2 An Image for DVC

Dams require significant investments and the DVC was no exception. The initial projected cost of the project was Indian Rs. 250 crores (or Rs. 2.5 billion) [6: 143]. Initiated soon after independence, the project hit roadblocks from the start, particularly financially, and India could only undertake the project with loans from the World Bank. Almost all the heavy equipment initially came from European and American private firms leading to significant costs and delays in construction [32]. These delays further raised the costs of the project as loan repayments were postponed. Given India's dire financial resources at the time and mounting coats, legitimizing the DVC with a monetary cost-benefit analysis was not very convincing. It was left, instead, to strong proponents of the DVC dam to gather support for the project in other ways.

### *6.2.1 The Team*

The DVC had two initial champions, Prime Minister Nehru and the scientist Meghnad Saha. Nehru, as India's first Prime Minister and a freedom fighter, had strong support among the masses. He was a strong proponent of science and technology for development and in large dams, Nehru found a way to showcase these values. He believed dams could make an enormous difference in the lives of India's citizens, particularly in the rural areas. In Nehru, dam proponents found an enthusiastic, visible, and well-liked supporter.

While Nehru was an enthusiastic supporter of dams in general, it was Saha who got him interested in the DVC. Saha was a renowned scientist and well known among the English-literate in the population, particularly in Bengal, one of the states affected by the DVC. Following an illustrious scientific career, Saha grew disillusioned with what he saw as the ivory tower of academia. Having decided he wanted to contribute to society,[8] Saha had started emphasizing the importance of rivers for the prosperity of the state and the country since the 1920s. He wrote several editorials and articles in *Science and Culture,* a journal he founded. Saha's involvement with the DVC project started soon after the flood of 1943 that devastated Bengal. In the aftermath of the flood, the Governor of Bengal appointed a Board of Inquiry headed jointly by Saha and the Maharaja of Burdwan to propose possible solutions to the problem. Saha concluded that dams and related infrastructure were the best way to prevent flooding and used his journal to garner support for DVC. He aimed his campaign primarily at the English-literate public in Bengal, among whom he was well respected. Saha provided "his audience (especially in Bengal) with a new vocabulary and a new image to describe what a properly scientific state could do." [32: 129]. Saha visited the TVA in the U.S. during 1944-45 for a tour and back in India Saha managed to access one of the few copies of David Lilienthal's book "*TVA: March on Democracy*" available in India. Lilienthal was the primary planner for TVA and Saha invoked Lilienthal's authority in calling for a TVA for India. At the time of its independence, India lacked strong role models for engineers and scientists. So, involving foreign engineers and experts proved extremely helpful not just for technical reasons, but also in 'selling' the project to internal constituents. Lilienthal in turn dispatched William Voorduin, a TVA engineer to advise the Government of India on DVC. The first chief executive of the

[8] http://www.vigyanprasar.gov.in/scientists/saha/sahanew.htm

DVC, Sudhir Sen, was also instrumental in executing the plan for the dam and in maintaining support for it in later stages.

### *6.2.2 The Artifact*

DVC's material benefits were elaborated across several documents, including those reviewed by the Constituent Assembly. Voorduin's plan, which formed the initial blueprint for the project, proposed that DVC would provide perennial irrigation for about 760,000 acres [35: 538]. Saha was enamored by the power generation possibilities of the project, calculated at 850 million kWh per year, and remarked, " People have often asked, 'Supposing that the power is developed, what can you do with it?' This is like asking the question 'What will you do with a gold mine if you can discover it?' (quoted in [32: 126])."

Newspaper headlines from the time, as well as commemorative stamps, focus on the size of the dams and the scale of their operations (see Figure 3). At one point in 1945, Saha posted large posters along the walls of several main streets in Kolkata with the 'Diagram of TVA Water Control System,' from TVA's Annual Report, 1941 (see Figure 2). Saha used this image since the DVC was modeled on the TVA and no other representations of the DVC existed at that time. The goal of the image was to showcase the DVC's size and impact to Kolkata residents [32].

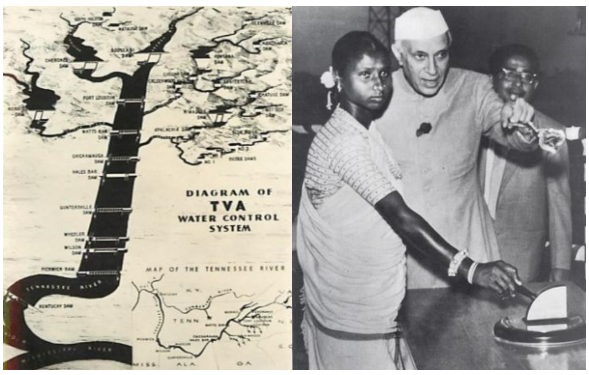


**Figure 2: TVA Water Control System image used by Saha to represent the DVC (left); Nehru asking a girl from a local community to inaugurate the power station at DVC's Panchet dam by flipping a switch, December 1959 (right).**

Incidentally, though a plan was eventually drawn for the DVC and was even published in the *Times Atlas* between the 1950s and 1990s, it was never realized [32: 3-5, 157][9] underscoring the constantly changing trajectory of the central technological artifacts of the DVC project. These recurring shifts explain why it was crucial to showcase not just the scale of the artifact, which was likely to change, but also its potential tangible and symbolic benefits, in order to maintain legitimacy for the project.

### *6.2.3 Benefits*

Voorduin's initial plan for the DVC described the dam as a "multipurpose development plan" and listed as its objectives "achieving flood control, irrigation, power generation and navigation in the Damodar Valley."[10] Sudhir Sen, the first chief executive of the DVC, was responsible for "persuading key members of three governments, bureaucrats and the public about the virtues" of the DVC plan [32: 171]. While justifying irrigation for one area at the expense of another, he said that even in the non-irrigated land,

> *"Forests, orchards and live stocks, properly managed along modern lines would yield much higher incomes…To this should be added a host of small industries which could be quickly developed…There would be a host of new industries, large and small, and of services, all spawned and spurred by two factors: availability of power and rising income of the region." (quoted in [32:172]).*

In his report "Planning for the Damodar valley," Saha lamented the fact that river planning in India had always been piecemeal, based on parochial demands, and without a scientific basis. Saha contended that along the Damodar river, "Nature, vested interests and thoughtless management made a once prosperous valley a wilderness*."* But now that the United States and the Soviet Union had "pioneered the knowledge and technology" to "correct" this approach, "Nature, Man and Science can again make it a smiling garden" (quoted in [32: 123]), Sen and Saha's statements illustrate how the benefits of dams were described using not just numbers and pictures, but also narratives. But even more than the potential tangible benefits that these claims invoked, perhaps it is Nehru's famous statement that dams were the "temples of modern India" that best captures what dams such as DVC symbolized to India and Indian leaders at the time.


**Figure 3: Stamp of one anna value, released on 26 Jan. 1955, depicting DVC's Tilaiya Dam (Inaugurated on 21 Feb. 1953)**

In spite of Nehru's authority and support for dams at the time, this moment in history was no doubt different than the building of the railways in British India. Infrastructure projects in British India had little need for public support. In the electoral democracy that took its place after India's independence public support became a matter of concern. However, low levels of literacy and awareness, as well as state-backed broadcast media, meant that winning support was relatively easily accomplished. This changed in the late 1970s and early 1980s as the human displacement cost and other failures of earlier dam projects resulted in visible opposition to large dams [30]. Increase in literacy levels, the mobilization of displaced populations, and the ability to leverage mass media for opposing large dams helped its critics. Large dams were no longer the symbol of progress that they were right after Independence. They were replaced subsequently by information technology (IT) as the symbol Indians came to associate most with progress.

[9] Today, the total length of the DVC irrigation canals is 2494 km; the largest dam, Panchet, is 45 m high and 6777 m long.

[10] DVC's current mission echoes these objectives, but includes "promotion of afforestation and control of soil erosion in valley area; and, promotion of public health, agriculture, industrial, economic and general well being in Damodar valley" [15].

# 7 UNIQUE IDENTIFICATION PROJECT

If the railroads were built in an India the British sought to 'civilize,' and dams in an era when an independent India wanted to prove its ability to engineer a mega-project and to be 'modern,' the UID project came post-liberalization and at a time when Indian IT engineers were globally well-respected. It is against the backdrop of a growing and self-confident IT sector that the ideas, technology and strategies of the UID project have to be understood.

In 2006, an Empowered Group of Ministers under the auspices of the Prime Minister's Office started meeting to put together a strategy to assign unique identification to every resident of India.[11] This group recommended setting up an executive authority called the Unique ID Authority of India (UIDAI) that was anchored in the Indian Planning Commission for a period of five years, but was technically outside the government. UIDAI was formally constituted on January 28, 2009 and Nandan N. Nilekani, former founder and CEO of the large Indian IT firm Infosys, was appointed its chairman later that year. In the years since the start of the project, the various reasons invoked for issuing unique IDs (security, welfare, efficiency), as well as the various bodies in charge of issuing them, have led to conflicts [14]. It has taken constant work from project personnel to win and retain political support for the project.

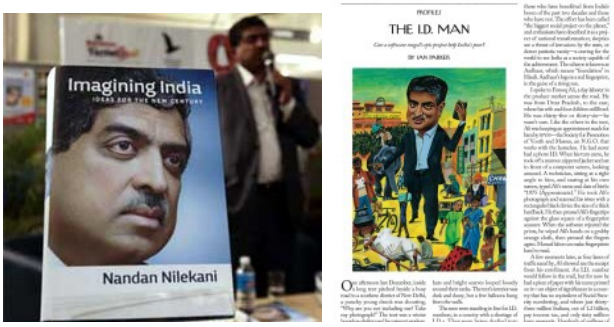


**Figure 4: Nilekani at the release of his book (left); His profile in *The New Yorker* ("The I.D. Man") (right)**

## 7.1 Building the UID system

Simply put, the UID project collects demographic and biometric details of residents, ensures these details are not already present in the UID database ('de-duplication'), allots a UID number to that resident (who is now 'enrolled') and later, sends them a document (earlier a letter, now a card) confirming their number. Subsequently, when the resident needs to use that number, they present their number and provide their biometrics to the institution requiring 'authentication.' The request is checked against the UID database, which returns a "yes" or "no" answer to confirm or reject that the UID number and biometrics match. It is scale that makes the project complex and scale that has shaped the organization of personnel and technologies in the conception and implementation of the project so far. The UIDAI is organized into two primary units: a Technology Development Unit (TDU) and a Project Management Unit (PMU), but beyond these two primary functional units, UIDAI is an 'outsourced ecosystem' of various organizations that ensure that the enrollment and authentication of individuals under UID is uniform across the country [27: 156]. Both public and private firms are part of this ecosystem and large and small firms compete to participate. The Central Identities Data Repository (CIDR) contains the personal identity data of all UID-holders. UIDAI owns and manages the CIDR and is also the overall regulator and overseer of the UID authentication system. All processes are controlled by UIDAI through published guidelines on how to train and certify enrollment agents, what devices to purchase and how to use them, how to conduct enrollments etc. These guidelines, as well as a list of all empaneled and contracted organizations, are available on the UIDAI website.

There are currently 25,000-30,000 enrollment centers across the country. An enrollment center is equipped with at least one biometric device, an iris scanner, a webcam, two computers (one for the enroller and one for the resident to see the details) and numerous cables. Many enrollment centers have two such 'stations' for enrollment and some have up to four. Thus, hundreds of thousands of each of these devices are being used across the country. The scale of computations at the CIDR is no smaller, with over 1 million UIDs being processed in a day, which translates to 200+trillion matches to ensure de-duplication. The system does close to 100+ authentications per day. With a data packet of nearly 5 MB per resident this adds up to 10-15 PB of raw data. Further, the data is mapped across at least two sites for redundancy and security [28]. The UID project has not been modeled on any single e-governance or other project, but the project's technical team often invokes Google, Facebook and other systems that deal with datasets of similar magnitudes as their 'model' for system architecture, including in their use of open source software such as MySQL, MongoDB, Hadoop, and Solr.

## 7.2 An image for UID

Alongside building the technological and organizational framework for the project, the UID project has been conscious from the start of building alliances and an image for itself. It has been a high profile project since its inception for many reasons: its well-known champion, significant monetary cost, the technological scale of the system it was to put into place, the ambiguous legal status of the UIDAI and of UIDs and privacy concerns. Consequently, the project has attracted tremendous media coverage and encountered significant opposition [31],[41],[56]. Without enough people enrolling, the system's utility would be dramatically reduced, which also made public support critical. Besides the public image of the project, the UIDAI also needed the support of the many entities it worked with in the course of project implementation, including the private companies to which technical components for the project were outsourced. Since these companies were investing large amounts of capital on a project that was unprecedented in scale, could potentially fail for either technical or political reasons, and might not provide the financial returns that were expected of it, the UIDAI had to work to cultivate and maintain support from these companies. Similarly, the project required the support of the many bureaucrats it worked with. In terms of political support too, while the project had support at the center since the start, it required state-level support across the country since several UID applications would be decided at that level of the administration. The construction of a positive image for the UID was, thus, at

[11] The idea of a unique ID for every Indian citizen had also been proposed earlier in the context of security concerns.

least as critical as in the previous cases we discussed. Moreover, this image had a much more varied audience in this case: activists, media agencies, the public, private companies, bureaucrats, and a range of political actors at the state and center. The UIDAI itself was cognizant of the importance of reaching out to a broad audience with a positive image of the project, as is obvious from their explicit Information, Education and Communication Strategy.[12]

We argue that the construction of an image for this project posed some unique challenges. Unlike with the railroads or a dam, there was no material technological artifact that could inspire awe through its sheer physical scale or functioning in this case. To the extent that the scale of the digital infrastructure used in the project was unprecedented, several technical milestones were achieved in building a robust and flexible system architecture. However, these were not meaningful to those outside of a fairly small technical community.[13] Even the data repository and authentication systems servers, as the most large-scale technological components of the project, were not visible to the public. The only publicly visible technologies were biometric and iris scanners, and cameras. Further, the ID number itself was neither visible, nor its benefits apparent. Thus, the construction of an image for the UID could not rely on a visible technological artifact or on the UID in isolation. This created a problem both for proponents of the project, as well as for those opposing it. As we describe next, we found that the project dealt with this issue by creating a material form for the UID, connecting the UID to other artifacts and schemes, emphasizing the potential benefits of these connections and drawing on the 'clean' backgrounds of its prominent implementers who were neither bureaucrats, nor politicians.

### *7.2.1 The Team*

The construction of an image for the UID project has involved drawing on not only the UID and its promise, but also on the reputation of its implementers as well-recognized technologists and businessmen. As we already saw, mega-projects have tended to have such a champion. In this case, it was entrepreneur and technologist, Nilekani, who was said to be the Prime Minister's personal choice for the post. As a co-founder of Infosys, India's first homegrown IT company, and as the author of *Imagining India*, where he showed an interest in governance issues and policy-making and lays out his rationale for a unique ID, it is not difficult to see why Nilekani met the PM's criteria when he was looking to induct "talented professionals in managerial and decision-making positions in the government"[5].

Of the many people involved in the project, Nilekani continues to be its public face and his profile has appeared across a range of international media including *The New Yorker* and *Wired* [9],[48]. The rest of the design team was handpicked by Nilekani and they, in turn, recruited others to the project. Many of the technologists who eventually formed the core of the project's technology team became involved in the project through Nilekani's presentations to multiple audiences in the initial stages of the project.[14] Several UID team members were graduates of Nilekani's alma mater, the Indian Institute of Technology, Mumbai. The head of the administrative unit, a bureaucrat named R.S. Sharma, too was selected by Nilekani to ensure that a person with a technological background and interest was given that role. Nilekani also conducted presentations that helped him enlist politicians at the national and state levels and facilitated initial consultations with NGOs and activists.[15]

If the railroads and dams had strong connections with international domain experts, this time the experts were all homegrown. The international links came into play in a different way: the design team's work experiences outside India, the reliance on internationally established device standards where possible, and in comparing costs with similar projects undertaken elsewhere.

### *7.2.2 The Artifact: Making UID Material*

At its inception, UID was supposed to be just a number that would be allotted to people and associated with their biometric details. Those with numbers could subsequently use their number in conjunction with biometric data (finger or iris scans) to authenticate themselves. The project also had no other name or logo at its inception. With time, all of this changed. By October 2011, UIDAI decided that UID cards, and not merely numbers, would be issued when people enrolled [29]. The project was also re-christened 'Aadhaar,' meaning 'foundation.' This was partly because the acronym 'UID' was proving to be confusing [52]. But equally, Nilekani described the new name as giving "more character to the high-profile project" and signaling its "transformational potential" [66]. The idea behind naming the project Aadhaar was to communicate "the fundamental role of the number…as a universal identity infrastructure."[16] The Aadhaar logo was also launched a few months after the start of the project, in April 2010. The logo was meant to represent "a new dawn of equal opportunity for each individual, a dawn which emerges from the unique identity the number guarantees for each individual" (see Figure 5).


**Figure 5: Aadhaar Logo (left); the use of the logo in publicity materials (right)**

The card, the name 'Aadhaar' and the logo have since become synonymous with UID. Aadhaar also has a byline 'Aam Aadmi Ka Adhikaar' or 'the right of the common man.' Other associated

[12] http://uidai.gov.in/awareness-and-communication.html

[13] Although team leaders indicate that people from all walks of life evinced a keen interest in technological components [43].

[14] From personal interviews with technology team, Nov 2012.

[15] http://uidai.gov.in/consultations.html

[16] Details on name and logo from: http://uidai.gov.in/aadhaar.html

taglines include 'Anokhi pehchaan, rahein aasaan' or 'unique identity eases your path.' The name of the project, its logo and taglines have appeared regularly on enrolment brochures for the project, in UIDAI's press releases, in the interviews of UIDAI personnel, in speeches by politicians and in opinion pieces and other articles on the project in mainstream media. The first enrollee had her picture featured in most mainstream media outlets, with Congress President Sonia Gandhi handing her an enrolment slip, with "Aadhaar" forming the stage backdrop (see Figure 6). The enrollee's village was labeled an "Aadhaar Village" [12].


**Figure 6: From top – Aadhaar launch; 200th million recipient; and linking Aadhaar with a bank account (Note visible changes in the size of the artifact used for publicity)**

In addition to material representations for the UID project and the UID itself, another way to make it material has been through connecting it to schemes and transactions, either existing or new. The 'Aadhaar' brand name itself emphasizes its purpose as "a foundation over which public and private agencies can build services and applications that benefit residents across India." [66]. Two existing schemes or types of transactions, in particular, stand out for the frequency with which they have been invoked in discussions of the UID project: the Indian guaranteed employment and public works program (National Rural Employment Guarantee Act and Scheme, NREGA/S) and banking transactions [19],[22].

### *7.2.3 Benefits*

If making the UID material - through printing a card for it, associating it with a name, tagline and logo, or connecting it with known schemes and transactions - was a component of creating an image for the project, emphasizing its benefits was an important second step. As we have already seen, at the core of the project is the idea that having a unique identity is critical, worthy of being a right, and the first step towards providing "equal opportunity." In fact, Nilekani wrote about a citizen's "right to an 'acknowledged existence'" [42: 367] even before the establishment of the UIDAI. Having such an identity is, thus, itself seen as a benefit. Second, this ID is described as infrastructure on which other services can ride, and thus most other discussion of benefits is in relation to its specific linkages with existing transactions and schemes. For example, the portability of the number was powerfully invoked in the context of low-income migrants' access to public schemes and services as they moved across the country [59].

In addition to these tangible and direct benefits, there was the larger theme of Aadhaar as a manifestation to the world of India's IT prowess, symbolizing a "new and modern India" and as achieving "national integration" [53]. The elimination of poverty, "social inclusion,"[54], "plugging leakages" [2] and "reducing corruption" [3] came up repeatedly in media interviews and statements by UIDAI authorities, and politicians [55]. Given the raging debate and protests against corruption taking place in India in this period, tying the project to these concerns became an important way in which to secure and maintain support from the political class. Much as we saw with the railroads and dams, both the perceived tangible benefits and symbolic ones, were required to create a positive image for the project. Furthermore, not just UIDAI but even politicians and policymakers leveraged these claims to earn the support of a wide variety of groups.

## 7.3 Beyond the Image

While the UID project's 'success' cannot be gauged at this stage, and will in any case be differ across social groups judging from past examples of projects of this scale, it is clear that the project has attracted over 410 million people for enrolment, besides the politicians who support it and the bureaucrats and technologists who elected to work on the project. We do not suggest that the enrolment numbers were only due to the projected positive image of the project. No doubt, making the number mandatory for participation in many transactions, as well as the fear of being excluded without it, played an important role. But we argue that the meanings that were painstakingly associated with the UID played a significant part in gaining support for the project in its initial stages. This becomes apparent when we see the project continue in spite of significant protest [22], [26], [31], [41], including charges that the UIDAI and its work are illegal and unconstitutional, as well as personality clashes between Nilekani and politicians [14]. Finally, in spite of significant opposition opponents have struggled to frame their criticisms of the project, given both that the project did not have many precedents whose consequences could be analyzed, and because its benefits were expressed at levels of abstraction that made them hard to criticize.

# 8 DISCUSSION AND CONCLUSION

Our goal with studying the railroads built during British colonial rule, the dams built shortly after India's independence from British rule, and the UID project currently underway in India, was to understand how mega infrastructure projects have been represented to their potential users and investors to gain legitimacy, how these representations have evolved over time covered by these cases and what might set e-infrastructure projects apart from other mega infrastructure projects. We were interested specifically in how three aspects of these projects were presented and leveraged: the how (project implementation and team), the why (goals and benefits) and the what (technological artifact). As the prevalent technology, structure of rule, and visions of development changed, how did the process of gaining legitimacy for mega infrastructure projects evolve along these aspects? We discuss these aspects next, based on the three cases we considered.

All the projects we examined were associated with visible champions: Dalhousie for the railroads, Nehru and Saha for the dam, and Nilekani for the UID project. The reputation of these individuals, as modernist, visionary leader, eminent scientist or successful technologist and businessman, as well as their standing as men of integrity, was leveraged in each case to attract supporters and finances. Given the very different regimes and times in which these projects were undertaken, the audience for the projects was quite different. With the railroads, the support of the Indian public was not as important for the sustenance of the project, especially in the initial phase. The audience, instead, was potential investors in Britain (and to a smaller extent, in India) and British policy-makers in both countries. It was to them that Dalhousie's reputation as a modernist reformer was leveraged. With DVC, Saha was able to successfully leverage his scientific reputation among the English-speaking public in Bengal, and Nehru used his political clout to sell the project to the Constituent Assembly in spite of India's dire financial condition at the time. Finally, in the case of the UID, politicians, technologists, activists and the entire adult population of potential ID holders had to be wooed. An IT-entrepreneur chairperson proved popular image at this time when the IT sector was the poster child of the Indian economy, while bureaucrats and politicians were despised as corrupt.

The 'why' of these projects i.e. their projected benefits was closely tied to ideas about development and progress prevalent at the time. The railroads focused on civilizing the natives, the dam on achieving modernity, and UID on eliminating corruption. Obviously, each emphasized different benefits. The British spoke of the benefits of fast transportation to traders and investors for whom speed was important. They also saw the railroads as a way to get the 'natives' to adopt good, English values, and to give up the caste system. With dams, the emphasis was on flood prevention, irrigation, power generation, and benefits to industry. Dams were also projected as evidence of India's march towards modernity. With UID, the project was linked to the elimination of poverty and corruption, themes that came up repeatedly in discussions during Anna Hazare's 2011 anti-corruption campaign in India.

Pollock & Williams warn us that growing any kind of infrastructure is paradoxical: while designing it for all possible future uses, there is no certainty what goals and activities an infrastructure will be put to [49]. In discussing the 'what,' i.e. the central technological artifacts of a project, this paradox is the most important similarity we note between the projects. But it is also in discussing the 'what' that we see the most significant differences between the cases. For one, the UID project was deployed much more quickly than the other projects we described. While political pressure was definitely one reason for this speed,[17] the nature of e-infrastructure also made fast deployment possible. The UID project was also distinct from the earlier projects in not being visible enough [10]. How then was it presented to different audiences? The railroads and dams concerned technological objects made of brick, mortar, iron and steel, installed in public, their scale and effects concretely visible. The servers of the UID project, on the other hand, were not stored in public. In the UID case, 'scale' itself had a different meaning, measured in terabytes that were only comprehensible to a limited population, where earlier infrastructure projects could dazzle a wider audience by descriptions of the tons of steel used, or thousands of kilometers of line laid. Moreover, an 'identification number' too could be 'seen' only through its effects, or by deliberately associating it with a physical object. The biggest difference, thus, was in how an 'ID' had to be made material and linked to various other schemes before an image could be built for it. Mosco argues that 'mythmaking' has been part of the introduction of many technologies around the world. He further suggests that typically, only after these technologies have lost their novelty and become too banal to be remarked upon, have their more grounded promises been realized [40: 19]. Thus, while the railways could not break the caste system, they did make travel easier and faster, contributed to an increase in trade, to an expansion of the banking sector and to the training of individuals as railway employees. But much of this happened after the technology ceased to be novel and became invisible to their users. Dams provide a counter example. They were embarked upon with similar enthusiasm but, for the large part, failed to live up to their expectations in the long run. Their initial period consisted of similar 'mythmaking', but the technologies involved in this case never became 'banal' à la Mosco [40]. Following Bowker, we argue that e-infrastructure is invisible to begin with [10]. The mythmaking phase of projects such as UID therefore, focuses on making the infrastructure visible. Whether and at what stage the UID will become banal or invisible once more, is open to question. But as the pressure on the project mounts in what is possibly the project's last year in its current form, it is likely that the UIDAI's efforts will be to keep the project and its infrastructure as visible as it can.

At the start of this paper, we proposed that our historical analysis would be a contribution to the literatures on mega infrastructure projects and ICTD. The UID case emphasized the importance of making e-infrastructure visible and material in order to leverage it and gain legitimacy. By situating the UID project within a longer tradition of technological projects that sought to 'improve' society, we illustrate continuities in how such projects are leveraged as political symbols and show how intangible association of progress with a project centered on a novel technology is as pertinent today as it was 150 years ago.

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[17] The UID team was also motivated to ramp up the project since it realized that the project could be discontinued following a potential change in government after the 2014 elections.

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