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Between metis and techne: politics, possibilities and limits of improvisation

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ABSTRACT

Geographers, especially those working in developing country contexts have often encountered improvisation because it plays a critical social and cultural role. Engaging with anthropologist James Scott's conceptualisation of *metis* – contextual, practical and flexible skills and knowledge – and *techne* – universal technical knowledge – this paper furthers the geographical scholarship on the politics of improvisation.

The paper makes three main contributions. First, using *metis* and *techne*, it provides a new conceptual repertoire for making sense of improvisation. The paper places improvisation at the nexus of *metis* and *techne*. Second, it pushes the understanding of the morality of improvisation by attending to the role of relationships of power in morally and materially legitimising improvisations. Third, although states and experts celebrate and actively engage with improvisation, this paper demonstrates that they also create limits and boundaries for improvisation. These limits demonstrate a contradiction in experts' actions.

This paper is based on a nine months ethnographic research on two energy projects carried out in 2012–13 in five villages in Bihar, an eastern state of India. It used participant observations, home tours, interviews and group discussions.

Entre *mètis* et *technè*: politique, possibilités et limites de l'improvisation

RÉSUMÉ

Les géographes, tout particulièrement ceux qui travaillent dans le contexte des pays en développement, ont souvent abordé la notion d'improvisation pour son rôle social et culturel essentiel. En discutant les conceptualisations de *mètis* par James Scott (1998) – en tant qu'ensemble de compétences et de savoirs contextuels, pratiques et flexibles – et de *technè* – en tant que savoir technique universel –, cet article fait progresser la recherche géographique sur les politiques de l'improvisation.

L'article y contribue de trois façons. Il propose dans un premier temps un nouveau répertoire conceptuel pour comprendre

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l'improvisation en faisant appel aux concepts de *mètis* et de *technè*. L'article place le concept d'improvisation à la rencontre de la *mètis* et de la *technè*. L'article améliore dans un deuxième temps la compréhension de la l'improvisation et de sa moralité en étudiant le rôle des relations de pouvoir dans la légitimation morale et matérielle des improvisations. Dans un troisième temps, cet article montre que, malgré le fait que les États et experts encensent l'improvisation et y participent activement, ceux-ci créent aussi des limites et des barrières à l'improvisation. Ces limites révèlent les contradictions au sein des actions des experts.

Cet article est réalisé à partir de neuf mois de recherches ethnographiques autour de deux projets énergétiques menés dans le période 2012-2013 dans cinq villages du Bihar, un État de l'Est de l'Inde. Il utilise comme méthodes l'observation participante, des visites d'espaces domestiques, des entretiens et des discussions de groupes.

Entre metis y techne: política, posibilidades y límites de la improvisación.

RESUMEN

Los geógrafos, especialmente aquellos que trabajan en países en desarrollo, a menudo se han encontrado con la improvisación porque desempeña un papel social y cultural crítico. Elaborando sobre la conceptualización de *metis* (habilidades y conocimientos contextuales, prácticos y flexibles) y *techne* (conocimiento técnico universal) de James Scott, este artículo promueve la investigación geográfica sobre las políticas de la improvisación.

El artículo hace tres contribuciones principales. Primero, utilizando *metis* y *techne*, proporciona un nuevo repertorio conceptual para dar sentido a la improvisación. El artículo coloca la improvisación en el nexo de *metis* y *techne*. En segundo lugar, estimula la comprensión de la moralidad de la improvisación prestando atención al papel de las relaciones de poder en la legitimación moral y material de las improvisaciones. Tercero, aunque los Estados y los expertos celebran y se involucran activamente con la improvisación, este artículo demuestra que estos también crean delimitaciones y fronteras para la improvisación. Estas delimitaciones demuestran una contradicción en las acciones de los expertos.

Este artículo se basa en una investigación etnográfica de nueve meses sobre dos proyectos de energía llevados a cabo entre 2012 y 2013 en cinco aldeas en Bihar, un estado del este de India. Se utilizaron la observación participante, visitas a hogares, entrevistas y discusiones grupales.

Introduction

Improvisation has an essential place in development projects and contexts. In India, *jugaad*, a particular form of improvisation has emerged as a driver for indigenous innovations and global learnings (Radjou, Prabhu, & Ahuja, 2012). In Zimbabwe, in the wake of economic crisis, *kukiya kiyi* or various forms of making-do emerged as survival strategies (Jones, 2010).

In Sierra Leone, the Kiro term *dreg* signifies 'hustling ... unskilled, temporary and risky' work, another aspect of improvisation (Shaw, 2014, p. 320). Chinese *guanxi*, Saudi Arabian *wasta*, Brazilian *jeitinho*, and Russian *svyazi* are similar constructs (Ferreira, Fischer, Porto, Pilati, & Milfont, 2012; Smith et al., 2012).

Although improvisation has become pervasive in many contexts and has embedded itself in everyday life, it is essential to understand its situated nature. Scholars often position improvisation within local knowledge and subaltern activism (Roy, 2011b, 2011a), and as an opposite to science and technology (Landström, Whatmore, & Lane, 2013). However, this article demonstrates that, through improvisation, local knowledge often moves into the realm of universal technoscientific knowledge and vice versa, and that elites are as much complicit in it as the subaltern (Jeffrey & Young, 2014; Roy, 2011a).

This article contributes to a growing geographical literature on improvisation. Engaging with James Scott's (1998) conceptualisation of *metis* – contextual, practical and flexible skills and knowledge – and *techne* – universal technical knowledge –, and drawing on literature from Human Geography and Critical Development Studies, it furthers an understanding of the politics of improvisation. To illustrate the workings of power and resistance, the manuscript positions improvisation as a political process (McFarlane, Desai, & Graham, 2014; Pyyry & Tani, 2017). Politics in this context can be understood through the interactions between relationships of power and types of resistances (Li, 2007). The article attends to the politics that operates in everyday life, and through which experts and people, depending on the context, employ one form of knowledge or the other. Focusing on this politics, the article fills a crucial gap in the current scholarship, which fails to answer why experts at times encourage improvisation and at others condemn it. An emphasis on the relationship between *metis* and *techne* helps to understand the continuous interplay between contextual and codified knowledge that is central to improvisation.

This article makes three main contributions to the geographical scholarship on improvisation. First, it demonstrates that James Scott's (1998) ideas on *metis* and *techne* provide a useful conceptual repertoire for making sense of improvisation. Improvisation is a coordination between *metis* and *techne*; it flourishes at their nexus. Depending on the context and need, actors use one form of knowledge or the other to improvise and in the process take *metis* into the realm of *techne* and vice-versa. Second, the paper pushes the understanding of the morality of improvisation, from thinking about its context-dependent positive and negative traits, to consider the role power plays in morally and materially legitimising improvisations. Third, although experts celebrate and actively engage with improvisation, placing it in a somewhat legitimate space (Jeffrey & Young, 2014; Radjou et al., 2012), these legitimisations are not boundless. This paper demonstrates that experts create limits and boundaries for improvisation. This also reveals a contradiction in the experts' actions.

The following section gives a review of the scholarship on improvisation and, engaging with broader literature, explains James Scott's (1998) ideas on *metis* and *techne*. After this, the methods and case studies for this paper are explicated. The three sections following the literature review and the methodology engage with the empirical material: (a) tracing how experts claim to learn from *metis* and attempt to convert it into *techne* to develop standardised, universally applicable projects; (b) explaining the importance of improvisation in these projects and; (c) handling the question of power and morality. The final section outlines this article's main contributions for geographies of improvisation.

Literature review and theoretical framework

Geographies of improvisation

In recent years improvisation has received increasing attention from geographers (Landström et al., 2013; McFarlane, 2011a; Vasudevan, 2014; Young, Kumar, & Jeffrey, 2017). This scholarship demonstrates that improvisations are carried out in everyday life, especially when living with technologies (Pink & Sumartojo, 2017), and encompass the social, the political, and the material (Jeffrey & Young, 2014). In addition to work by geographers, scholarship from anthropology and planning help develop what one could begin to think of as 'geographies of improvisation'. This scholarship includes a range of theoretical approaches like assemblage theory (McFarlane, 2011a; Pugh & Grove, 2017), postcolonial theory (Roy, 2011a), political typology (Ghertner, 2017) and non-representational theory (Miller, 2016). It associates improvisation with informality, entrepreneurialism, urban culture, creative governance and rights to the city (Laws & Forester, 2015; McFarlane, 2011a; Roy, 2011b). Three main themes come through¹.

First, improvisation is about making-do under challenging circumstances. In contexts with limited resources, improvisation becomes critical for maintenance and upkeep (Graham & Thrift, 2007). Anand (2015) shows this in his research on the maintenance of Mumbai's water infrastructure by state officials. Their strategies are based on practical knowledge and experience which other employees of the department repeatedly contest. Chattaraj (n.d.) frames the state's use of 'flexible, negotiated and improvised governance practices', as 'jugaad state' (improvisational state) (p.23). Similarly, Laws and Forester (2015) talk of 'always improvised "street level democratisation"' that involves pragmatic actions by planning and policy practitioners in response to changing clients, policies and environments (p.17). At the same time, Healey (2004) through a discussion of creativity and experimentation, argues for a space for improvisation in governance practices (see also Hillier, 2000 on the importance of informal and ad-hoc networks). Such making do is not limited to the state's material infrastructure. Through his work on incremental dwellings in Mumbai's slums, McFarlane (2011b) illustrates how people are forced to improvise in the face of deep urban inequality.

Connected to this spirit of making do, the second theme sees improvisation as subaltern activism: entrepreneurial initiatives, claims to development benefits and resistance strategies of poorer people. Balls (2016) finds that in Uttar Pradesh improvisation has helped develop a solar market that caters to poorer customers, albeit through low-quality products. McFarlane (2011a) frames the hacking of public phone booths to make free calls and disrupting phones of members of the state legislative assembly by Mumbai Slum Dwellers Association as 'tactics of urban resistance' (p.367). On the other hand, Ananya Roy (2011b) calls for a sober take on the depiction of urban poor's improvisation as a 'strategy of ingenuity' (pp.20–21). She sees it as the 'new millennial utopia', one that needs to be deconstructed and understood better (pp.20–21). As Roy (2011a, 2014) reminds us through the case of illegal farmhouses owned by industrialists and ministers in Delhi, improvisation is not limited to the poor; elites are also highly implicated in it.

This leads to the third theme that sees improvisation as a source of corruption and symptomatic of systemic risks. Jauregui (2014) notes in her ethnography of police in India that both police officers and citizens legitimise activities that are otherwise seen as

corruption, by framing them as improvisation. Similarly, Jeffrey and Young (2014) elucidate how brokers and owners of private colleges in Northern India use 'shady' tactics and engage in criminal activities to get ahead and legitimise these as improvisations. Ghertner (2017) explains that, in Delhi, ex-government employees pose as state authorities and improvise an informal infrastructure to deliver groundwater to households. In light of such activities, Birtchnell (2011) contends that framing improvisation purely in terms of entrepreneurship risks hiding the undeniable fact that it is rooted in a lack of resources and hazard. In the same vein, McFarlane (2011a) argues that improvisation is a coping mechanism 'forced upon many people in contexts of state welfare abandonment' (p.367). Improvisation helps governments shed their responsibility towards citizens by appealing to their entrepreneurial spirit of 'making do', backed by a neoliberal market logic (see also Vasudevan, 2014). In such a context, the Indian government's use of improvisation (*jugaad*) to advertise a nationalistic 'spirit of ingenuity' is unsurprising (Jeffrey & Young, 2014, p. 183).

These three themes also indicate the morally ambiguous nature of improvisation. Is it good or bad, empowering or disempowering, desirable or undesirable? When it comes to project designs, activities that experts have not planned into the original designs, activities that push boundaries and create surprises, result in problems. Chatterjee (2004) provides a good example explaining that 'persistent theft and the legal difficulty of recognising illegal squatters' has forced Indian electricity companies to negotiate 'collective rental agreements' (p.56). While the squatters understand and admit that their illegal occupation of the state's land and services is 'contrary to good civic life', they make moral claims, on the state's responsibilities and, of a community that affirms the values and 'duties of good citizenship' (Chatterjee, 2004, pp. 56–60). The squatters improvise to access electricity illegally, and then, the electricity companies improvise to create paralegal arrangements. These unplanned activities are also managing or coping mechanisms in situations that are less than ideal because, for both, the illegal squatters, and the electricity company, the system does not work otherwise. Many poorer people have to engage with this sort of brokerage in their everyday lives (Corbridge, Williams, Srivastava, & Veron, 2005). When such improvisation is normalised, as it has been in many parts of India, it sometimes becomes exploitative for poorer people. These two understandings, the first negative, because *unplanned activities* jeopardise projects and products and are undesirable traits for designers and project managers, and the second positive, because *managing or coping* help things go on and are desirable traits, portray the moral juxtaposition that improvisation signifies. These negative and positive sides of improvisation make it 'morally loaded' (Jeffrey & Young, 2014, p. 188).

While covering a broad range of theoretical and empirical settings, existing work on improvisation has yet to systematically understand how contextual, dynamic, in-the-moment practices are assimilated into more formalised systems of knowledge. Consequently, it fails to answer why experts and formal institutions sometimes encourage improvisation and at other times discourage it. We can understand these dynamics by engaging with James Scott's (1998) ideas on *metis* and *techne* and viewing them in relational terms. The relationality between *metis* and *techne* helps to understand the continuous interplay between context-specific and codified knowledge that, as this paper demonstrates, is central to improvisation².

Metis and techne

James Scott (1998) explains metis as the ‘sort of practical skills’ situated in the large gap between genius and codified knowledge (p.136). Corbridge (2001) interprets metis as ‘self-reliance’ and ‘local knowledge’ (p.84). However, in Scott’s (1998) conceptualisation, metis is more than local knowledges, indigenous skills, and folk wisdoms. Scott (1998) explains that these terms ‘confine this knowledge to “traditional” or “backward” peoples’ ignoring the fact that they are embedded in most modern activities (p.424). The tag of ‘traditional’ becomes the basis for denying artisans and peasants ‘practical and symbolic access to the modernity’ that experts take as superior (Herzfeld, 2005, p. 370). Scott (1998) finds ‘local knowledge’ and ‘practical knowledge’ better, but points out that their understanding as restricted and static categories does not do justice to the dynamic nature of metis (see also Macnaghten, 2016; Scott, 2005). Metis is ‘continually revised’; as problems change, so do the solutions (Li, 2005, p. 389). The dynamic and modern (in addition to the traditional) nature of the knowledges and skills at play in this article necessitate an engagement with metis.

As opposed to metis, techne is universal. It is ‘precise, comprehensive, reliable, impersonal and universally applicable’ (Zuern, 2009, p. 589). Techne goes beyond specific problems, place, time, and context (Kenney, 2010; Scott, 1998). For example, the mathematical formulae to explain gravity are universal. They work everywhere, every time, without question. Such technical or expert knowledge develops through processes which identify patterns that are ‘not bound to specific circumstances of time, place and culture’ (Esteves, 2008, p. 1937). Importantly, techne affords predictability, controllability, quantitative accuracy and objectivity, and helps establish expertise (Zuern, 2009; see also Esteves, 2008).

It is also briefly worth considering how metis and techne relate to Aristotle’s episteme, techne and phronesis. Bent Flyvbjerg (2001) summarises the three Aristotelian terms as follows: ‘episteme concerns theoretical know why and techne denotes technical know-how, phronesis emphasises practical knowledge and practical ethics’ (p.56). Techne is then commonly understood as ‘applied episteme’ (Flyvbjerg 2001, p. 111). The important point here is that both, techne and episteme, ‘derive from logical deduction and aim for universal principles’³ (Kalyan, 2014, p. 70). Flyvbjerg (2001), puts Aristotle’s techne and episteme on the side of Scott’s techne when he clarifies techne as ‘any type of blueprint social engineering based on science (episteme)’ (p.127).

Scott’s metis seems similar to Aristotle’s phronesis defined as ‘practical knowledge and practical ethics’ (Flyvbjerg 2001, p. 56), but critically differs as, underlined by ‘subtlety, indirection, even cunning’, metis ‘cannot be understood in rational terms’ (Macnaghten, 2016, p. 8). The practical *ethics* side of phronesis makes it different from metis. Flyvbjerg (2001) explains that phronesis is ‘a sense of the ethically practical’ and ‘concerns analysis of values’, of good and bad (p.57). Such value judgements are specific and contextually subjective (van Dijk, 2011, p. 130). This makes phronesis useful for analysing values and their ‘implications for action in the achievement of the good life’ (Gunder, 2011, p. 209). In addition, phronesis is ‘public deliberation’ whereas metis is action (Gunder, 2011, p. 209). Metis is more practical than ethical whereas phronesis is more ethical. Metis opens paths of resistance for the subaltern, even if the tactics might fall on morally ambiguous grounds (Brady, 2003). De Grandis (2016) puts it succinctly:

Compared to *phronesis*, *metis* operates where not only there are conflicting values and uncertainty, but there are unjust power relations, iniquitous motives, unreasonable

positions and stubbornness as well. Smart responses to such circumstances are not necessarily ethical. (p.94)

Four key points about metis and techne inform this article. First, as explained above, metis is more than just indigenous, folk or traditional knowledge and wisdom. Second, metis is dynamic. It responds to the 'constantly changing natural and human environment' (Scott, 1998, p. 313) and 'takes on many masks and metaphors' (Shah, 2012, p. 511). As opposed to this, techne is settled and stable knowledge. It can be structured as 'small, explicit, logical steps' that can be broken down and verified (Scott, 1998, p. 320). It can be 'stored in artefacts' and transmitted through formal education (Kenney, 2010, p. 179). Third, metis consists of several interrelated elements that come together for it to work (de Certeau & Rendall, 1988; Scott, 1998). Due to this dependency on variables, and its abstract nature, the essence of an idea emerging in one place, or some of its constituents, can travel to another place but not its exact composition. Techne can travel accurately and precisely due to its standardisation (Scott, 1998). Fourth, due to its specificity and complexity, metis has 'no general and abstract formulation' (de Certeau & Rendall, 1988, p. 82). It does not lend well to 'formal procedures of rational decision making' (Scott, 1998, p. 318). Techne is most suitable for activities with specific goals that need quantitative accuracy and verification (Scott, 1998). The goals and the process to reach the goals are standard, non-changing, and quantifiable. Techne reinforces established models to 'constrain experimentation and penalise difference' (Zuern, 2009, p. 589).

Although metis and techne are two distinct forms of knowledge, they are not disconnected (Tilly, 1999). They inform each other. Herzfeld (2005) reminds us that planners and experts also have local knowledge and cunning which helps them persuade citizens in different places (see also Tironi, 2015). Tironi (2015) notes that 'the technical and the political, the episteme and the metis, and the scientific and the experiential are often entangled in complex networks of knowledge circulation' (p.71). Indeed, metis and techne are entangled in a network. This is not to argue that they cannot or do not exist as distinct forms of knowledges, but rather that, metis and techne meet each other, inform each other, and in this article, crisscross each other's realms. Teasing them out is useful as, metis, 'which is ascribed an agency of critiquing the violence of "seeing like a state"', is useful for demonstrating the knowledge and moral politics between experts and people (Shah, 2012, p. 511). In addition, Macnaghten (2016) suggests that, by facilitating various forms of resistance, metis affords a power reversal between the weak and the powerful. However, metis can also be embedded within techniques of government for use against the poor (Di Giorgio & Habibis, 2018).

Metis and techne provide a useful analytical repertoire to understand how particular contextual knowledges are co-opted in designs by experts, standardised, and implemented in other places, revealing a complicated struggle of 'local resistance and dissent' in which improvisation becomes a tool to modify project designs, and to resist against such modifications (Damonte, 2016, p. 958).

Data and methods

A large part of India's population still does not have access to electricity. Low carbon decentralised energy, with its promise of efficiency, reliability and eco-friendliness,

promises to solve this problem. According to 2011 census, with only 16% of households electrified, Bihar state has the lowest electrification rate in India⁴. Within Bihar, electrification is concentrated in the urban areas: 67% of urban households are electrified, compared to only 10% of rural households. Rural electrification is a more prominent issue in Bihar as about 89% of its population lives in rural areas⁵.

This manuscript draws on comparative research of two low carbon energy projects and two baseline energy systems in five villages in Bihar. The baseline scenario consists of a village, Rangpur, connected to India's central grid and another, Berangpur, without electricity. In the village without electricity, people depend on kerosene oil for lighting (Table 1).

The first case study is Lighting a Billion Lives (LaBL). In 2007, The Energy and Resources Institute (TERI), a prominent Indian not-for-profit educational and research institute, initiated LaBL. Although TERI and its LaBL team work as not-for-profits, entrepreneurs run projects in the villages for profit. In an entrepreneur's house, LaBL sets up a solar lantern charging station with 50 or 60 lanterns for which villagers pay daily or monthly rentals. LaBL also uses micro-grids and solar home systems, but this paper focuses on its solar lantern programme. Donations from corporate social responsibility programmes, government schemes and multilateral and bilateral organisations finance the projects. LaBL has projects in 3,100 villages, which impact more than 890,000 households⁶. LaBL was present in two research villages, Bijuriya and Sahariya.

As opposed to LaBL, the second case study, Husk Power System (HPS) is a for-profit enterprise that finances, operates and maintains biomass gasifier based micro-grids in villages. For a set rental, customers are allotted fixed electricity wattages. HPS receives finance as subsidies from government organisations, loans from venture capital firms and philanthropic organisations and grants from multilateral and bilateral organisations. Its 75 plants impact 120,000 people⁷. The company's team manages and maintains its micro-grids. HPS was working in one research village, Hardiya, and had previously worked in another, Bijuriya.

During 2012–13, the author spent three to six weeks in each of the five villages for a nine-month-long multi-method ethnographic study involving 60 home tours and family interviews (34 higher caste and 26 lower caste), 10 group discussions and 24 elite interviews. Participant observations data was recorded in 580 diary pages and more than 1200 photographs and videos. The author conducted two higher caste, seven lower caste, and one mixed caste group discussions. Of these, one was a mixed gender group and one female-only group. The elites interviewed included two HPS micro-grid managers and three LaBL entrepreneurs who could provide histories of the projects and give insights into their functioning; village elders who provided historical context of the village; and village council leaders. One LaBL NGO director, one LaBL manager, one HPS deputy director and several electrification experts were also interviewed. During the

Table 1. Social makeup and energy sources in research villages (based on fieldwork data).

Village	Social makeup	Energy sources
Rangpur	Hindus; equal proportion of higher and lower castes	Central grid, kerosene
Berangpur	Predominantly lower castes Hindus and Muslims	Kerosene, diesel generator micro-grid
Bijuriya	Hindus; larger population of lower castes and smaller of higher castes	Central grid, kerosene, LaBL, HPS (HPS shut down)
Sahariya	Hindus; predominantly higher castes	Central grid, kerosene, LaBL
Hardiya	Hindus; predominantly lower castes	Central grid, kerosene, HPS

fieldwork, project brochures were collected. Also, data were collected from project websites and reports for document analysis.

Metis to techne: contextual to standard

Development project designers and managers often claim to learn from local contexts. By designing and building projects from the ground up, experts claim to incorporate metis – contextual knowledge and skills – into them. However, learning from metis and incorporating it into the design, they develop standard, replicable models to apply everywhere. This section argues that, by doing this, experts attempt to convert the ‘contextual and particular’ metis into the universal techne because it serves the specific purpose of developing and governing large-scale solutions.

A business of rural electrification that *transcends the conventional ideas* around delivery of electrical energy to masses, HPS has created *unique models* of decentralized electricity generation and distribution that can be well managed by the *locals using local* resources, thereby *bringing the age-old wisdom* of self-sufficiency of villages to life.

Husk Power Systems website, 13 April 2015

In this quote, HPS invokes two ideas. First, the organization discusses discarding old, conventional ideas of electricity delivery and taking up its new, unique model. In contrast, when discussing its unique model, HPS talks about using age-old wisdom, local resources, and contextual knowledge drawn from the places in which it develops its ideas and designs its materials. HPS gets gasifiers fabricated locally rather than buying from established companies. Instead of concrete or iron poles, it uses bamboo sticks to relay transmission lines, a tactic used by local diesel generator micro-grid operators for decades. HPS also uses locally sourced rice husk as fuel. Contextual and frugal material, and knowledges rather than standardised, proprietary knowledge products help HPS save costs.

Technological innovation and evolution is a central part of the energy provisioning process at Lighting a Billion Lives[®]. The programme’s foremost mandate has been the development and provision of clean technology solutions that are *relevant and customized* to end user preferences, usage behaviour and affordability. Since 2008, the programme has continually applied *field experiences and feedback* to improve, modify and advance its energy solutions to better suit end users.

Lighting a Billion Lives website, 13 July 2015

LaBL uses contextual knowledge gained through field experiences and feedbacks from villagers to become relevant to local requirements. As figure 1 shows, LaBL solar lanterns mimic kerosene lanterns that Indian villagers have used for decades. The wide bottom of the solar lanterns stores energy in a battery like a kerosene lantern that stores kerosene in its bottom. The solar lanterns have three light levels – high, medium and night light. In kerosene lanterns, turning a knob increases or reduces the light level by burning more or less wick. Both HPS and LaBL rely on village entrepreneurs with contextual knowledge to run local operations.



Figure 1. LaBL solar lanterns (left). Kerosene lanterns (right).
(Source: Author)

The project [LaBL] technology mimics existing cultural practices. Patterns of social and economic relationships and even the ways the lantern is used remain largely the same, while the lantern itself has been swapped for one that is clean and even provides a higher quality of light.

Smita Rakesh, The Energy and Resources Institute⁸

Scholars and funding agencies find grassroots and contextual knowledges, and local people increasingly important in projects (A. Smith, Fressoli, & Thomas, 2014). Metis makes these projects sensitive to local contexts, suitable for local lives, and appropriate for the problems at hand. As Ms Rakesh describes above, they fit the local culture and appropriately solve the problem of polluting energy sources, and low levels of light. They become easier to engage with, operate and maintain. To connect to these discourses, and other relevant actors, like funders, HPS and LaBL attempt to connect to metis. They claim to learn from the local context and assert reliance on local materials, people and their knowledges.

However, to make the design process manageable and to develop standard, replicable models, experts establish a stabilised notion of culture and people. They standardise initial ideas developed in a specific cultural context, create standard configurations and replicate projects across a country or several countries. LaBL uses the same solar lantern and same charging station, with the ability to charge the same number of solar lanterns in many

villages, across multiple countries. HPS installs the same micro-grid with similar capacities, using the same fuel in every village. This is an attempt to translate 'contextual and particular' metis into 'universal' techne (Scott, 1998, pp. 312–320).

Simplification and standardisation have two benefits. First, standardisation helps devise large-scale solutions and implement projects universally (Tsing, 2012). As Scott (1998) notes, creating standardised solutions is not an error but is instead an essential component of large-scale projects. LaBL is attempting to light a billion lives. It operates in 23 (diverse) Indian provinces and 12 countries across two continents. HPS is trying to electrify 10 million people. It works across two continents. In a step towards comprehensive universality, more recently, energy access companies have claimed the applicability of the same models of solar lamps in global South and North, albeit for different purposes. Sun King, a market leader in solar lamps in global South sells its lamps as camping and hiking equipment in the USA and Europe⁹. Sun King designed its lamps in Indian villages similar to LaBL. Waka Waka, a Dutch solar lantern company, adopts the same approach by spreading across Africa and Europe¹⁰.

Energy access is a big problem. Globally 1.2 billion people lack access to electricity, and 2.7 billion people rely on traditional biomass (IEA, 2016). To connect with other actors claiming metis is important. At the same time, to connect with actors like financiers and policymakers looking to address a big problem, experts need big solutions. To provide big solutions, projects are designed and structured to develop general and universal 'models' that can be easily and swiftly implemented in several places. Such 'models' also help to develop fixed and precise investment estimates, budgets and targets. As is characteristic of techne, concrete numbers developed based on concrete models help devise concrete future plans, make them quantifiable and verifiable, and help track them comprehensively. The model promises to transform these energy access projects into large-scale projects, bringing electricity to a significant number of people and bringing significant returns to their investors (Cross, 2013), both crucial objectives for financing institutions (see IFC, 2012, on energy access as a significant opportunity for companies).

Second, standardisation and simplification make the governance of projects smoother and more manageable by creating strict, explicit, and logical steps. Standardisations have become central to neoliberal regimes and 'audit culture' (Freidberg, 2007, p. 328). They help collect information, objectively assess, create transparency, demonstrate accountability and drive continuous improvements in projects. Techne is useful in keeping things on track and therefore has a 'privileged position in the policy process' (Parsons, 2004, p. 55). This is not possible with metis which changes from place to place, is 'confusing, incoherent and unassimilable' (Scott, 1998, p. 323). Therefore, experts 'attempt to reformulate systems of knowledge' to close off uncertainty and make way for the 'logical deductive rigour' that they are used to (Scott, 1998, p. 321).

At the same time, standardisation and simplification remove uncertainties, contingencies, and limit the chances of modification. They take the local knowledge out of the 'local' and make it the 'expert's'. As Rose (1999) notes, 'the processes of simplification embody the expectations and beliefs' of experts (p.204). The assimilation of metis becomes a mere disguise to claim ground-up innovation and incorporation of contextual knowledge. The replicable model is no longer socially contingent, 'local and divergent' (Rose, 1999, p. 322). Standardisation eliminates chances of future introduction of metis from the places to which

the project travels. In keeping with Scott (1998), the projects' designs are shaped by metis, but contrary to his expectations, the projects themselves are not 'diverse, and adaptable' (p.353). Even though many experts understand the importance of modifying projects with changing contexts, projects do not change due to a need for universal models. The model limits the capacity of technical experts to account for and embed metis from the places to which the projects travel. Standardised models constrain the 'field of inquiry' leading to a gain in 'precision and scientific power' but a loss of relevance (Scott, 1998, p. 322). By beginning with metis and ending with techne, these projects make a double move: they make *claims* on the local and contextual knowledges and materials – metis – and *claims* of a universal 'model' made of standard and replicable knowledge and materials – techne.

However, while experts attempt to convert metis into techne, metis still plays a key role in projects. As projects move from design boards to the real world, they rely more on improvisation of infrastructures and governance structures. The next section discusses how metis and techne crisscross the projects through improvisations by people and experts, in different spaces, and at different times.

Between metis and techne: improvisation to improvisation

As in the case of Bollywood costume imitators described by Wilkinson-Weber (2010), obstacles and constraints are vital drivers for improvisation. They help to understand the limitations but also grasp the possibilities that particular situations and conditions afford (Landström et al., 2013, p. 687). The people and spaces that these energy projects encounter are heterogeneous which 'leaves an enormous space open to improvisation' (Mbembe, 2006, p. 385). People using LaBL and HPS do not always conform to project designers' standardisations. Using metis, they improvise to use electricity in ways that are not part of the standardised models. Experts see some of these improvisations as legitimate while deeming others to be illegitimate. At the same time, experts also improvise to manage and maintain projects (Ghertner, 2017). This section examines these politics, possibilities, and limits of improvisation.

To manage with limited electricity, or the available electrical equipment, and get maximum benefits, experts *expect* people to use their metis and improvise, albeit within particular limits. For example, people need to install LaBL lanterns at high positions for their light to reach maximum distance and light up the maximum area. For this, LaBL provides handles on the top and bottom of the lanterns. However, LaBL does not prescribe the provisions for hanging the lanterns. People's metis drives these ad hoc decisions. They use their metis, developed by dealing with similar energy artefacts like kerosene lanterns (they also have handles on top), or through the experience of using LaBL lanterns over time, to make such decisions. Figure 2 shows the use of metis for such improvisations. People exchange knowledge informally with each other and improvise their domestic and commercial spaces to make the best use of solar lanterns.

Similarly, micro-grid users employ their metis to place light bulbs in particular locations, and at particular heights to light the maximum area. As they cannot afford an adequate amount of electricity, people often place a single bulb near windows or doors to light multiple spaces. They also make holes in the walls for one bulb to light multiple rooms. As shown in figure 3, many people install multipurpose bulb holders with plug points to charge mobile phones. To make the best use of both light and mobile



Figure 2. Various improvisations of and around kerosene lanterns (right). Various ways of using LaBL solar lanterns by improvising the space around them (left).

(Source: Author)

charging facility, they strike a critical balance between the height of installation and ease of accessibility. People install light bulbs in specific spaces where they can place mobile phones for charging. Some fashion ledges to place mobile phones. Here also, using their contextual and specific knowledge, people improvise their domestic and commercial spaces to make the best use of the bulb and holder.

These metis based improvisations are desirable, and often encouraged by experts. Projects do not work well without them. Scott (1998) proposes that formal processes are highly dependent on informal processes and cannot function without them (p.310). Without metis, people will not be able to improvise the spaces around them, and these projects will not work as well as they do. That is why experts create spaces for such improvisations in project designs, like handles on both ends of LaBL lanterns. However, along with creating spaces for improvisations, experts also create boundaries.

People manage electricity in many other ways. LaBL recommends that solar lanterns be used for a maximum of four hours a day, they should not be discharged completely, and the high setting of lights should be used only in exceptional circumstances. However, people often use the high setting for every purpose. The fields and forests that surround these villages are home to many small carnivores and reptiles. To keep the animals away while they are sleeping some people leave the lanterns on all night, a practice that many carry out with kerosene lamps too. Applying this pre-established local practice to solar lanterns means that people use them until the battery is fully discharged. This is an unplanned use of the lantern from the expert's perspective, but for people, this is just using their metis to 'manage' the energy source, and getting most out of what they are paying for – the juxtaposition that improvisation signifies.



Figure 3. A lightbulb installed on the window to light multiple spaces (top). A bulb with plugs for charging mobile phones and spaces created for them (bottom).
(Source: Author)

Due to a cap on electricity consumption in HPS, people have to use several times more expensive (INR80-100) Compact Fluorescent Lamps (CFL) rather than their preferred choice, incandescent bulbs (INR10). Even if people use only one bulb at a time, CFL is required because most locally available incandescent bulbs are 60W or 100W, well above the 15W or 30W limits planned by HPS. This creates a problem. Most people invest in wires, switches and CFLs when they join HPS but once a CFL fuses, they face financial difficulties in replacing it with another expensive CFL. They subvert HPS plans by buying the cheaper incandescent bulbs as replacements. The breakdown of lighting equipment results in the improvisation of the electricity network. While people try to manage with cheaper light bulbs to maintain their access to electricity, the incandescent bulbs withdraw unplanned levels of electricity from HPS. These improvisations do not follow any predetermined course of action; they are situated acts to fulfil specific aims.

The unplanned uses from the experts' point of view and energy management from the people's point of view create problems of upkeep. The improvisation of solar lanterns drains their batteries faster affecting the daily backup (number of hours) and long-term battery life. Incandescent lamps place extra load on HPS's generating equipment, affecting their short-term performance and their long-term life expectancy. In

their existing standardised configurations, the projects risk breakdown if they allow these improvisations to penetrate the boundaries created by the experts.

What we see is that, for experts, not all improvisations driven by metis are necessarily either good or bad. Good improvisations and bad improvisations depend on the experts' judgement. Experts make space for improvisations around the boundaries of the projects (for example, around the solar lamp or the HPS light bulb), but as soon as the improvisations penetrate these boundaries, and change the properties of the project itself, they become undesirable. To resist these threatening improvisations, experts also improvise to manage and maintain the projects. They change the project designs and lead to unplanned uses. However, due to unequal relationships of power, experts do not consider their improvisations wrong.

As projects move from one context to another, it becomes hard to predict what might go wrong, and at which point. In such cases, maintenance does not follow project designs. It becomes improvisational (Pugh, 2013). For example, here a LaBL entrepreneur discusses his improvisational response for controlling people's use:

The battery does not last very long on high setting. This means the battery is weak. Although in the normal setting, there is good light; one can study. Everyone wants to get the most out of their INR2 (daily rental); they use only the high setting.

All lanterns had a high setting. I have disconnected all of them, got all wires [for the high light] cut. Because there were too many complaints. The repairperson told me how to. He came from Delhi to fix the lanterns, from the [solar lantern] company. All the lanterns he fixed, I got [high light wires] cut.

[...]

TERI does not sanction this. They have made it, how can they. We do this to keep our system going. So that there is no misuse. If you need high [light], it lasts for 1-2 hours. If you use it for that limited time, then it is ok. Until the time you do not consider it [the solar lantern] your own, until then, how long will this system last? There will be complaints until the time you do not consider it your own. People want to suck the life out [of the lanterns] against the INR2 they pay.

[...]

You want high setting! However, if the company will improve its product. If the company says that it will last for 5 hours then what problem do I have? I will actually like it.

Brij Kumar, LaBL entrepreneur, higher caste, Sahariya

The entrepreneur disconnects the wire for the high light setting in the lanterns to control people's unplanned uses. The high setting withdraws more energy from the battery, and the charge lasts for shorter periods compared to the low light setting. By controlling the extent of light from the solar lanterns, and limiting people to the low light setting, the entrepreneur ensures that the lanterns provide light for extended periods. This solution, however, reduces the options for people who can no longer study without the high setting. While LaBL recommends the high light for studying, my research found many children studying with the low light option of LaBL lanterns because the high light did not work. By changing the solar lantern's properties, the entrepreneur forces people to manage with low lights, and engage in an unplanned use of the lanterns. However, this improvisation is acceptable for

the expert, the LaBL entrepreneur. He does not see this as problematic because, from his perspective, it helps in the upkeep of the solar lantern programme.

Cutting wires, hacking the solar lantern, and changing its standard configurations are not part of the original LaBL design. This is an unplanned activity, an improvisation. This seems like a local, contextual and specific improvisation, one emerging from metis. However, the entrepreneur has learnt it from the maintenance experts sent by the solar lantern manufacturers. A well-established and settled technoscientific knowledge, a *techne*, travels from the solar lantern manufacturing factory to a village. This *techne* gets to work in the specific context of a village and solves the 'problem' of a particular entrepreneur. A *techne* moves into the realm of metis. A universal knowledge takes the cloak of the contextual.

It is important to note that sometimes the entrepreneur improvises to manage¹¹. Solar lantern spare parts and batteries are expensive and take time to travel from their manufacturing facilities to the village. The solar lantern scheme must keep going, not only to maintain access to clean lighting, albeit not in the capacity and form originally planned, but also to maintain the entrepreneur's source of income. Faced with a lack of resources, the entrepreneur uses the *techne* gained from maintenance experts and improvises. Infrastructure schemes 'often depend on people's capacity to work quickly and creatively with whatever resources they have to hand' (Young et al., 2017, p. 3). After all, 'improvisation allows the work of maintenance and repair to go on when things may seem bleak' (Graham & Thrift, 2007, p. 4).

HPS managers attach a light bulb in series outside every house so that the electricity going to the house runs through it. The bulb starts glowing brighter if the household uses more than allotted electricity, revealing unplanned use. In extreme cases, the light bulb outside fuses, disconnecting the household's electricity supply. The electricity supply resumes only after the person pays a fine, and installs a new indicator bulb. The use of bulbs as the fuse is also a form of metis that local diesel generator micro-grids have used for decades. Although many micro-grids use smart meters or automatic fuses, HPS adopts a locally improvised solution to keep costs low and manage with limited resources. However, people also improvise to tackle these mechanisms. Some people put a coin in the bulb holder before installing the indicator bulb outside the house. The coin maintains the electricity flow and prevents the bulb from glowing bright or fusing, even with unplanned use of electricity. Using this improvisation, people avoid identification and disconnection. Again, forms of improvisation are pitted against one another. There is a constant struggle between HPS and system users, and HPS is now looking into smart meters to control unauthorised uses¹². Metis from the use of local bulbs as fuses gets into the smart meters. Metis leads to the development of *techne*.

As entrepreneurs learn to cut wires and improvise in specific contexts, *techne* travels to the realm of metis, and as HPS learns from the local use of bulbs as fuses to develop smart meters, metis again travels to the realm of *techne* (as it did during initial project designs). In both LaBL and HPS, metis and *techne* merge into and emerge from each other's realms. Improvisation is situated at this nexus as different actors, depending on the situation, employ one form of knowledge or the other to improvise. Some of these improvisations take one form of knowledge into the realm of the other, as in the case of cutting lantern wires.

The morality of improvisation

Jauregui (2014) finds that *jugaad* is about 'quick and dirty fixes or problem solving through improvisation, especially in a context of scarce resources' (p.77). Improvisation is about *managing* with limited resources like electricity or allowing things to continue in difficult conditions (Silver, 2014). It also helps 'generate and articulate desired futures' that may not be a part of formalised designs (Silver, 2014, p. 799). On the other hand, improvisation leads to *unplanned* activities, throws up surprises, changes properties of projects, or causes harm. It can be risky, dangerous, and lead to quality compromise, inferior practices and 'systemic risk' (Birtchnell, 2011; Jauregui, 2014). Improvisation is deeply embedded in 'moral and symbolic economies' (Philip, Irani, & Dourish, 2012, p. 16). Scholars have discussed the morality of improvisation mainly with respect to its context-dependent 'positive traits – thrift, quick thinking, imagination – and ... negative ones: a lack of principles, shoddiness, and a predilection for shortcuts' (Jeffrey & Young, 2014, p. 188). In addition to the context, relationships of power play a central role in understanding the morality of improvisation. There are two aspects to this.

The first concerns the relationship of power between users and experts. This paper has shown that both users and experts engage in improvisations. However, the question is: whose morality counts? In the quote in the last section, the entrepreneur argues that people's improvisations lead to *misuse* while his own improvisations prevent such misuse and sustain the project. There is an inherent contradiction in such situated action by experts. Both forms of improvisation 'break' the system – insofar as a 'broken system' means a system operating at a level lower than its planned ideal capacity – but experts consider their own improvisations as morally legitimate and users' as morally illegitimate. Experts tolerate or actively support particular *metis* and improvisation in particular spaces and within particular limits, for example, for hanging lanterns and light bulbs. This is mainly because these improvisations do not penetrate the project boundaries and cause no upkeep problems. However, they consider the improvisations by people for their own ends, and that may destabilise the projects illegitimate and try to control them. Experts consider the tactics of control that help in the upkeep of the projects, and the unplanned activities and improvisations generated by them, legitimate. This is because people improvise for personal benefits whereas experts *claim* to improvise for the benefit of the wider population. As Young et al. (2017) propose, 'improvised responses ... particularly when motivated by individual rather than collective interests, can ultimately work to reinforce patterns of inequality and exclusion' (p.2). This claim of collective interest gives experts a higher self-judged moral ground and helps sustain their own improvisations.

As explained in the last section, experts also improvise to control people and their uses, cope with upkeep problems, and maintain their livelihoods. Maintaining livelihoods is not a collective goal, rather an individual goal for the entrepreneurs. The motives of controlling people and sustaining their own livelihoods make the experts' moral high ground questionable. However, following Scott (2005), the moral high ground, and the legitimacy of the expert's improvisation is also sustained by 'the authority of the official regulations' (p.399). In this case, it is after all the expert who judges which improvisations are good and which bad. In addition, in LaBL and HPS, users join and leave the projects, but the schemes and the experts managing these schemes go on¹³. In short, the monetary, knowledge and political

powers that back the experts, push this 'cultural encounter' of improvisation in their favour (Scott, 2005, p. 401).

The second concerns the relationship of power built on socio-cultural inequalities. In the research villages, people with more social, economic, and political power improperly used solar lanterns and micro-grids more. In Bijuriya and Hardiya, both experts and users report that it is more common for higher caste and class families to engage in unplanned uses, for example, to run fans or television sets in HPS.

Most problems are from our [higher caste] society. Lower [*chota*] castes never give any problem. Too much knowledge leads to problems. People that are more educated think they are very clever [*hoshiyar*].

Dharmendra Kumar, LaBL entrepreneur, higher caste, Bijuriya

If they do not steal, the cost of services could come down. Rich do more stealing because they have more electronic equipment. However, they do not want to pay. You are rich with money not by mind.

Ravi Kumar, Deputy Director, HPS

Due to their higher material capacities, higher castes and classes own more electronic equipment and therefore need more electricity. In addition, due to their higher social, material and political power, they are less afraid of social sanctions, and penalties from experts. In Bijuriya, the HPS micro-grid manager (a higher caste male) and operator (a lower caste male) were beaten up when they tried to stop a powerful higher caste family's unauthorised use of electricity. Members of a lower caste family, while they might have resisted penalties, would not have dared physical violence on the higher caste micro-grid manager in this village where higher caste families own most land and hold most power. Indeed, open physical violence by a lower caste person on a higher caste person was not reported in any research village. Although groups that are more powerful face fewer direct challenges to their improvisations, their morality is often questioned behind their backs. In many interviews and group discussions, both, lower and higher caste people blamed their villagers, especially the powerful, for using more electricity than they were allotted in HPS. Here, the improvisations of the powerful find material legitimacy but not moral legitimacy.

As mentioned before, although they are better at it, improvisation is not only a strong person's game. Roy (2011a) suggests that improvisation is a 'flexible strategy wielded differentially by different social classes' (p.231). During the fieldwork, it was observed that the unplanned uses, in the ways described in the earlier sections, were distributed, if unequally, across all social groups. A knowledge of what people need energy to do and how their benefits can be maximised drive these improvisations. Most people in the villages, irrespective of their social, material and political power, have this metis. However, it is important to remember that improvisation is a flexible strategy that leads to variable effects. At times, it results in democratisation – for example, when users can subvert experts to derive more benefits from the projects – and at others, it exacerbates social inequalities – for example, when dominant social groups further their dominance through improvisation.

Conclusions

This article makes three main contributions to the geographical scholarship on improvisation by tracing its politics in the design, implementation and everyday operation of energy projects. First, it demonstrates that James Scott's (1998) ideas on *metis* and *techne* provide a useful conceptual repertoire for making sense of improvisation. Depending on the situation, actors choose to employ one form of knowledge or another to improvise. At these points, *metis* and *techne* merge into and emerge from, each other's realms. Some improvisations take one form of knowledge into the realm of the other, as when the cutting of lantern wires brought *techne* from solar lantern factories in the realm of *metis* in the village. In this paper, improvisation is a coordination between *metis* and *techne*, contextual and universal, flexible and standardised forms of knowledge. Knowledge moves between these two realms and improvisation flourishes at this nexus.

Second, the analysis pushes the understanding of the morality of improvisation from thinking about its context-dependent positive and negative traits (managing within limited resources versus subverting the system) to considering the role power plays in morally and materially legitimising improvisations. It argues that experts' claim of improvising for the greater good gives them a higher moral ground. However, their motives for controlling people and sustaining individual livelihoods make the experts' moral high ground questionable. Backed by their social, economic and political power, stronger social groups in the villages – higher castes and classes – are able to give their improvisations material legitimacy but not moral legitimacy.

Third, scholars know that formal order – states, experts – celebrate and actively engage with improvisation, placing it in a somewhat legitimate space (Jeffrey & Young, 2014; Radjou et al., 2012). This is because projects do not work without improvisation. However, such celebrated and active engagements are not boundless. This paper has demonstrated that experts create limits and boundaries for improvisation. As projects need improvisations based on *metis* to maximise their benefits, experts allow, even desire improvisations, but within strict limits. Many improvisational responses generate new practices and designs, but experts do not consider them within the boundaries of legitimate knowledge. This is a political move through which experts' knowledge takes a higher epistemic ground and creates boundaries to control people. The picking and choosing of legitimate and illegitimate improvisations also reveals a contradiction in the experts' actions.

Geographers are uniquely positioned to exploit this placement of improvisation between *metis* and *techne* to understand further the long-standing situated actions of experts (including the state) and citizens in global South, but also the new tactics acquired in global North in the context of austerity and growing (energy) poverty. Are there other instances of the exchange between *metis* and *techne* through improvisation? Which improvisations (and by whom) are encouraged and legitimised, and which discouraged and arrested? Can we, or should we even attempt to, develop an ethical paradigm for judging improvisations or does the teasing out of power relations provide a good general sense of morality within improvisations? What can 'geographies of improvisation' learn from 'geographies of innovation', on the politics of knowledge and conversely, can *metis* and *techne* provide a useful conceptual repertoire for economic geographers studying innovation? Further delving into these questions can nurture a fruitful domain of geographies of improvisation.

Two recommendations for designers and policymakers are clear. First, rather than attempting to standardise metis, experts should focus on its essence. For example, using local materials, people and knowledges is a good idea, and so are solar lamps and micro-grids. However, using the same solar lamp or micro-grid everywhere is not a good idea. This creates more labour for experts and potentially slows the progress of schemes. However, a scheme that can embed metis from new places will always work better and be locally more beneficial than a fast-moving one that eliminates and ignores metis. This leads to the second recommendation on fluid designs. Product and project designs that are more open and readily facilitate local improvisations will help introduce of metis into designs repeatedly. Such fluid designs might be less governable but will be more attuned to local contexts, and therefore endure longer (Kumar et al., 2019).

Notes

1. In the work cited below, many scholars work with jugaad/jugaar (Balls, 2016; Birtchnell, 2011; Chattaraj, n.d.; Jauregui, 2014; Jeffrey & Young, 2014; Roy, 2011a, 2011b), some explain practices that can be understood as improvisation (Healey, 2004), while others directly use improvisation (Anand, 2015; Ghertner, 2017; McFarlane, 2011a, 2011b; Young et al., 2017). Many of these scholars (McFarlane, 2011a; Roy, 2011a) engage with informality, which is intimately connected to improvisation. The space of informality cannot be occupied without improvisation.
2. Thanks to the anonymous reviewers for helping tease out this point.
3. This why some scholars merge Aristotle's episteme and techne into either episteme or techne (Freidberg, 2007; Scott, 1998).
4. Census of India (2011): http://www.censusindia.gov.in/2011census/hlo/Data_sheet/SourceofLighting.pdf.
5. Census of India (2011): http://censusindia.gov.in/2011-prov-results/paper2/data_files/india/Rural_Urban_2011.pdf.
6. <http://labl.teriin.org/about.php>.
7. <http://www.huskpowersystems.com/about-us/>.
8. Energy for a Shared Development Agenda: Global Scenarios and Governance Implications: <https://www.sei-international.org/mediamanager/documents/Publications/SEI-ResearchReport-EnergyForASharedDevelopmentAgenda-2012.pdf>.
9. <https://www.greenlightplanet.com/press/sun-king-pro-makes-a-perfect-camping-light-and-charger-pack/>.
10. <https://us.waka-waka.com/>.
11. Entrepreneurs occupy a territory of semi-expertise because they come to gain some knowledge about, and control of, these energy project. Their limited knowledge gives them control over some local aspects but not over higher-level aspect that project designers control. Expertise is fragmented and multilevel and the boundary between experts and subjects is not always strict and clear (see Kumar, 2015, pp.168–171). However, for clarity of analysis, this paper works with a clear boundary between experts and users. (Thanks to the editor for reminding me of this).
12. More recently, HPS has started using smart meters widely in its network, which they claim makes their network 100% 'theft proof' (<http://www.huskpowersystems.com/what-we-do/>). HPS started testing these meters in 2011 and an informal discussion with a HPS cluster manager during the fieldwork for this paper revealed that users had already started improvising and bypassing the meters.
13. The schemes can break down but as Li (2007) has so poignantly explained, they reassemble either as new or modified schemes of improvements.

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