Knowledge and practice for India as a developing country[1].

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Abstract

Inequity of development outcomes such as in heath, education, incomes, access to resources, etc., is now an important issue which needs immediate attention. An assertion of this paper is that partly, these are consequences of a failure of knowledge systems and not correctable by purely macroeconomic arrangements. In our analysis, knowledge formation in Indian higher education institutions (and consequently society) is highly problematic and suffers from serious issues of practice, relevance, excessive merit, knowledge capture, aspirational dysfunction and so on. The second major issue is that, besides industry, the state and society are important (and complementary) players in knowledge formation and consumption. The development agenda and programs, such as drinking water or NREGA pose a huge demand on knowledge production, which is either unmet or is sought from the the "informal sector", i.e., NGOs, civil society organizations and so on. This supply and demand mismatch is a primary cause of poor developmental outcomes. We propose a modification to the current training of engineers and applied social scientists, and a focus on engagement between educational institutions and regional governance, as a way out.

India has always been a land of great contrasts, and more so now in the welfare of its people. While a mere 100 individuals corner about 20% of our nation's GDP[2], millions and millons must live their lives on less than two meals a day. Moreover, this inequality seems to be increasing not only in terms of earning power, but in most other attributes such as access to education, health, livelihoods or water--see for example, Das and Zajonc (2008) in the area of education, or WB-ICSSR (2010) overall. The reasons for this are hotly debated by many economists, policy-makers and public figures.

An assertion of this paper is that there are many systemic deficiencies which are unlikely to be corrected by purely macroeconomic arrangements. Two diverse examples of such deficient systems are (i) the urban planning sector and (ii) the water and sanitation sector. Addressing these deficiencies will require a deeper sectoral understanding and a more profound intellectual inquiry about the engagement between society, government and its knowledge institutions. Our main thesis is that the essential ingredient in the overhaul of our key systems is the management of knowledge. It has been clear that our knowledge systems are failing to meet not only our demand for technicians and professionals, but also for the *public intellectuals*, i.e., those who understand the theory, who can communicate its practice, and who can lead in the public discourse to revamp our key systems. It is this matter which is the subject of this note.

The main points of this paper are (i) practice is an essential knowledge system and requires distinctive skills, (ii) training in practice is largely absent in our education and knowledge systems, (iii) this

practice deficit has severe consequences, foremost in poor development outcomes, and the hovering threat of *knowledge capture*, and finally (iv) a possible way out using the development agenda itself as a training tool. We add here that the importance of a "learning society" for development has been explicitly pointed out in Stiglitz 2011.

The primary background for this study comes from the author's field work, largely in Maharashtra but also elsewhere, and largely in the area of rural drinking water, but also other sectors. It is also based on the decades of experience of CTARA with rural development in Konkan and west Maharashtra, and also its situation within IIT Bombay and the consequent dialogue between academicians, practitioners and researchers.

1. **An elementary theory of practice and of societies**

Practice is a well known paradigm of learning, and one which is closely connected to empirical observations. Be it personal or societal, practice involves executing certain protocols, observing outputs, and then suitably modifying the protocols, and iterating this loop till a desirable level or nature of outputs are obtained. Let us define societal or developmental *practice* as composed of the following interactions between *agents* and *society*: (i) a sequence of protocols to be executed by agents, with outcomes observable by society, (ii) a system of evaluation of these outcomes by society and a feedback to agents, and finally (iii) a system of adapting the protocols by the agents to achieve better outcomes as judged by society. A culmination of this iterative refinement is what we will call a *good practice*. This is a sequence of protocols which result in positive outcomes for a society, as judged by it. Economics is but one language of analysing or describing some good practices. Culture is another.

A typical practice loop is illustrated below in Fig. 1. The loop begins with a problem as posed by society. This problem is modeled and formalized by translating societal variables which are typically trans-disciplinary, into more disciplinary analytic variables which are amenable to analysis and design. This is then followed by a disciplinary design and synthesis phase. The final elements of the loop are deployment, evaluation and validation. Thus, practice is an essentially creative and inter-disciplinary skill which responds to trans-disciplinary societal demands and yet uses highly structured disciplinary knowledge.

There are obvious similarities between the practice loop and the science loop of observation, theorization and validation. While the science loop begins with observations and ends at it, the practice loop begins with society and ends at it. Both are iterative and incremental, start with concrete inputs and yet end in a desirable but abstract output. A *good practice*, the abstract output of a practice loop, is essentially a loop which generates positive societal value, and like scientific theories, has all the properties of *knowledge*.

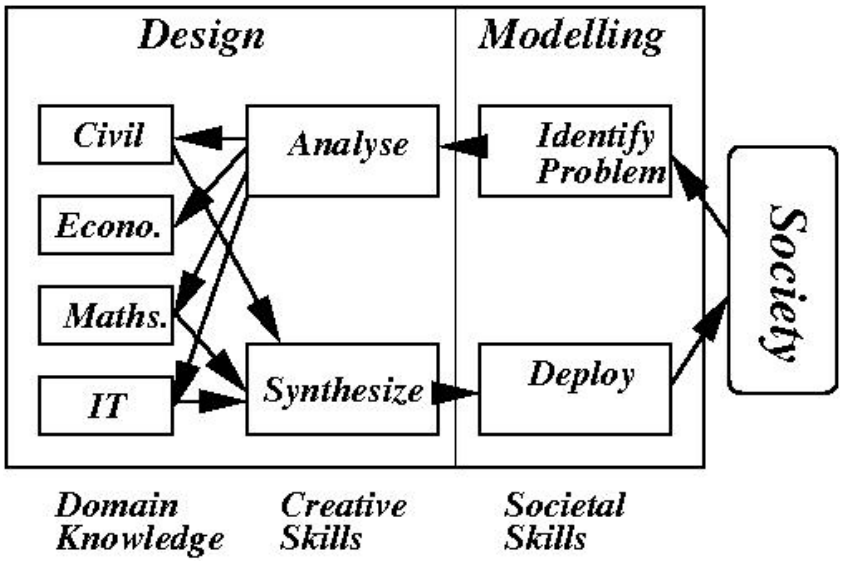

Figure 1: The Practice Loop

Take for example, the implementation of a village piped water supply system. The practice loop will take us through protocols to model and measure the village and its needs and resources, such as existing and desired quality of service, ability to pay, caste and class relations, nearby sources of water and their strength, and so on. This will lead to a number of domain specific design activities, such as design of a *paani samiti* and a tariff, simulations of various physical assets, and so on. This is then followed by deployment and a validation of the expected outcomes and if necessary, a second practice cycle. Thus a practice loop consists of many *protocols* of analysis, design and deployment, each being the subject of research and improvement. A good practice would be a culmination of this research[3].

The simplest good practices are perhaps of practicing artisans such as the blacksmith or the potter and these consist of only a handful of protocols. There are the more advanced good practices, e.g., of companies in the retail sectors, and now the massive loops engaging several companies and agencies, such as in large urban systems. Indeed, most industrial societies have assimilated these good practices and these are embedded into their companies, factories, government bureaucracies, various departments at universities, consultancies and so on. Smaller sub-cycles and protocols are documented in textbooks and standards which are taught and transmitted. See Sohoni (2012b) for a discussion on how companies respond to societal demands and the limitations of this mechanism.

A training in good practice must encompass three basic skills listed below.

- *Interfacial skills* of observing, modeling and parametrizing societal problems, deploying solutions, and of observing and evaluating outcomes.
- *Design (i.e., creative and interdisciplinary) skills* of assimilating feedback, analysing and decomposing problems into domains and then synthesizing solutions.
- *Technical or domain skills* of solving well-posed domain problems in the applied or pure, physical or social sciences.

All of these have analogues in the method of *Science*, e.g., the skill of building and operating

instruments of observation.

The above classification of skills as being *interfacial, inter-disciplinary* and *technical* will be used later. We will also use the words *knowledge, development* and *education system* with their usual meaning. However, for this paper, a *society* is an aggregate of its people, its culture, its incentive structures and includes its knowledge systems and practices.

The Indian polity actually boasts of several societies (as defined above). Based on many attributes such as rural vs. urban, nature of employment, livelihoods and skills, access to amenities etc., these may be coarsely classified into two distinct (caricatures of) societies[4], viz., (i) *Bharat* and (ii) *India*. In the world, there are several societies such as *East*, *China* and so on, and one which we will frequently refer to is *West*, variants of which are followed in much of the western world.

Bharat, consisting of about 80% of India's population, has agriculture, traditional artisanship and petty manufacturing and service, as their basic practice loops. However, most of its knowledge resources, such as in pottery, house-building, traditional medicine, and so on, whatever their scientific bases, are now dwindling. Its physical resources too are either (i) of increasingly poor quality or (ii) largely being expropriated by *India*[5]. Its manufacturing output comes from small workshops and their jobs, largely casual and informal. Its people are riven by legacy problems, such as caste conflicts, asset inequality and so on. In fact, *Bharat* is not a monolith at all but is an overlapping collection of regional *Bharat*s, all similar to each other. Another peculiarity is the aspirational dysfunction: no role models exist within *Bharat* proper; all are related in some way to *India* (either as the petty *sarkari* official or as jobs in *India*'s cities). Compounding this is a broad insurgency of *Tribal* wishing to opt out of *Bharat* and *India*.

The people of *Bharat* are supposedly eventually to *develop* into *India*. The current population of *India* is about 20% of India's population and is largely urban. It has nominal control over *Bharat* via a government whose upper echelons belong to *India* and lower *sub-taluka* employees come from *Bharat*. Most elected representatives of India come from or migrate to *India*. Commodity production, infrastructure development and most other industrial activities come from machines imported or good practices borrowed from outside, generally, *West* and now *China*. Practices developed in *India* are largely embedded as a *service or ancillary sector*, serving people of other societies[6]. These are largely devoid of interfacial or design skills and are restricted to technical skills. Thus, within the physical boundaries of India, there is largely[7] no *good practical* knowledge production for the people of *India* or of *Bharat*.

Global is a recently proposed society modeled after *West*. It is based on a (reasonable) claim that *West* has served its people well, a (doubtful) belief that the world will converge to a common society close to *West* or *Global*, and finally the (unbelievable) claim that good practices of *West* remain so for *India* and *Bharat*. Proponents of *Global*, such as the World Bank[8], argue that *India* should adopt *Global*, which will lead to the development of both *India* and *Bharat*. This essentially means the subsumption of *India*'s knowledge structures into *Global* and aligning the institutional and incentive structures according to it. This also means borrowing interfacial and design skills (besides technical skills) from *Global* as well. This is already evident by the participation of *Global* as consultants to various statal and para-statal agencies and also the pressure to allow FDI in all sectors.

2. Knowledge Institutions

The educational system in a society is central to its reproduction and the success of its development aspirations. For it is here that agents are trained, through curricula, in the practices of the society. It is the basic investment that the society makes towards knowledge formation. It should also serve as a partner and location for good practices to emerge, for it offers the necessary continuity and intellectual space.

In this section, we will look at the system of *professional* education in *India* and its recent trajectory. We will focus on the *practical* aspects of the output of such educational institutions, as opposed to their *blue-sky* research pursuits. The engineering side (also see Sohoni 2012a for a longer exposition) of professional education in India began in 1847, with the Thomson College (now IIT Rourkee), and subsequently, the College of Engineering, Pune and others of similar vintage. These colleges trained engineers in the technical aspects of the field and for a reasonably clear professional trajectory either in the public services or in key industries. The interfacial and creative or interdisciplinary skills were acquired on the job. Good practices were developed and codified and maintained within the institutions and public departments. These have served as standards till today and much of engineering practice in India is through such standards distilled from the experiences of that time.

Nehru's dream of a modern India led to the foundation of the Indian Institutes of Technologys (IITs), and later, of the Regional Engineering Colleges (RECs). The RECs were to supply trained manpower to the large number of regional development projects then underway, and the IITs to assimilate international science and technological research and to adapt it for India's development[9]. The IITs are based on a knowledge system and a notion of validity based on abstract scientific analysis rather than practice and long experience. This system and its curricula were borrowed from elite institutions, such as the Massachusetts Institute of Technology (MIT), of *West* of the 1950s. At that point, the maturity of *West*'s companies, the breadth and depth of engineering practice, the centrality of *West*'s scientists in the second coming of Physics (in the form of transistors, nuclear energy and so on), the breadth of engineering education paradigms, all were important in the decision of some of *West*'s elite institutions to migrate to a more abstract scientific notion of engineering. All of this was ignored while installing this abstract DNA into the IITs. See Terman (1976) on the history of the MIT electrical engineering department and Basset (2009) on the strategic aspects of the MIT-IIT collaboration of that time.

Right from the first year, the IITs worked in quite the reverse way: instead of bringing in international scientific practices, it took away trained Indian scientist-engineers and put them in the international job market[10]. Since the training at the IITs was what was meant for companies of *West*, these graduates were quickly absorbed there. The huge differential between the productive and remunerative power of *West* and of *India*, created a massive demand for the IITs among prospective students. This was construed as a vindication of abstract engineering. As a result, the influence of the IITs on the national discourse on engineering training and research increased. Thus an existing educational system of engineering practice was replaced gradually with an abstract notion of engineering which is devoid of interfacial or inter-disciplinary skills. It also led to an unraveling of traditional relationships between specific engineering colleges (such as IIT Rourkee) and key engineering departments of the government and key industries.

The liberalization of the 1990s saw first a de-technicalization of the job market, in the form of

information technology (IT) jobs, followed by consultancy, banking and finance, and then an ancillarization of Indian engineering to companies of *West*, starting with the automotive sector. This created a mismatch between what was taught and what was found desirable in the job market for engineering graduates and a further shift of engineering curricula away from practice and towards the abstract or the limited. However, other than in the IITs and a few other colleges, there are hardly any teachers of abstract engineering. As a result, this curriculum is taught poorly and most students graduate with very little practical or abstract skills[11]. Since the best employers are the banking, finance, consultancy, IT companies and then the ancillaries, the skill-set sought by employers has shifted away from technological to the inter-personal (see, for example, p.30 of the World Bank report WB 2011). The engineering college now serves as a finishing school where the peer group, points for organizing student festivals and competitions, business plans, internships and so on, and multiple-choice aptitude tests, are the key metrics by which companies measure applicants. Thus, the engineering job market has essentially failed[12]. It now works as a signaling game, as in say, Stiglitz 1975, for allocating wage-arbitrage jobs for *West*.

Yet we persist, not only with the abstract model but also with the incentives which have caused this failure. In fact, a recent World Bank and Ministry of Human Resource Development (MHRD) project, (see TEQIP 2012), attempts to cement the linkage between engineering education and the 'global' demand. In reality, the curriculum completely ignores the development needs of *India* or *Bharat* and the interfacial and interdisciplinary skills which these require. For example, the ordinary dug-well, the drinking water source for over 50% of our people, remains outside our curricula. Even for the urban-living *India*, first-hand familiarity of urban water supply systems, and the people and institutions behind them, lies beyond the pale of most curricula. Thus it is no surprise that India has an intractable drinking water problem.

The social sciences poses a more interesting, and perhaps a more challenging problem. Firstly, it is not clear if Indian social scientists have considered *good practices* and especially *intervention design*, as objectives of a curriculum. At the bachelor level, training in social sciences stresses largely on scholarship and reading of a choice of texts with regional, national and international contexts. It does not usually probe the local context, and certainly not with a view of intervening. There are no courses, e.g., on employment guarantee schemes or on cooperatives and how they function. Thus, the question of developing or transmitting good practices does not arise.

The *social work* program, as visioned by the UGC (UGC 2006), has always been *practice* driven. This revision itself came after a 30-year lull during which the curriculum remained frozen in a framework of community service. The training here is closest to developing societal and interfacial skills within the limited scope of social entities such as the individual, group and community, and also in social rehabilitation work with hospitals, prisons, or in riot-affected areas and so on.

At the graduate level, the Tata Institute for Social Sciences (TISS), founded in 1936, is an exception to the typical graduate institute, in that it has a clear applied program. Some schools of TISS have indeed developed *research* protocols and performed much applied research and assessments for government agencies. However, these suffer from several deficiencies. Firstly, these protocols are usually limited to purely social attributes and their interactions, and thus fail to capture inter-disciplinarity and design. Secondly, much of the protocols are from the view-point of the grass-root activist with a stress on redistribution of wealth rather than its creation. This is exemplified by the training program[13] for the

fellows of the prestigious Prime Minister's Rural Development Fellowship, as designed by TISS.

On the whole, other than the antiquated Participatory Rural Appraisal (PRA, an immersive protocol of documenting a village, formulated around 1980), there is no *social* protocol which is broad enough and in common practice. This is a serious lacuna for there are many situations which are common and which would benefit from standardized protocols for analysis and design, e.g., in the cooperative sector or certainly in the drinking water sector (e.g., estimating the ability of a community to pay for water). Another example is the APL-BPL (above-below poverty line) protocol used by researchers but which is hardly ever used in practical situations for designing interventions.

At the graduate level, the leadership in social science teaching and research lies within a small set of institutions. Most of these, such as the Jawaharlal Nehru University and Delhi School of Economics etc., have been pursuing excellence via research. The typical research methodology relies on textual analysis, use of secondary data and possibly some protocols for gathering primary data. The training and the output of these graduate schools is frequently contextualized by its relationship to *West*, and in many cases, financially supported by it. See, for example, Chatterjee 2002, on the extent and need for this, and also the Vaidyanathan review report ICSSR 2007, or Deshpande 2002. While many migrate to *West*, some graduates go on to form the backbone of the development and *policy* (see ahead) dialogue and populate the amorphous development space of NGOs, academicians and advisors to the government.

While most engineering curricula have a nominal representation of courses from social sciences, this window of influence is generally ignored by social scientists. No special courses have been designed to train the engineer in the interdisciplinarity that is required. On the other hand, no such inter-disciplinarity is required in the social science curricula. Indeed, though millions of rural women spend much time and energy at the dug-well, social scientists do not seem to see it as a social device at all, and worthy of study, for it is in no social science curriculum. In fact, there seems a perception among some of our social scientists that many of *Bharat*'s problems do not need trained engineers at all, and that that NGOs aided by *barefoot professionals* trained by *resource persons* suffice[14]. In fact, such training, called *capacity building,* is now a cottage industry which lies outside formal knowledge structures. Moreover, we see that huge programs of several thousand crores base even their *asset creation* on such training modules.

Finally, there is the ever fashionable area of *policy*. The word should generally refer to a 'principle or rule to guide decisions and achieve rational outcomes'[15] i.e., a body of study useful in many situations, starting at the college cafeteria or the bus station. However, in India, it usually means the discourse of the anointed few for consumption (if at all) by the highest echelons of power and largely unconstrained by technical boundaries of the sector. See for example, Sohoni (2012c) on how the WB poses the urban water policy question. Further, policy in India is implied and taught only at the national level and occasionally at the state level. Decision-making at the district, taluka or levels below that are neither studied nor taught. Simple problems at the taluka level, e.g., fixing a policy for taluka-level public transport, are left unexplicated and unattended leading to poor outcomes, contributing to their politicization. See, e.g., Challam (2002), who raises this locality question in particular, Balakrishnan (2008), and also Smita Srinivas (IIHS 2012, 0:20).

Thus, nowhere do we see a curriculum that actually teaches protocols which start from society and end

at it. Or an understanding that societies function because of virtuous cycles which generate value and which need careful nurture. Nowhere is there a mention that an educational institute should function as a regional knowledge resource and problem solver.

3. The developmental consequences

The developmental consequences for *Bharat* are of course, devastating. Many of the millenium development goals, such as provision of water, health care, etc., are related to good practices. Our performance in most such indicators is absolutely dismal and we will not go into depressing details but just focus on one example, that of rural drinking water.

Drinking water in *Bharat* starts at the dug-well. Even so, its science and engineering are poorly understood. Design of suitable region and use-specific yield tests and their practice remain to be established. Simple design of piped water supply systems is error-prone and unreliable. Most schemes face repeated failure due to a variety of reasons--they are either too expensive to operate, or the community too fragmented or the source too weak, and so on, all of which should have been determined before the fact. The state machinery is too weak or ill-trained to deliver. Consider, e.g., the district of Thane, Maharashtra with a rural population of 23 lakhs across 900 gram panchayats and over 5000 habitations. The rural water supply department has 14 engineers and 28 diploma holders (and no other field professional and no applied social scientist) to serve this population, i.e., roughly 1 per 50,000. At that per-capita, the engineer must have superhuman technical and social skills and use the most modern tools and protocols. But in fact, the design and analysis protocols have not changed in the last 20 years. There is no simulation and no optimization. There is no algorithm for the location of stand-posts. There is no failure analysis and very few standards for reporting. In fact, there are dozens of professional colleges in Thane district, and many of them in rural areas, but none interact with the department in any meaningful way, simply because they have no knowledge to offer and the department has no way to receive it. There is no serious protocol of knowledge and practice transmission within the department itself and many senior engineers are demoralized.

To compound this is a state policy which is curiously beholden to World Bank thinking in its choice of solutions and institutional arrangements. In 2003, came the WB sponsored Jal Swarajya I, a market oriented 'demand driven' policy which relied on villages selecting social organizations and technical service providers from a panel of NGOs and private companies. This did not consider that an efficient market requires a large pool of competent companies, discerning villages officials with reasonable skills of formulating contracts, and a judicial process of enforcing them efficiently. Next, was an abandonment of surface-water based multi-village schemes as a possible solution to drinking water problems. This in itself runs contrary to the recent Govt. of India policy document, DDWS 2011, which sees the emergence of exactly such schemes. Finally, there is an attempt to launch Jal Swarajya II before the reviews of Jal Swarajya I are in.

The people suffer immensely. Many parts of Maharashtra cannot bathe or wash clothes for months together. Women walk several kilometers to fetch drinking water or fight with their neighbors when tankers arrive, never on schedule. Many migrate to towns or to hard temporary jobs such as brick-making, leaving behind their children and their old. All this creates a charged backdrop ripe for politicization of the simple function of drinking water provisioning. In fact, most government departments are poorly staffed and are caught in a downward spiral of diminishing expectations and

returns. There are hardly any academic institutions of standing who engage with these departments in their day-to-day research requirements.

The absence of practice has also led to a variety of phenomena, foremost among them, is the large space for NGOs (see, Shah 2008, for a discussion on this matter). They seek to bring this missing knowledge workers to development problems. However, the scale of the problem has led NGOs to speak of capacity building. It includes among other things, an attempt to create barefoot professionals (see Ambasta, Shankar and Shah 2008), who should actually have been trained in our colleges, or to build accounting or map-reading skills, which should have been taught in our schools, and so on. Poverty of trained professionals and of poor protocol design has led to a monitoring gap which is to be compensated by *community based organizations*. The language of capacity building, community participation etc., has now entered government lexicon and has led to an NGO-fication of many development functions. This is leading to a serious erosion in the morale and legitimacy of government departments and eventually of the government itself. This is also leading to a theory that good intentions and commitment are enough to bring about change. This is incorrect on both counts: good intentions are certainly no substitute for hard analysis of outcomes and a feedback loop. Also unreasonable, is to demand *commitment* (e.g., 'community participation') as a basis for designing systems as opposed to *community adherence* to a well-chosen set of rules implemented by professionals (also see the study WB 2012b which now seems to question its own preoccupation with participation). This aversion to professionals is all the more curious if we look at some of the massive asset creation programs, e.g., the National Rural Employment Guarantee Scheme (NREGS) and the Integrated Watershed Management Project (IWMP). Nowhere have these sought to influence engineering curricula or research, or science teaching in schools, instead relying on capacity building. Thus we have the ridiculous situation of the daughter struggling with *parallelogram ABCD* at school, while the father learns to draw contour lines on his lands.

Now, coming to *India*, the effect of this practice vacuum on *India* is also extensive. Foremost, is a complete inversion in the so-called engineering job market (see for example, the interview of of Mr. A. M. Naik, of Larsen and Toubro, Economist 2012a). This has led to a steep drop in the overall quality, efficiency and competitiveness of engineering. The small innovative engineering firm, the work-horse of the European economies, is absent in India. See the new World Development Report 2012 of the World Bank (WB 2012), especially Chapter 3, and Table 3.13 (page 112). It is the organized service sector which contributes much more to GDP growth and is much more responsive to education (or labeling), and far more attractive than manufacturing (see Ramaswamy and Agrawal 2012). This skew in the sectoral composition of growth and output is worrying many economists (see, e.g., Singh 2008). In fact, many social scientists fear a further delinking of growth and employment, see the recommendations of the WB-ICSSR (2010).

The cities of India are in a shambles. There are few who can plan a sewage system or persuade citizens of its utility, or who will design and optimize public transport. Large cities may have the money to employ foreign consultants, but smaller cities have no access to routine consultancy. The overall absence of practice has also changed how we govern ourselves. The absence of interfacial and interdisciplinary skills in our training has contributed to poor stake-holder rapport, poor planning and decision-making and a limited solution space. Our knowledge and policy space too is now dominated by multi-lateral agencies and consultancies (see for example, the influential report McKinsey 2010), whose interests may conflict with broader social interests.

4. Knowledge and Society

The wider implication is of course, a discourse of education which has lost its bearings. Without the guiding notions of practice and societal value, it is dominated by a notion of excellence which is administered by a small set of elite institutions. Much energy and treasure is spent in designing tests for identifying excellence, the process of labeling, and also by a vast multitude of hopefuls in preparing for these tests. For this small set of institutions, their definition of excellence has led to their own stultification and exploitation by *West*'s institutions and companies, by the successful students and a *rentier* faculty body (again, see Sohoni 2012a).

The excellence of science casts it as being the output of the urbanized and developed world which needs to be distributed evenly, i.e., of 'taking science to the rural areas'[16], (much like the polio vaccine). It has created a small upwardly mobile elite set, which relies on the productive, intellectual and remunerative practices of the *West*, rather than those of *India* or *Bharat*. This actually causes the broader *society-to-society* accountability loop of an educational system to unfold into a hierarchy of societies, and a *personal* (as opposed to social) outcome where 'excellent' members of a lower society migrate to the next society. Accountability *within* is substituted by an *upward accountability* called 'merit' which is a proof of excellence rather than of demonstrated practice or value creation. While it correlates with class, it also provides a 'fair' and 'meritorius' mobility. Every year, whole 'merit lists' of people effectively migrate to the next class and this does diffuse some of the class tensions (also see Kapur and Mehta, 2007). However, it is extremely bruising and wasteful, and as we have noted, especially devoid of value creation. At the higher end, it has made education into a negative-sum game where thousands compete on a narrow metric for limited positions with disproportionate personal rewards. It has also destroyed the contemplative and intellectual nature of an education which is societally answerable.

Moreover, it has modified the very definition of higher education as a process which helps in *conveyance* to a better society rather than on *in situ betterment*. Education is seen as the only train out of Jhunjhunu, and not as skills to make a better life within it. This makes every student a temporary resident in her own town, and one waiting for the right opportunity. It also causes a restlessness and impatience in the student with her own location and a highly distracting aspirational mobility. The first casualty is empiricism, the skill of gathering data to one's benefit, and the very basis of science. It is clearly difficult to see the village well as a scientific device and observe it, if one regards oneself as a temporary resident in the village. One would rather learn about the city and its ways. The second consequence is that this impatience limits the problems which are found worth solving, and the space of implementable solutions. Only the immediate problems, and for these, only short term interventions will find traction, as opposed to the deeper problems of sustainability, or the more studied, and possibly more efficient, long-term solutions for immediate problems.

More important, this sequence of graded societies terminates at the ultimate knowledge role-models for *India*, and these are the elite knowledge institutions of *West*, i.e., the MITs, the Harvards and the World Bank and elite consultancies. This crystallization of the knowledge hierarchy is recent and has led to the Indian version of the *knowledge society*. In this version, we have a collective recognition that (i) knowledge, like perfumes, is branded, i.e., has social value besides its use-value, (ii) only branded knowledge is true, i.e., only it has the ability to discern, and (iii) true knowledge can bring desirable

outcomes and change. It is the collective outcome of these three points that closes the practice loop for us, completely subsuming *India* within *Global* (see figure below). Thus, this ends with the truly knowledgeable international elite institutions advising our government, and thus our people, on many issues ranging from adolescent girls, drinking water to massive urban systems[17]. We illustrate this knowledge cycle as below.

5. Knowledge Capture

Several features deserve special attention. The first is the general regard, unalloyed with suspicion of any kind, that Indian people have for their elite educational institutions. This is in contrast to the situation in *West*, where excessive 'mertiocracy' has always been dubiously regarded[18]. The second feature is the joint 'advising' of the government of India by the international knowledge elite on the one side and the *idealists*, i.e., social science elite, a few elite NGOs, etc., on the other side. The usual home of the idealists is the Planning Commission from where they hope to engage with the development agenda. The final point to note is the long cycle by which our people influence their own governance in the matter of knowledge.

This long cycle has several important consequences. First of all, it makes the practice loop very very expensive. We see that simple advice, such as '*please ensure that your design has a separate drinking*

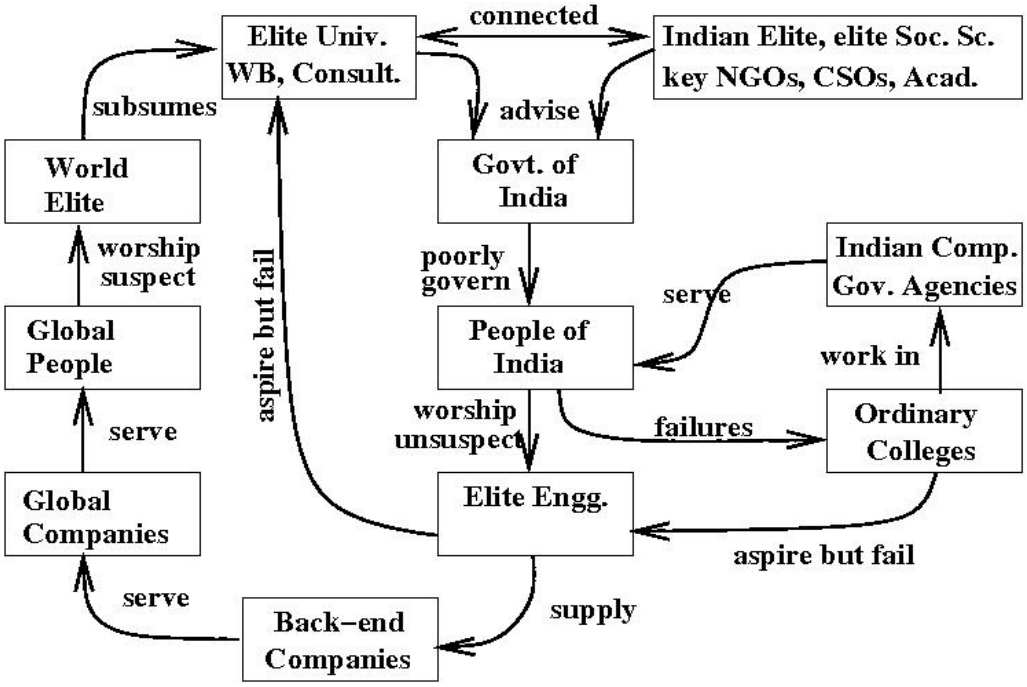

Fig. 2: The knowledge cycle

water source for each community', must come from an expensive and branded consultant for it to be believed by the Principal Secretary and put into practice by the Junior Engineers. We see further that monitoring of outcomes must also be done by the knowledge elite, for only they can discern truth[19].

This leads to a complete shut-out of local institutions, local intellectual leadership and entrepreneurship. Thus, this globalization of the practice loop leads to a complete breakdown in local empiricism, i.e., the local capacity to gather data and organize it to ones benefit.

This relegation of empiricism to a higher knowledge elite and the subsequent loss of scientific temper, we term as *knowledge capture*. This is of course, a political and anthropological issue, related to the nature of legitimation of knowledge and complicates the benign view of knowledge as a purely clarifying and liberating force. This relationship between knowledge and power has been commented on by many authors, e.g., Weiler (2010) and the authors cited therein. Economically speaking, such relegation is of course, irrational, and leads to very inefficient outcomes such as rent-seeking by the knowledge elite, poor suitability of solutions and so on. It is also concomitant with a devaluation and delegitimization of local knowledge structures.

Indeed, these rents are already visible in the disappearance of the Indian public intellectual. More and more of our newspapers, in their own search for excellence, now purvey foreign content or Indian content by foreign or NRI authors, and other *professional intellectuals*, i.e., intellectuals without stakes. This is almost total in the physical sciences, where the domination of *West* is complete. More worryingly, it is happening in the social sciences as well. Many NRI and foreign professors are now corresponding editors, regular contributors to our big newspapers, or hold positions of eminence within the government. Many of them have personally benefited from and will benefit from multilateral agencies which have a direct *financial and strategic* interest in influencing policy in India. The brand equity of the professional intellectuals is also crowding out the local intellectuals, especially *those with stakes*, and is also exacerbating an existing divergence between the vernacular or the experiential and the english-speaking or the analytic intellectual. The proliferation of research on South Asia by researchers and institutions from outside India has been observed by many authors, including Balakrishnan (2008) and especially Deshpande (2002), who wonder about the distinction between researchers on South Asia and researchers from South Asian institutions. But they miss that, ideally speaking, *practice*, proximity to the field and personal stake of the researchers, should give native institutions an insurmountable edge in quality.

The power of the international knowledge elite within India is a part of a global phenomenon of knowledge concentration, i.e., of a widespread belief that there are only a few institutions (or knowledge systems) in this world which can bring about change of any sort. Thus, in a sense, there is a *universal* science, or even worse, *universal* engineering, both commodities of great value, and held by the very few. In India, this belief is almost complete. Indian corporate houses make donations to the international knowledge elite for work in India, e.g., the Tata-MIT center for frugal engineering. The children of many of our ministers, bureaucrats, professors, the rich, the professional, etc., all study in these elite institutions[20]. Those who return, form networks and alliances which make this belief self-fulfilling.

The behaviour of the global elite institutions is not very heartening, for they see concentration as a strategic advantage and not as the iceberg in the path of Science, which will destroy its internal machinery, and ultimately sink it. The World Bank (and the consultancies) studiously avoids bringing about collaborations between regional premier institutions and regional governance. In fact, it supports a globalization of engineering through projects such as the partially government-funded TEQIP (TEQIP 2012). Sadly, the Harvards and the MITs (which are not banks) also seem to propagate this

knowledge concentration. This is seen by several initiatives, perhaps well-meaning, which make effective use of their brand-name. Foremost among them: (i) pushing their own practices, research and open or specialized course-ware which substitute for local material (ii) gaining access to national and state-level administrators and representatives, without regional collaborations. Such initiatives adversely impact the production of local knowledge and its legitimacy and discourages collaborations between regional players to discover solutions to local problems. In the long run, it is also inimical to Science itself, for it confuses branding with knowledge production and complicates a sense of fraternity and membership which are so essential for its vitality.

A case to illustrate the point is the recently established *Indian Institute for Human Settlements* (IIHS, www.iihs.co.in), a Section 25 company to train future urban planners. It is partnered by MIT and a host of other international entities and boasts of (academic) advisors of the highest international repute and an illustrious board of some of the most influential corporate citizens of India. Not surprisingly, even though it has to graduate its first student, it is the only educational institution mentioned by *The Economist* in a recent article on Indian urbanization (Economist 2012b).

6. The way out and who is to do it

Development is a very complex process mediated by many forces such as the political economy, governance and so on, besides just knowledge structures, and it would be naive to assume that fixing one of them, will be adequate to bring about change. Moreover, current macroeconomic incentive structures, the global phenomenon of knowledge concentration etc., are all very serious headwinds to the process. All the same, knowledge has proved an important ingredient in transforming both governance and the political economy.

Clearly, the focus should be on a re-design of our processes of accumulation and transmission of knowledge and practice to *enable its generation and consumption at the lowest, broadest and most inclusive levels*. There are many possibilities for this, each with its pros and cons. We choose what is most convenient for us, situated as we are in an 'institute of excellence' and perhaps what is most direct, viz., the provision of development services such as *sadak, bijli, paani*.

The first question is to solve the problem of *agency*, i.e., who will lead in the transformation. Here, the situation is dire and is best understood, as in Stiglitz (1975), by the sorting and labeling role of an educational system (as is most evident for the IITs, IISERs, IIMs, St. Stephens and so on). The classification of students as *less* or *more* able, benefits employers for achieving better productivity. However, it translates into a redistribution of wages of individuals, with the more able receiving better wages, generally at the cost of the less able. Whence, rationally speaking, employers and the more able should pay for such sorting and labeling. The rationale for public spending on such functions of educational institutions is justified only if (i) the overall productivity benefits of sorting exceed the unsorted case, and (ii) these excess benefits are distributed so that everyone is better off. For if not, the less able should vote against such expenditure. Sadly, both these aspects are largely absent in the Indian mobility-based educational system. Even more, the conflation of *merit* with the current bases of sorting, and its reward, distracts attention from what is essentially a transfer of productive assets of one society to the service of the next. It is only when the population of *India* and *Bharat* comprehend this absence of social outcome with education that the agency problem will be satisfactorily solved. One approach would be to enable this line of thought by examining *merit* closely, thereby leading to a more

public understanding of its mechanics. This was partly done in Sohoni 2012a. The second is the more constructive approach of solving the *capacity* problem in development. This we do by redirecting the 'failed' to gainful employment within their own society, and a partnership in their own development. It is this that we explore here.

The first step is to formulate an elective *development curriculum* for all degree students in the social and physical sciences. This should explain to students the basic aspects and discourse of governance and regional development and develop the required quantitative and interfacial skills. It should also include an operational familiarity with at least one development sector such as water, electricity, agriculture, health, public transport and so on. The development curriculum should train students to work with stakeholders such as elected representatives, administrators, NGOs, civil society, companies and so on. This training should enable students to conceive of themselves as viable action-agents and not merely as future employees (again, see Sohoni 2012b). Next, is the construction of a pedagogical device and a knowledge commodity called the *development protocol*, i.e., a tested good practice which generates societal value, e.g., the design and implementation of watershed programs, village electricity plans, monitoring and evaluation of water supply schemes, local bus time-tables and so on. These protocols should address typical developmental problems faced by districts, *talukas* and towns. The protocols should be woven into this curriculum as a sectoral field and design experience. The development curriculum and the field protocols should put students in direct contact with different stake-holders and thereby to understand practice and its value.

The second step is to solve the 'realization' problem, i.e, of translating the created social value into financial value and gainful employment. In principle, this should be easy since most public systems are in such a decrepit and inefficient state that an increase in efficiency will easily pay for itself and the knowledge bearer who brought it. However, it will require creating professional avenues for students, fresh graduates, universities, entrepreneurs and small businesses to take up opportunities in development programs while *ensuring outcomes*.

Both the training and the realization problem need some re-design in the conduct of our developmental processes. Firstly, it requires identifying (perhaps from existing multi-disciplinary institutions) *Development Research Institutes* (DRIs) who should be tasked with developing and implementing the above curriculum by designing courses and teacher training programs. It should also generate impeccable case-studies and provide a platform for research and discourse. The DRI should bring in new tools and new methods from the physical and social sciences and from engineering to bear on common development problems and yet ensure that the practices developed remain accessible to the common student. It should also engage with NGOs, civil society and mediate with regional governance and other stake-holders. It should illustrate how regional institutes of higher education can be an important resource for development processes and outcomes. Besides meeting this instrumental needs of society and state, it should also strive to bring in a new methodology of research. This methodology should be a synthesis of the critical skills of the social sciences and the analytics of the physical sciences and strive to expand the canvas of realizability. Such research should yield an exciting series of *Theory and Practice* courses, for example, for Rural Public Transport or Employment Guarantee.

Much of the above recommendations are being pursued by CTARA, and it is hard work. See our (pending) proposal (CTARA 2012), for *development professionals* made to the Ministry of Rural

Development (MoRD) where we explicate some of the above recommendations, and also the role of the DRIs. See the M.Tech in Technology and Development curriculum at www.ctara.iitb.ac.in and the design and outputs of the UG Supervised Learning program at www.ctara.iitb.ac.in/tdsl. Also see the design of the Consultancy Cell, www.cse.iitb.ac.in/~sohoni/tdcc to create a market for development professionals by incubating consultants who will work in the sector.

Finally, coming to the 'realization' problem, there must also be a systematic effort by the MoRD, the Ministry of Urban Development, other ministries and State governments to create opportunities for professionals to work and demonstrate value, and also educational institutes to participate. Such opportunities are numerous, e.g., at the state-level program offices of national programs, district level coordination, monitoring and evaluation positions, occasional research positions such as on drought and its management, and so on. Formal avenues exist for this collaboration, e.g., the statutory District Planning Committees, or the District Innovation Fund, but these should be broadened and made more transparent. Ministry of Human Resource Development (MHRD), the Department of Science and Technology (DST) and state level agencies should ensure that such applicable research is funded and eventually makes its way into engineering and applied social science curricula. Finally, the Ministry of Finance should drop its preoccupation with just macro-economic variables and do what Solow did, viz., endogenize into its macroeconomics the external variable called *technology* or in modern parlance, *knowledge*.

Endnotes

1. An earlier version of the paper was presented at the seminar "Concepts, Theories and Practices: The Changing Relationship between Science, State and Policy" on 26th-27th November, 2012, at the Indian Institute of Advanced Studies, Shimla.
2. See, for example, Arundhati Roy in Financial Times, 12th January, 2012. Or see *For Richer, For Poorer*, in Economist, 13th October, 2012, where we see 48 individuals acounting for 11% of India's GDP. This fraction varies as the stock market moves.
3. See the video (Sohoni 2012b), for an expansion on this process.
4. This is based on several statistics on employment, amenities and education and includes the Employment and Unemployment Statistics (2009-10) of the Labour Bureau and the 66th round of the NSSO (2009-2010). We see here that about 73% of the households are rural. Also about 20.8% of males (rural+urban, age 7 or above) are educated at the higher secondary levels or above. The female fraction is lower at 12.8%. Per 1000 working people about 89 work in manufacturing while 455 (i.e., more than 5 times) are connected with agriculture. Of the employed people of India, the "trade, hotel and restaurant" sector employs more (27%) than both the "manufacturing" or the "other services" sectors in urban India. Only 17% are regular/wage employed. About 83% of rural households and 25% of urban households used wood, dung, coal or chips as cooking fuel. Another measure is the sources of income and its distribution. We refer to Vanneman and Dubey (2013) for data of 2009-10. For the top quintile, wages constituted a mere 4% of their average income and salaries contributed 46%. For the next quintile, these numbers are 25% and 30% respectively. Thus, we see a steep drop in income security from the first quintile to the next. The first decile about 45% of the total income.
5. The 2009 State of India's Environment Report by the Ministry of Environment and Forests outlines the stresses on India's physical resources and its degradation and pollution. For example, the growing stock per hectare of forest area is roughly 58 cu.m. for India, which is

roughly 60% of south Asia's average, reflecting poor densities and poor sustainability of our forests. The expropriation of these resources for India happens in many ways. Allocation of land for mining, cash crops, water for industry are a few examples. Again, water for cities, such as Mumbai, comes from Shahpur *taluka*, deep within *Bharat*'s domains, while the *taluka* itself suffers from a huge drinking water problem.

6. Core industry has largely failed in knowledge production for *India* or *Bharat*. We take four examples. IT remains largely focused on revenues from outside India. For example, in 2011, only 3% of Infosys' revenue came from India. In the pharmaceutical sector, for Ranbaxy in 2011, only 20% of its revenue came from the (highly regulated) Indian market. According to Ranbaxy, it was only in 2011 that India developed its first (modern) drug molecule, and this was by Ranbaxy and it was for Malaria. India's demand for telecom. equipment for 2010 was about Rs. 60,000 crores and about 90% of this was imported or of imported components. In 2010, Jindal Steel and Power spent Rs. 12.25 crores on R&D (of which Rs. 6.45 crores were capital expenditure). This was out of a turnover of Rs. 13,000 crores. In the same period, it spent Rs. 2.8 crores on purchasing software licenses and Rs. 19 crores on vehicles.
7. There are exceptions, see, e.g., the database of innovations documented by the Honeybee Network (www.sristi.org). By this author's experience, the scale and extent of such innovations remains small.
8. There are many examples of WB recommending West's practices. Again, if we look at urban water, the reforms recommended by the WB and its partial adoption by Maharashtra (see Sohoni 2012c) indicate a trajectory of privatization of water supply functions. In the report (WB 2011) on jobs in south Asia, its recommendations follow much of West's macroeconomic framework for analyzing employment.
9. The Regional Engg. Colleges (RECs) were set up as a partnership between the Centre and the State governments as a part of the 1st and 2nd Five-year plans. Their mandate, as seen in the plan documents, was to address regional needs for developmental projects and of industry. The IITs came out of the Sarkar Committee report and subsequent reports, as institutes of national importance. According to Nehru, IIT Kharagpur, the first IIT "represented India's urges, India's future in the making".
10. S. P. Sukhatme, past director of IIT Bombay, in his book, *The Real Brain Drain*, estimates this number to be 30% for a period in the 1970s. For the fraction of graduates in the top 25%, and for Electrical Engg. graduates, this faction was 42% and 60% respectively. Also see a related article by the author in Economic and Political Weekly (vol. 23, No. 25, 1988). A study from IIT Madras also estimates it to be 26% for a larger period.
11. The GATE exam, administered by the IITs, measure the engineering aptitude of engineering graduates. The number of students who "qualify" , i.e., are eligible for MHRD support, in the GATE examination has been roughly constant at 20%. See http://www.iitsystem.ac.in/academics/GATE-Report-2011.pdf
12. See pg. 8 of the 2011-12 placement report of IIT Bombay (http://placements.iitb.ac.in/files/IITB_Placement_Report_2011-12.pdf). Roughly 42% of the jobs went to IT, consulting and finance. This number does not include off-shore engineering jobs (Samsung, Sony and so on) or management jobs. For another example, see the 2012 engineering placements for the Government Engineering College, Thrissur at http://placement.gectcr.ac.in/. 320 students out of a batch of 418 joined IT.
13. The PMRDF program for 2012 is available at www.cse.iitb.ac.in/~sohoni/PMRDFtraining2012.xlsx

14. See for example, Ambasta, Shankar and Shah (2008), in their review of NREGA, moan the lack of technical capacity. While at the block level, they recommend civil engineers, at the district level, their recommendations are "existing officials, NGOs experts or independent experts who volunteer" for the district level Technical Resource Support Group. They also say that the District Program Coordinator (DPC) must be a "professional", but fail to mention his/her training. In Maharashtra, the Collector is the typical DPC. For another example, see the chapter on Water in vol. I of the cabinet approved draft of the 12th plan. We see on page 156, in Box 5.2 titled 'Participatory Groundwater Management in India' the predominance of barefoot professionals and NGOs as providing 'trail-blazing' solutions to problems of groundwater management.
15. Policy as defined by www.wikipedia.org, the online encyclopedia.
16. See C.N.R. Rao on 31st July, 2012, in http://www.highbeam.com/doc/1G1-298127308.html
17. The WB supports the Integrated Child Development Services (ICDS) program wherein adolescent girls are an important target group. It also supports the Mumbai Metropolitan Regional Development Authority (MMRDA).
18. See for example, the article *Meritocracy in America*, in The Economist, December 29th 2004, which points to some of the scrutiny this subject has faced. The Occupy Wall Street and the 99% movements also led to an intensive debate on the role of economics in perpetuating inequality. Also see Krugman, *America's Unlevel Field*, in New York Times, Jan. 8, 2012.
19. See for example, the highly influential WB report of 2008, on evaluating existing rural water supply regimes and their performance. Its recommedations on multi-village schemes are visible in the Govt. of Maharashtra policies. See Sohoni (2012c). On the other hand, no such study has been commissioned by the Govt. of Maharashtra in the last 10 years.
20. See Kapur and Mehta (2007) on the political economy of higher education, and also on estimates of over (USD) $3billion in 2005, spent on tuitions by students going abroad. The University Grant Commission budget for 2012-13 is roughly (in USD) $2.2 billion.

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