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Research article

Perspectives on Modernization: Nation-State, Engineering, and the Chinese Project

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Abstract
The term "modernization" carries two distinct meanings that are often conflated: an analytical concept in Western social sciences describing the historical emergence of modernity, and a political project of national development in non-Western countries. This paper connects these meanings through a single overarching theme: the role of engineering and engineers in modernization processes. The first section sketches a sociological debate on modernity, technology, and nationalism. It traces the evolution from the universalist theories of modernization and their critique to contemporary concepts of multiple and reflexive modernities. The second section examines historical studies of engineers as both subjects and objects of national modernization policies, with a focus on their role in sociomaterial transformations, underlying state-building and expansionism. Drawing on comparative historiography, it analyzes patterns across the first-wave to the "catching-up" modernization scenarios. The third section takes China as exemplifying a distinctive catching-up approach and postulates a philosophical interpretation of modernization as social engineering, arguing for the need to overcome a narrow, Eurocentric understanding of engineering itself. This framework synthesizes Western critical theory with Chinese philosophy of engineering to envision a hypothetical emancipatory path for twenty-first century modernization. This hypothetical imaginary constructs a perspective on modernization as a creative, reflexive, and participatory process of constructing the social world, where humans remain the subjects rather than objects of progress.

Keywords: Philosophy of engineering; Theory of modernization; Critical theory; National modernization; Social engineering; Globalization.

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Научная статья

Перспективы модернизации: национальное государство, инженерная деятельность и китайский проект

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Аннотация
Термин “модернизация” используется в двух, зачастую смешиваемых, значениях: как аналитическая категория западной социальной науки, описывающая историческое возникновение обществ модерна (современности), и как политический проект национального развития в незападных странах. В данной работе эти значения связаны сквозной темой: роли инженерии и инженеров в процессах модернизации. В первом разделе очерчивается социологический дискурс о связи модерна (современности), технологий и национализма. В нем прослеживается эволюция от универсалистских теорий модернизации и их критики к современным концепциям множественной и рефлексивной модернизации. Второй раздел посвящен историческим исследованиям инженеров как субъектов и объектов национальной модернизационной политики, с акцентом на их роли в социоматериальных трансформациях, лежащих в основе государственного строительства и экспансии. В нем сравниваются сценарии “первого эшелона” и “догоняющей” модернизации. Третий раздел рассматривает Китай как пример особого подхода к догоняющему развитию и предлагает философскую интерпретацию модернизации как социальной инженерии, аргументируя необходимость преодоления узкого, евроцентричного понимания самой инженерии. Китайская философия инженерии (“гунчэн”) синтезирует западную критическую теорию с китайской философией техники, сохраняя гипотезу о возможности эмансипационного пути модернизации в XXI веке. Это взгляд на модернизацию как на творческий, рефлексивный и партисипаторный процесс конструирования социального мира, в котором человек остается субъектом, а не объектом прогресса.

Ключевые слова: Философия инженерной деятельности; Теория модернизации; Критическая теория; Национальная модернизация; Социальная инженерия; Глобализация

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INTRODUCTION

The visions and politics of globalism that were dominating after the end of the Cold War have been challenged in recent decades with the formation of new blocs and the rise of the Global South. The discourse on technological sovereignty, nationalism and militarization has emerged against the ongoing globalization of markets and media, cultural and technological deterritorialisation and massive migration. Citizenship regimes are contested by supra- and sub-national identities, networks and lifestyles, and states compete with transnational and non-state actors in efforts to control the flows of peoples, technologies, ideas, information, capital, resources, and waste. While possessing the greatest technological means, nation-states are facing their most significant constraints since the emergence of this institution.

The problems states face in the social organization and the distribution of agency are both theoretical and practical. The future of governments largely depends on their capacity for anticipating and designing social processes without evoking backlashes and their abilities to keep up with "reflexivity" of modernity (Beck et al., 1994). Insofar as modernization is considered an ongoing process, it is inextricably linked to engineering: both historically (the revolutionizing of productive forces) and metaphorically (social experimentation and rationalization). Our ambition here is not so much to create a wholly new theory of modernization as simply to reconstruct developmentalist discourse around one theme: engineering as a modernization project, and engineers as agents of modernization. The first section of our argument sketches the sociological debate on the relationship between modernization, technology and nationalism. The second considers historical studies of engineers as subjects and objects of national modernization policies. Finally, turning to the contemporary Chinese context and drawing on Li Bocong's philosophy of engineering, section three criticizes Western critical social theory and hypothesizes a Marxist-humanist imaginary of modernization as social engineering with the potential to overcome contradictions.

MODERNITY, TECHNOLOGY, AND NATION

The idea of social development was – and largely remains – the basic assumption of modernity, one of the core categories of social sciences and political ideologies, a cognitive scheme and a self-fulfilling prophecy. The perception of development as both explanation for social reality and a possibility for its construction is associated with the secular understanding of society and history, as well as with capitalism's expansive and innovative orientation, complemented with the elements of religious or utopian visions of transcendence and liberation. In modern social and political thought, whether evolutionary or revolutionary, development is both the goal and simultaneously the means of achieving this goal. The definitions of social development, then, are based on explicit or implicit assumptions of what are the possible and desirable social changes, and re-interpreted from the different historical standpoints. Conceptualizing modernization in terms of social developments occurring during the past five centuries at various pace and in diverse forms globally requires reflection on the descriptive and normative elements of our socio-political thinking.

The notion of modernization is defined differently in the disciplinary contexts of history and sociology and performs a special function in political projects and policies that appeal to national imagination or memory. In historical studies, the concept of modernization served primarily for periodization and played a more descriptive role, narrating the cause-effect explanations and documenting the empirical diversity of national paths, including the non-Western "catching-up" efforts in Russia, Japan, Turkey, et al. Sociology, emerging itself as a form of self-reflection of modern societies, was for a long time aimed at developing models or "ideal types" of modernization. Even before the term was introduced, the classical social theorists of the "long nineteenth century" – August Comte, Karl Marx, Herbert Spencer, Emile Durkheim, Max Weber, and Ferdinand Toennis – attempted to explain what was happening in the West, and tended to see it as a general theory of social development.

The most influential theories of modernization of the twentieth century by Talcott Parsons (1951) and Walt Rostow (1960) were articulated in the context of decolonization and formation of new nation-states outside a Euro-American center, where they were then tested in the political practice of national elites – depending, imitating, or opposing themselves to "the West" (Varouxakis, 2025) – in competition with Marxist progressivism and Soviet influence (Gilman, 2003). At the same time, universalist modernization theories were challenged by the historical comparisons (Bendix, 1964; Moore, 1966) and the critiques of Eurocentrism and methodological nationalism (Prebisch, 1950; Frank, 1966). In the late XX century, socio-historical scholars developed nuanced concepts of "multiple modernities" (Eisenstadt, 2002), and placed nation-states within a wider context of the modern world system (Wallerstein, 2004). Focusing on the present, the concepts of "late," "radical," "reflexive," "unfinished," or "liquid" modernity were developed (Habermas, 1981; Giddens, 1990; Beck, 1992; Appadurai, 1996; Bauman, 2000), where modernization was interpreted as an ongoing process, or, rather, as various uneven trends occurring at different levels, rather than the teleological approximation of an "end of history."

Whereas historically in the West national developmentalist policies took shape in conjunction with specific ideologies such as liberalism, socialism, nationalism, imperialism, conservatism, fascism, in non-Western state-led, top-down reform programs"modernization" has become an explicit objective and official term. Modernization has itself become an ideology. But as both theoretical category and political term, the concept of modernization becomes subject to internal oppositions between the "traditional" and "modern" stages, between "the West" and "the Rest", and between the nation-state and its "environment". The later is seen as presenting potential serious threats but also most importantly as a stimulus for the innovation or adoption of new technologies and institutional models. In a historical perspective, this aspect is challenging for both "methodological nationalism" and its critique (Chernillo, 2011).

The first wave of modernization developed a variety of technological and institutional innovations in the context of wars among the Western nations. From the formation of parliaments and scientific academies to industrialization of war, technologies and institutions were invented and "travelled" first within Europe itself and then to colonized countries, fueled by the imperialist competition and national liberation

movements. However, institutional and especially technological transfer received more focused attention in the histories of non-Western modernizations, which emphasize "skipping," "compression," great leaps across stages. Since science and technology are perceived as "universal" and potentially importable, the projects of mobilized modernization that aimed for sovereignty and welfare (with or without cultural Westernization) largely relied on borrowing and subsequent development of a scientific and technological base. The role of governments in the formation of professional engineering is a bright example of nationalist developmentalist policies, allowing for comparisons between the scenarios of modernization.

ENGINEERS IN MODERNIZATION

Within this context of learning, competition, adaptation and localization of science and technology between nations, the formation of the engineering profession implied more than just production or transfer of knowledge. For a long time, engineering embodied techno-progressivist ideals aligned with "national interests" interpreted in terms of economic growth and military dominance. Engineers have been both agents and products of modernization. As a social group, however, engineers were almost unnoticed by classical sociology, despite its interest in industrialization and rationalization – their role overshadowed by the impersonal forces of capitalism, as if science and technology could be directly translated into economic wealth (Kazakova & Gavrilina, 2021). Until the massification of engineering profession and the rise of technocracies in the XX century, the agency of engineers was secondary or associated with scientific and political elites, bureaucracy, and entrepreneurs.

In retrospect, the co-development of engineering and modernization in Europe has been highlighted in historical studies. These have revealed diverse patterns in the formation of engineering science, education and professionalism with regard to the social structural, political, cultural and economic contexts in the Western societies (Meiksins & Smith, 1996; Channell, 2019). The social standing and lifestyles of engineers varied in different industrialization scenarios – statist or capital-driven, national or colonial resources and markets – but the centrality of engineering for industrialization is indubitable.

In the early modern period, engineering was differentiated from architecture and primarily associated with fortifications and military vehicles (Ferguson, 1992) and participated directly in the territorial expansion of early nation-states and the centralization of power and control. Construction of "bridges and roads" (the name of one of the first technical universities in Europe, located in France) ensured connectedness of the territories, the coordination of periphery with the centre, overcoming provincial fragmentation and local identities, and operation of national bureaucracies, armies and markets: literally and metaphorically, nation-building. Engineering of infrastructures and mobilities was the "backbone" of modernization, the socio-material embodiment of the distanciation of social action in time and space (Giddens, 1990), and what Michel Foucault (1991) called the "governmentality" of societies. Similarly, the growing

technologization of maritime fleets – from wood and sails to steel and steam – enhanced and manifested imperialist expansion (Rodger & Buchet, 2017; Marsden & Smith, 2005).

The XVII and XVIII centuries were pivotal for engineering in Europe for linking the rise of professional engineering with Enlightenment, nationalism, and warfare (Verin & Gouzevitch, 2011; Alder, 1997). Professionalization and growing disciplinary specialization of military and civil engineering was a prerequisite for further industrialization. Engineers as a social group personified the "modernizing" transition from ascribed to achieved status, replacing aristocratic privileges with meritocratic prestige through a scientifically-laden education and state service. Engineering for army and government materialized the ideas of knowledge as power: rationality, quantification and control. "Enlightened absolutism" in Europe was strongly promoting engineers through state-organized schools and large-scale infrastructural projects (Gouzevitch, 2011), while politically fragmented states lacked such capacity (De Lorenzo, 2011).

In the European periphery, the mobility of engineers in both directions – recruiting engineers from abroad or sending them for training to the foreign industrial centers – was promoted by governments, aligning national priorities with individual careerism (Cardoso de Matos & Diogo, 2007). Engineers played the role of "linking agents" in the transfer of technology (Anduaga, 2011), not only enacting the formal, decontextualized knowledge of natural and engineering sciences, but localizing "best practices" to specific needs and resources. In the context of Russian statehood, the import of technologies was a systematic policy: from inviting Italian architects in the early Russian Tsardom to the large-scale recruitment of Dutch, German and British engineers by the Russian Empire, training travels, and developing its own technical educational system based on the French and Prussian models (Rieber, 1990; Gouzevitch & Gouzevitch, 2003). For the continental empire of Russia, connecting and integrating remote territories through roads and railways was a centuries-long quest, a condition for further industrialization, and an embodiment of state power (Schenk, 2014). Peter the Great initiated the construction of a maritime fleet as a deliberate catching-up effort in competition with European empires; Russia's loss to Japan in the "opening battle" of the XX century, which was largely determined by Japanese success in the adoption of technology and expertise from Britain, was an immense blow to state authority.

The United States of America in the XIX century, initially relying on both French and British traditions, developed its own practically-oriented engineering education, driven by the market demand and local resources (Kranakis, 1989; Mitcham, 2019). Entrepreneurship played the greatest role in American industrialization even with respect to infrastructures and transportation systems in ways that had no analogies in the "old world" and formed the basis for a distinctive professional culture. Industrialists such as William Sellers who, in alliance with a civil society institution (the Franklin Institute) and private railroad enterprises, stabilized the whole national standardization system, personified this national engineering style (Sinclair, 1969).

The "latecomers" to industrialization enjoyed not only opportunities to skip stages of development but also higher selectivity in available technologies and institutional models. The Ottoman Empire, Japan and China attracted foreign engineers in the XIX-early XX centuries to strengthen national technological sovereignties (Fukasaku, 1992;

Martykanova & Kocaman, 2018; Wu, 2024). In contrast, in colonized countries such as India, metropolitan engineers played the role of maintaining the monopoly of colonial administration on control over economic process, and organization of dissemination of knowledge was to that extent limited (McLeod & Kumar, 1995; Weiler, 1996).

The XX century altered the social position of the engineering profession. With the industrialization of war and formation of the mass societies and regimes, the production of engineering cadres became subject to its own massification, with growing disciplinary specialization and the standardization of education. With the spread of Taylorism and Fordism, the functions of design, planning, management and control over production to a large extent were all delegated to engineers, promoting an ideology and self-identity of technocracy as conceptualized by Thorstein Veblen (1921/2001). In capitalist countries, engineering became a white-collar, middle-class, predominantly male profession. Socialist engineers as a part of "scientific-technological intelligentsia" maintained a culture of state service and were mobilized for large-scale governmental projects. After the influx of Western technologies and organizational practices in the 1920s, and the mobilized industrialization for the World War II, the Soviet Union itself became an exporter of engineering cadres and education: first to China during the 1950s (Zhang et al., 2006), and then to newly independent nations of Asia, Africa and Latin America (Coenen & Kazakova, in press).

During the second half of the century, engineers from the Eastern and Western blocks, personifying the rivalry between a (US-dominated) modernization doctrine and Soviet Marxism, competed for the "hearts and minds" of the Global South (Engerman et al., 2003). Soviet engineers performed their social and geopolitical mission and their "internationalist duty" in large-scale infrastructural projects for developing countries. The spread of Soviet "soft" and "hard" power to the South coincided with the development of Marxist theory of Scientific-Technological Revolution in the 1960-1970s, where engineers were destined to play the role in the acceleration of the productive forces and reducing the wealth gap between industrialized and industrializing countries.

In general, during the Cold War, the global circulation of engineering knowledge was reoriented from the import of Western expertise towards the establishment of national systems of higher technical education based on the growth and internationalization of engineering sciences combined with localization of engineering practices. The adaptation of technologies to the needs and conditions of non-Western countries stimulated "waves" of technological and organizational borrowings and modifications, e.g. from Europe and United States to Soviet Union and from the Soviet Union to China. Engineers became the practitioners and representatives of developmentalist policies and the agents of "technopolitics" (Hecht & Edwards, 2007). The engineering profession became adjunct worldwide to national projects.

CHINESE MODERNIZATION AS AN ENGINEERING PROJECT

Contemporary non-Western modernization is characterized not only by the potential technological leaps and opportunities to alter established institutional models, but also by a temporal compression of socio-technical challenges, as the processes of

industrialization and urbanization occur simultaneously with digitalization, and a demographic transition coincides with the expansion of mass consumerism. Modernization shifts from strictly economic aspects of growth toward social organization and developmental constraints are insufficient for meeting the welfare protection and environmental obligations and concerns of contemporary developing states. Reformist meliorism or "piecemeal engineering" as argued for by Karl Popper (1957) and other liberal critics of the revolutionary or statist projects in the XIX and XX centuries, are often inadequate in the face of contemporary social complexity and risks.

In Western discourse the concepts of "social engineering" and "social technologies" carry negative – manipulative, totalitarian or dystopian – connotations. Reflexive modernization, however, inherently implies a more or less scientifically-grounded form of social design in a broad sense – from pedagogical standards to urban planning, and from biopolitics to environmental programs. As long as nation-states remain the major form of social organization in the world, urgent socio-technical and environmental challenges require some level of efficient responses that build on their agency.

Drawing on Li Bocong's philosophy of engineering (2021), we want to explore how it might be developed into social and political philosophy. For this, the notion of engineering itself should be redefined. According to its Latin etymology, engineering in the Western languages is associated with individual ideas ("ingenuity"), which leads to further oppositions between the subject and objects of knowledge-power, human and nature, intellectual and physical labour, innovation and maintenance. The Chinese term "gongcheng" 工程has a different etymology associating it with project or construction work. This allows Li Bocong to focus not only on the aspect of design, which is central to Western philosophy of engineering, but to also include the stages of organization, planning, implementation, using and living with artifacts and systems, shifting the perspective towards coordination of collective actions by engineers, management, workers, users, and more. Compared to this extended concept of engineering, modernization can also be seen as a process which combines planning and calculation with social creativity and experimentation, and requires coordination between various actors without suppression of their interests. This understanding is not contradictory to the ideals of "unfinished" or "reflexive" modernity as an open and non-determinist process; it allows maintaining activist and moderately optimistic visions in the face of the multiple crises humanity has brought on itself.

Chinese philosophy of engineering emerged within a Marxist tradition. China was the first nation to synthesize the concept of modernization with Marxism, developing its strategy of "socialist modernization" at both theoretical and political levels. Although the founders of Marxism did not use the term "modernization," they famously captured the disruptive dynamism of the bourgeois and the industrial revolutions in *The Communist Manifesto*: "All that is solid melts into air, all that is holy is profaned, and man is at last compelled to face with sober senses his real conditions of life, and his relations with his kind" (Marx & Engels, 1848/2002, p. 26). Modernization radically breaks down old structures and compels people to actively remake their world, becoming itself a more planned and intentional, human-driven process: an engineering project. From this perspective the object of modernization research becomes the triad of nature, technology

and social organization: a relationship which is itself engineered and dynamic. Human beings transform nature with tools; new tools alter social arrangements; social conflicts and adaptations then reshape how tools are used and nature is exploited. The conflict between the development of productive forces and existing social relations drives social change, and engineering the resolutions for this conflict is a part of modernization.

Through the lens of Marxist philosophy, modernization can be interpreted as engineering with two aspects: (1) the material-technological dimension, in which humans transform nature and produce new wealth; (2) the social-system dimension, in which they consciously design and reform social institutions and relations. In the context of contemporary non-Western modernization, material-technological engineering had to develop, often in parallel, both industrial infrastructure (roads, dams, electrification, production) and digital infrastructure (telecom networks, data centers, satellites), often coordinated by the state or public-private partnerships, and radically transforming the social world within a lifetime of one generation. Likewise, at the level of social-system engineering, non-Western nations not only implemented new institutional governance structures, laws, educational systems, healthcare and welfare programs, but had to tailor them to their demographic and geographic conditions, such as rapid urbanization and, in the post-colonial context, contingently defined national borders.

Before the introduction of the welfare and environmental policies, the first wave of technological modernization in the West was driven primarily by competition and profit. It created, as Marx put it, “wonders” on one side and “misery” on the other. Its machinery embodied what critical social theorists later called “instrumental rationality” towards both nature and the organization of labour: exploitation and domination. Advanced industrialization adopted labour rights and consumerism, yet at the price of new forms of alienation and control in the growing comfort of mass society, which Herbert Marcuse described as “the rational character of its irrationality” (1964, p. 16). The Frankfurt school revealed the dialectical tension of material-technological modernization, which enables human empowerment over nature, while disempowering a human behind the facade of progress.

A later critique of material-technological modernization focused on the production of unforeseen consequences and global risks. Ulrich Beck argued that the distribution of risks in late industrial societies is intersecting with, but cannot be reduced to class inequality within nations. These manufactured risks are not external threats but self-inflicted consequences of modernization’s success: environmental and labour crises, nuclear threat, dislocation of population, etc. The risk society thesis supplements the neo-Marxist critique of instrumental reason with an ecological and safety imperative: that only reflexive modernization, revising and correcting its own techno-material development at both national and global levels, can be sustainable.

In the XX century, both capitalist and socialist states pursued ambitious projects of social engineering to modernize their nations, from the bureaucratic welfare-state planning to the centralized economic plans and mass campaigns of communist revolutions. The underlying idea of what James Scott (1998) termed “high modernist” faith is that society can be designed and managed with the same rational efficiency that engineers apply to machines: traditional social bonds and arrangements are to be replaced

by scientifically informed policies, laws, and organizational forms to create a more advanced society. The powerful unity of market and state, science and technology resulted in what Jürgen Habermas famously described as the colonization of the lifeworld by system imperatives. Although social engineering of modernity is eroding the social bases of freedom and solidarity, Habermas put his hopes in modernity as an "unfinished project," arguing for reviving communicative reason and public discourse about values and goals. He and the other theorists of the "second," "late," "radical," "fluid," and "reflexive" modernity, acknowledging its consequences, are striving to reform it from within, without rejecting modern ideals of reason and progress. With regard to both material and social engineering, the precautionary principle and ethics of responsibility are seen as continuation of the modern program.

Many of these Western critiques ultimately point back to the core issue Marx identified: the contradiction between ever-expanding productive power and the social relations that constrain and distort its use, where decisions are driven by short-term gains and externalized effects. As Marx suggested, resolving the modernity paradoxes would require a social engineering on the grandest scale: replacing capitalism with a freer association. Sublating the contradiction between "economic" and "social" spheres, noted by Habermas, and between the ever-growing needs and environmental constraints globally requires transcendence of partial, limited rationality of earlier modernization(s) as well as critical awareness and radical imagination. This puts a premium on what Beck calls reflexivity and what Marxists might simply call praxis: theory and action continually informed by feedback. Modernization must be treated as a continuous engineering process with built-in self-correction. In the XXI century humanity and its survival more than ever becomes the imaginary of a project for itself and, just as in Li Bocong's expansive understanding of engineering as project, this construction calls for wider participation, beyond political, economic and technocratic elites.

Li Bocong's philosophy recenters modernization on human creativity. He famously proposes to replace René Descartes' dictum "I think, therefore I am" with a new maxim: "I create, therefore I am." As Li argues, the traditional Cartesian focus on knowing subject vs. objectified world is insufficient in the modern era; what is needed is an affirmation of the human as a creative, world-constructing subject. In line with Marx' *Theses on Feuerbach*, human existence finds its fullest meaning not in abstract contemplation alone, but in the active, material creation of a better world. Emancipated by modernization, therefore, our primary identity should be that of creator of reality, not merely detached thinker or passive consumer.

Li Bocong's formulation implicitly asks: What if modernization were driven by human creative empowerment, rather than humans being driven by the autonomous imperatives of technique or capital? In his work on the philosophy of engineering, Li argues that engineering is far more than applied science or technical design; it is a comprehensive human activity that interweaves the material and the social. He emphasizes planning, purpose, and value as fundamental categories: engineering works are done for human purposes and within social constraints, which means questions of ideals, consequences, and responsibilities are intrinsic. In this respect, Li's Marxist-humanist standpoint harmonizes with Western critical theories while adding a

constructive perspective. Rather than merely critiquing the dehumanizing tendencies of instrumental rationality, Li seeks to reorient modernization by affirming creative praxis as the core of human progress. This has practical echoes in movements that emphasize participatory design, appropriate technology, and democratization of innovation, aligning technical advancement with the empowerment of communities.

Li Bocong is a scholar bridging Chinese Marxist thought and Western critical theory, and a life-long witness to Chinese modernization. China's social experimentation in the late XX and early XXI centuries has reaped enormous material gains, but also raised questions about sustainability, inequality, and cultural continuity. Li's philosophy of engineering, grounded in Marxist humanism, emerged as a response to these conditions, focusing on human empowerment, self-realization and transformative work. A key lesson from the Western critique of modernization is the need for reflexivity: modernization has to be self-critical and guided by awareness of its limitations and side-effects. Such a reflexive modernization would prioritize not just expansion but evaluation and adjustment of progress. Equally important is the collaborative and democratic character of any future modernization. This means treating citizens as co-engineers of their social world, not passive subjects of expert plans. In practice, experiments in collaborative governance, community-centered development, and workplace democracy all embody the idea that people should have a say in the modernization processes that affect their lives, which actually increases its adaptability.

In the Marxist-humanist tradition, the ultimate measure of progress is the extent to which individuals become free, creative, and fully developed human beings. This ethos resonates with the concept of human development advanced by thinkers such as Amartya Sen and Martha Nussbaum (1993). An ethical path of modernization would thus integrate principles of social justice, ecological care, and human dignity into the engineering blueprint. It would treat issues like reducing inequality, preserving the environment for future generations, and protecting individual autonomy as central criteria for evaluating progress, on par with traditional metrics like economic growth or technical efficiency.

CONCLUSION

Discourse on modernization has had two faces: one historically descriptive, another for political practice. Neither has thematized the centrality of engineering. To begin to redress this lacuna, we have, first, reviewed an existing sociological debate about modernization, technology, and nationalism and, second, called attention to some limited materials on engineers as subjects and objects of modernization. In a third move, however, we have tried to consider Chinese modernization in the framework of Li Bocong's philosophy of engineering as project as more explicitly placing engineering and engineers at the center of modernization theory and practice. This perspective establishes an opportunity to imagine modernization as a project of emancipation rather than a fate, a vision of development that enlarges human freedom, community, and creativity.

On this hypothesis, historical materialism reminds us that when material conditions and productive forces do not align with production relations, crises ensue. Reflexive modernization, then, becomes a fine tuning or synchronization: updating our institutions

to fit our productive capacities. Modernization as engineering project means jointly tweaking the technical systems and the social systems, e.g., developing the new, innovative forms of welfarism in the light of progressive automation and artificial intelligence. The Marxist-humanist tone that permeates such an analysis insists that humans must remain the subjects, not the objects of a truly emancipative and inclusive modernization for its own viability. Such an engineering outlook potentially combines human agency, collective collaboration, while acknowledging the uncertainties and risks of complex systems that require constant feedback and adaptations. Understanding modernization through the dual lenses of material and social engineering unites the tremendous power of human creativity and the need for caution and guidance by humane values. The engineering project of XXI century, if grounded in critical self-awareness and collaboration, holds the promise of the enlightenment dream without extinguishing the humanistic light that guides it. It is a path where modern society becomes, in effect, an engineered and engineering artwork of the people themselves.

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