

Capital, Science, Technology

The Development of Productive Forces in Contemporary Capitalism

Raúl Delgado Wise and Mateo Crossa Niell

Introduction

Understanding the way in which contemporary capitalism—which Samir Amin insightfully characterised as the era of generalised monopolies—organises productive forces is crucial to grasping both the forms of domination defining imperialism today and the profound metamorphoses that monopoly capital has undergone during the last three decades.¹

The concept of general intellect, put forward by Karl Marx, is a

Our analysis aims not only to reveal the deep contradictions of capitalist modernity, but also to highlight the important transmutation that today's monopoly capital is undergoing.

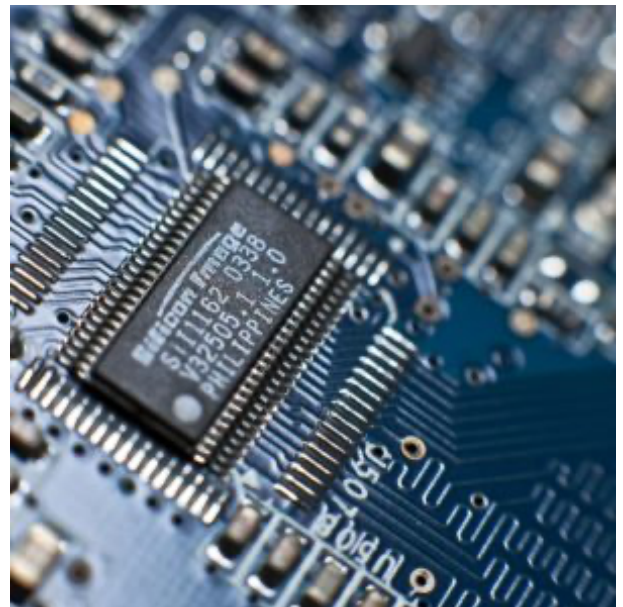
Far from acting as an engine for the development of social productive forces, it has become a parasitic entity with an essentially rentier and speculative function.

useful starting point for the

exploration

of the organisation of productive forces. Let us take the example of one of the most “advanced” innovation systems today: Silicon Valley’s Imperial System. Our analysis seeks not only to reveal

the profound contradictions of capitalist modernity, but also to highlight the significant transmutation that today’s monopoly capital is undergoing. Far from acting as a driving force for the development of social productive forces, it has become a parasitic entity with an essentially rentier and speculative function. Underlying this is an institutional framework that favours the private appropriation and the concentration of the products of general intellect.



¹ ↪ Samir Amin, [The Implosion of Contemporary Capitalism](#) (New York: Monthly Review Press, 2013).

Capital, General Intellect, and the Development of Productive Forces

Capitalism is characterized by the separation of the direct producers from their means of production and subsistence. This separation broke violently into the embryonic phase of capitalist development with the process that Marx referred to as “so-called primitive accumulation” (more correctly translated as “so-called primary accumulation”). It is not just a foundational process, external or alien to the dynamics of capitalism, but one that reproduces itself over time and is accentuated through new and increasingly sophisticated mechanisms with the advent of neoliberal policies, so much so that David Harvey proposed the category “accumulation by dispossession” in his book *The New Imperialism* to refer to this incessant phenomenon.²

Importantly, the primal separation of the direct producer that Marx describes in chapters 14 and 15 of the first volume of *Capital* is only formal. In the early stages of industrial capitalism, even if the direct producers did not own the means of production—which they considered foreign property and an external force of domination—they maintained some

The emergence of machinery and large-scale industry meant that capital succeeded in creating its own technical mode of production as the basis of what Marx conceives in the unpublished sixth chapter of Capital, volume 1, as the actual subsumption of labour under capital; in other words, the “specific mode of capitalist production”.

control over their working tools in the production process. Thus, the separation was not wholly complete until the appearance of large-scale industry in the second half of the twentieth century, which radically changed the situation. The production of machines by machines—that is, the use of an integrated machinery system, as a totality of mechanical processes distributed in different phases moved by a common motor—gave way to a complete separation between workers and their tools. This brought the optimal conditions for a second and deeper dispossession, relegating

labour to a subordinated role in the production process and converting the worker into an appendage of a machine. It is worth mentioning, however, that the use of this metaphor by Marx does not mean that the direct producer is unable to eventually contribute to the attainment of an improvement or a technological innovation. There are several historical examples that account for this possibility.

Nevertheless, in terms of the theory of value, there is a general movement toward the predominance of dead labour, objectified in the machine, over living labour—in other words, the prevalence of relative surplus value in the dynamics of capitalist accumulation. The emergence of machinery and large-scale industry meant that capital managed to create its own technical mode of production as the foundation of what Marx conceives in the unpublished sixth chapter of *Capital*, volume 1, as the real subsumption of labour under capital; in other words, the “specific capitalist mode of production.” As Marx wrote, “the historical significance of capitalist production first emerges here in striking fashion (and specifically), precisely through the transformation of the direct production process itself, and the development of the social productive powers of labour.”³

This process originated during the second half of the First Industrial Revolution and deepened during the Second Industrial Revolution (1870–1914), where science and technology appear as engines of production, forcing development as the so-called first globalisation was occurring. Since then, the growth of capital has been directly associated with the development of production forces and the consequent expansion of surplus value, mainly in the form of relative surplus value. At the same time, this is marked by the continuous increase in the organic composition of capital (the relation

² ↪ David Harvey, *A Brief History of Neoliberalism* (Oxford: Oxford University Press, 2005).

³ ↪ Karl Marx, chap. 6 in *El capital* (1867; repr. Mexico: Siglo XXI, 1981), 60.

between capital invested in the means of production and that invested in the labour force), where “the scale of production is not determined according to given needs but rather the reverse: the number of products is determined by the constantly increasing scale of production, which is prescribed by the mode of production itself.”⁴ This inherent contradiction in the specifically capitalist mode of production is related, in turn, to (1) the trend of concentration and centralisation of capital that accompanies accumulation dynamics and (2) the concomitant tendency toward absolute impoverishment of the working class, in what Marx conceives as the general law of capitalist accumulation:

*The greater the social wealth, the functioning capital, the extent and energy of its growth, and, therefore, also the absolute mass of the proletariat and the productiveness of its labour, the greater is the industrial reserve army. The same causes which develop the expansive power of capital also develop the labour power at its disposal. The relative mass of the industrial reserve army increases, therefore, with the potential energy of wealth. But the greater this reserve army in proportion to the active labour army, the greater is the mass of a consolidated surplus population, whose misery is in inverse proportion to its torment of labour. Finally, the greater the growth of the misery within the working class and the industrial reserve army, the greater the official pauperism.*⁵

The trend toward the complete separation of the worker from the means of production is consolidated into what Victor Figueroa described as follows:

*The factory offers us the image of a production center that does not demand workers’ awareness or knowledge of the production process.... As if the factory, being itself the result of the productive application of knowledge, demanded for the knowledge to be developed outside and, therefore, independently to the workers it houses, where immediate labour is presumably a mere executor of the progress forged separately by science.*⁶

In *Labour and Monopoly Capital*, Harry Braverman described this fissure as an essential part of the scientific and technological revolution that detached the subjective and objective content of the labour process.

*The unity of thought and action, conception and execution, hand and mind, which capitalism threatened from its beginning, is now attacked by a systemic dissolution employing all the resources of science and various engineering disciplines based upon it. The subjective factor of the labour process is removed to a place among its inanimate objective factors. To the materials and instruments of production are added a “labour force,” another “factor of production,” and the process is henceforth carried on by management as the sole subjective element.... This displacement of labour as the subjective element of the process, and its subordination as an objective element in a productive process now conducted by management, is an ideal realised by capital.*⁷

In the face of these circumstances, derived from the technical and social division of labour inherent to the specifically capitalist mode of production, it is worth asking ourselves: In what way does capital, beyond the immediate work that is deployed in the factory, organise the development of the productive forces? What kinds of workers, universities, and research centres participate in this process? What is the role of the state and other institutions? What role do accumulated social knowledge, basic and applied science play? What types of intangible and tangible products are

⁴ ↪ Marx, chap. 6 in *El capital*, 76.

⁵ ↪ Karl Marx, *El capital*, tomo 1, vol. 3 (1867; repr. Mexico: Siglo XXI, 2005), 804.

⁶ ↪ Victor Figueroa, *Reinterpretando el subdesarrollo: Trabajo general, clase y fuerza productiva en América Latina* (Mexico: Siglo XXI, 1986), 40.

⁷ ↪ Harry Braverman, *Labour and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review, 1998), 118.

Although Marx does not explicitly address this question in Capital, he coined the category of general intellect and made some considerations that provide important clues to help us understand the issue.

generated? What are the mechanisms and mediations involved in the transformation of scientific and technological work to productive forces? What kind of profit enters the scene and how does it affect the dynamics of social surplus value distribution, concentration, and centralisation of capital?

Although Marx does not explicitly address this issue in Capital except in marginal footnotes, in the Grundrisse's "Fragment on Machines," he coined the category of general intellect and made some considerations, in the form of notes, that provide important clues to help us understand the subject.

Nature builds no machines, no locomotives, railways, electric telegraphs, self-acting mules etc. These are products of human industry; natural material transformed into organs of the human will over nature, or of human participation in nature. They are organs of the human brain, created by the human hand; the power of knowledge, objectified. The development of fixed capital indicates to what degree general social knowledge has become a direct force of production, and to what degree, hence, the conditions of the process of social life itself have come under the control of the general intellect and have been transformed in accordance with it. To what degree the powers of social production have been produced, not only in the form of knowledge, but also as immediate organs of social practice, of the real-life process.⁸

From this, we can infer that fixed capital, or constant capital, is condensed into past material and immaterial labour (dead labour). Consequently, accumulated social knowledge is objectified in the means of production and becomes an immediate force of production. In other words,

general intellect is a collective and social intelligence created by accumulated knowledge and techniques. This radical transformation of the workforce and the incorporation of science, communication and language within the productive forces has redefined the entire phenomenology of labour and the entire global horizon of production. General intellect means that the general form of human intelligence becomes a productive force in the sphere of global social labour and capitalist valorisation. The power of science and technology are put to work.... With the concept of general intellect, Marx refers to science and consciousness in general, that is, the knowledge on which social productivity depends.⁹

With the advent of the capitalist mode of production, a new and particularly significant division was created between

The way in which the general intellect is structured, in its quest to accelerate the development of productive forces, takes on ever more sophisticated and complex modalities, as in the paradigmatic case of the Silicon Valley Imperial Innovation System.

what could be called immediate labour and scientific-technological labour. While the former unfolds in the factory, the latter is carried out separately and under different, although complementary, forms of organisation, with both converging in the critical function for capitalist development: the increase of surplus value. If immediate labour is actually subsumed by capital, scientific and technological labour can only be, at best,

formally subsumed, becoming what Figueroa calls a workshop of technological progress to distinguish it from the way immediate labour in the factory is organised.¹⁰ However, the way general intellect is structured, in its quest to accelerate

⁸ ↪ Karl Marx, Elementos fundamentales para la crítica de la economía política 1857–1858 (Grundrisse), tomo 2 (1858; repr. Mexico: Siglo XXI, 1980), 229–30.

⁹ ↪ Antonio Gómez Villar, "Paolo Virno, lector de Marx: General Intellect, biopolítica y éxodo," *SEGORÍA: Revista de Filosofía Moral y Política* 50 (2014): 306.

¹⁰ ↪ Figueroa, Reinterpretando el subdesarrollo: trabajo general, clase y fuerza productiva en América Latina, 41.

the development of productive forces, acquires increasingly sophisticated and complex modalities, as in the paradigmatic case of the Silicon Valley Imperial Innovation System.

The growing importance of immaterial work in the production process does not imply a “crisis” of the law of value, as suggested by Antonio Negri.¹¹ Rather, it implies that an increasing proportion of the social surplus value and the social surplus fund captured by capital and the state is redistributed toward activities aimed at promoting the development of productive forces. In other words, immediate labour and scientific-technological labour interweave dialectically to broaden the scope of capital valorisation through the deepening of exploitation. In this sense, under the prism of the theory of value, the general intellect contributes to increasing the organic composition of capital with a powerful leitmotif: the appropriation of extraordinary profits, that is, profits greater than the average profit, commonly conceived as technological rents. In this aspect, the Ecuadorian-Mexican philosopher Bolívar Echeverría specifies that there are

two poles of monopoly property to which the group of capitalist owners must acknowledge rights in the process of determining the average profit. Based on the most productive resources and provisions of nature, land ownership defends its traditional right to convert the global fund of extraordinary profit into payment for that domain, in other words, into ground rent. The only property that is capable of challenging this right throughout modern history and has indefinitely imposed its own, is the more or less lasting domain over a technical innovation of means of production. This property forces the conversion of an increasing part of extraordinary profit into a payment for its dominion, in other words, into a “technological rent.”¹²

It is worth noting that Echeverría brackets the notion of technological rent, associating it with ground rent—or surplus associated with the ownership of a monopolisable good that does not derive from incorporated labour during the production process. Under the new forms of general intellect organisation, monopoly capital appropriates profit through the acquisition of patents, without implying investments in the promotion and development of the productive forces, behaving in this sense as a rentier agent.

Unlike immediate labour, the subordination of scientific and technological labour to capital is extremely complex,

It is important to emphasise the fundamental role held by states in the distribution of social surplus to promote basic and applied science, supporting universities and research centres. The state also contributes to creating institutions and policies that allow for the private appropriation of rent to come out of the general intellect, which become crucial to the dynamics of accumulation and uneven development characterising contemporary capitalism and imperialism.

especially because the value that the scientific and technological labour force incorporates into the production process is not immediately objectified; it is the product and result of social knowledge expressed in the market once new commodities, new production processes, and new ways of organising and increasing labour productivity are concretised. Pablo Míguez refers to this phenomenon not as “a simple subordination to capital, but an independent relation to labour time imposed by capital, making it increasingly difficult to distinguish working time from production time or leisure

time.”¹³

¹¹ ↪ Antonio Negri, *Marx más allá de Marx* (Madrid: Akal, 2001).

¹² ↪ Bolívar Echeverría, *Antología: Crítica de la modernidad capitalista* (La Paz: Oxfam, Vicepresidencia del Estado Plurinacional de Bolivia, 2011): 78–79.

¹³ ↪ Pablo Míguez, “Del General Intellect a las tesis del Capitalismo Cognitivo: Aportes para el estudio del capitalismo del siglo XXI,” *Bajo el Volcán* 13, no. 21 (2013): 31.

From the theory of value perspective, the process of valorisation of scientific and technological labour is materialised in the production and circulation sphere, but in the distribution sphere of valorised capital, that social surplus value, mediated by intellectual property, is issued in the form of a rent. In this sense, it is important to emphasise the fundamental role held by states in the distribution of social surplus to promote basic and applied science, supporting public and private universities, as well as research centres. The state also contributes to creating institutions and policies that allow for the private appropriation of rent to come out of the general intellect. These institutions become crucial to the dynamics of accumulation and uneven development characterising contemporary capitalism and imperialism.

National and international patent laws are a mechanism for the privatisation and commodification of the commons, hindering potentially socially beneficial innovations.

the production and circulation sphere, but in the distribution sphere of valorised capital, that social surplus value, mediated by intellectual property, is issued in the form of a rent. In this sense, it is important to emphasise the fundamental role held by states in the distribution of social surplus to promote basic and

The transformation of the general intellect into an immediate productive force, materialised in new commodities and new ways of organising the labour process, requires the mediation of patents and a patenting system. In the capitalist mode of production, the creation of intellectual property through patents or patenting systems acquires a strategic importance in relation to the control and orientation of productive forces. This becomes a key element both for the private appropriation of products that emanate from the general intellect, and for the organisation of innovation systems. In this sense, national and international patent legislations constitute a mechanism that enables the privatisation and commodification of common goods, hindering potentially beneficial innovations for society.¹⁴ For example,

The legal mechanisms for the private appropriation of scientific-technological labour, with the patent as a nodal part in the restructuring of innovation systems, becomes a basic piece for the withholding of extraordinary profits made possible through global corporate regulation in tune with the imperial State policies.... Hence, international law functions as a core piece of private control of scientific-technological labour through a series of intellectual property and international trade regulatory agreements.¹⁵

Following this idea, Míguez argues that, in the context of contemporary capitalism, “intellectual property is reinforced as it is the only mechanism that allows for the private appropriation of increasingly social knowledge in its incessant quest to valorise capital.”¹⁶

The development of the productive forces in contemporary capitalism—and the course followed by the general intellect—cannot be understood separately from the contemporary domination of monopoly capital. This hegemonic fraction of capital—ubiquitous in contemporary capitalism—finds its *raison d’être* in the appropriation of extraordinary profits and technological rents through monopoly prices, among other processes. According to Marx, monopoly appropriation of profit through prices refers to prices that rise above the cost of production and the average profit together, enabling monopoly capital to appropriate a relatively greater portion of social surplus value than the one that would correspond to conditions of free competition.

Another fundamental feature of monopoly capital, as a *sine qua non* condition for obtaining profits, is its need to maintain lasting advantages over other possible participants in a particular branch or branches where it operates. Such advantages can be natural or artificial, depending on the combination of forms of surplus profit, which, in turn, configure

¹⁴ ↪ Guillermo Foladori, “Ciencia Ficticia,” *Estudios Críticos del Desarrollo* 4, no. 7 (2014): 41–66.

¹⁵ ↪ Julián Pinazo Dallenbach and Raúl Delgado Wise, “El marco regulatorio de las patentes en la reestructuración de los sistemas de innovación y la nueva migración calificada,” *Migración y Desarrollo* 27, no. 32 (2019): 52.

¹⁶ ↪ Míguez, “Del General Intellect a las tesis del Capitalismo Cognitivo,” 39.

particular monopolistic practices. One of these forms is related to capitalism's revolutionary development of productive forces, as envisioned by Marx: technological change. In this regard, Joseph A. Schumpeter—far from intending to identify his vision of technological change with that proposed by Marx in *Capital*—sets forth the existence of a positive relationship between innovation and monopoly power, arguing that competition through innovation or “creative destruction” is the most effective means of acquiring advantages over potential competitors. Furthermore, Schumpeter argues that innovation is both a means of achieving monopoly profit and a method of maintaining it.

It should be noted, however, that in the Marxist conception, there is no mechanical or direct identification of technological change with a positive vision of progress. On the contrary, being governed by the law of value and the necessity of capital to broaden accumulation, technological change does not escape the contradictions of capitalist modernity, which, as Echeverría emphasises, “leads itself, structurally, by the way in which the process of reproduction of social wealth is organised...to the destruction of the social subject and the destruction of nature where this social subject affirms itself.”¹⁷

The appropriation of extraordinary monopoly profits produced by means of intellectual property is accompanied in contemporary capitalism by a profound restructuring of this hegemonic fraction of capital, through a process of hyper-monopolisation, where three additional forms of profit appropriation stand out:¹⁸

- (1) The formation of monopoly capital global networks, commonly known as global value chains, through the geographic expansion of corporate power by transferring parts of production, commercial, and financial service to peripheral countries in search of cheap labour.¹⁹ Basically, it is a new nomadism in the global production system based on the enormous wage differentials that persist between the Global North and the Global South (the global labour arbitrage). This restructuring strategy has deeply modified the global geography of production to the degree that just over 70 percent of industrial employment is currently located in peripheral or emerging economies.²⁰
- (2) The predominance of financial capital over other factions of capital.²¹ In the absence of profitable investments in the productive sphere due to the over-accumulation crisis triggered in the late 1970s, capital began moving toward financial speculation, creating strong distortions in the sphere of social surplus value distribution through the financialisation of the capitalist class, which has led to an explosion of fictitious capital—financial assets without a counterpart in material production.²²
- (3) The proliferation of extractivism by monopolising and controlling land and subsoil by monopoly capital.²³ In addition to accentuating the dynamics of accumulation by dispossession, the growing global demand for natural

¹⁷ ↪ Echeverría, *Antología*, 173.

¹⁸ ↪ Francisco Javier Caballero, “Replanteando el desarrollo en la era de la monopolización generalizada: Dialéctica del conocimiento social y la innovación” (PhD dissertation, Universidad Autónoma de Zacatecas, Mexico, 2020).

¹⁹ ↪ Raúl Delgado Wise and David Martin, “The Political Economy of Global Labor Arbitrage,” in *The International Political Economy of Production*, ed. Kees van der Pijl (Cheltenham: Edward Elgar, 2015), 59–75.

²⁰ ↪ John Bellamy Foster, Robert W. McChesney, and R. Jamil Jonna, “The Global Reserve Army of Labor and the New Imperialism,” *Monthly Review* 63, no. 6 (November 2011): 1–15.

²¹ ↪ Walden Bello, “The Crisis of Globalist Project and the New Economics of George W. Bush,” in *Critical Globalization Studies*, ed. Richard P. Appelbaum and William I. Robinson (New York: Routledge, 2005), 101–9.

²² ↪ Robert Brenner, *The Boom and the Bubble: The U.S. in the World Economy* (New York: Verso, 2002); John Bellamy Foster and Hannah Holleman, “The Financialization of the Capitalist Class: Monopoly-Finance Capital and the New Contradictory Relations of Ruling Class Power,” in *Imperialism, Crisis and Class Struggle: The Enduring Verities and Contemporary Face of Capitalism*, ed. Henry Veltmeyer (Leiden: Brill, 2010).

²³ ↪ James Petras and Henry Veltmeyer, *Extractive Imperialism in the Americas* (Leiden: Brill, 2013).

resources and energy has led to an unprecedented privatisation of biodiversity, natural resources, and communal goods benefiting mega-mining and agribusiness. This implies the appropriation of huge extraordinary profits in the form of ground rent (unproduced surplus value) that translates into greater ecosystem depredation, pollution, famine, and disease with severe environmental implications, including global warming and worsening extreme climatic events that jeopardise the symbiosis between human society and nature.²⁴

The predominance and metamorphosis of monopoly capital under the neoliberal aegis has brought about far-reaching transformations in the organisation of production and the labour process. These transformations are integral to the global capitalist system's geography, leading to a fall of the welfare state, an increase in social inequalities, and the emergence of a new international division of labour, where the labour force becomes the main export commodity. This, in turn, gives way to new and extreme forms of unequal exchange and transfer of surplus from the periphery to the core economies of the system. In this context, the irruption of the technoscience revolution has generated new ways of promoting scientific and technological creativity, of organising the general intellect on a global scale and of appropriating its products.

The dominance and metamorphosis of monopoly capital under the neoliberal aegis has led to the collapse of the welfare state, the rise of social inequalities and the emergence of a new international division of labour, in which labour power becomes the main export commodity.

transformations in the organisation of production and the labour process. These transformations are integral to the global capitalist system's geography, leading to a fall of the welfare state, an increase in social inequalities, and the emergence of a new international division of labour, where the labour force becomes the main export commodity. This, in turn, gives way to new and extreme forms of unequal exchange and transfer of surplus from the periphery to the core economies of the system. In this context, the irruption of the

Untangling Silicon Valley's Imperial Innovation System

A strategic dimension of capitalist development in the era of generalised monopolies corresponds to the extraordinary

The organisational architecture of the general intellect in this complex economic terrain allows for the corporate control of the scientific and technological work of an impressive mass of intellectual workers trained in different countries of the world, both in the core and peripheral economies.

dynamism that the development of productive forces achieves through a rampant rate of patenting. Hence, it is vital to understand the characteristics of the most advanced innovation system today, hegemonised by the United States and georeferenced in Silicon Valley, which operates as a powerful patenting machine and has tentacles in various peripheral and emerging countries. The organisational architecture of the general intellect in this complex economic terrain enables corporate

control over scientific and technological labour of an impressive mass of intellectual workers trained in different countries around the world, both in core and periphery economies. In this system, a wide range of agents and institutions interact to speed up the dynamics of innovation, reducing the costs and risks associated with inventors and independent entrepreneurs—organised through innovative embryonic companies known as startups—to be capitalised by large corporations through the acquisition or appropriation of patents.²⁵

Some of the most outstanding features of what we conceive as the Silicon Valley Imperial Innovation System are:

- (1) The internationalization and fragmentation of research and development activities under “collective” methods of organizing and promoting innovation processes: peer to peer, share economy, commons economy, and crowdsourcing economy, through what is known as Open Innovation. These are forms of scientific and

²⁴ ↪ Guillermo Foladori and Naina Pierri, ¿Sustentabilidad? Desacuerdos sobre el desarrollo sustentable (Mexico: Miguel Ángel Porrúa, 2005).

²⁵ ↪ Raúl Delgado Wise, “Unraveling Mexican Highly-Skilled Migration in the Context of Neoliberal Globalization,” in *Social Transformation and Migration: National and Local Experiences in South Korea, Turkey, México and Australia*, ed. Stephen Castles, Derya Ozkul, and Magdalena Arias Cubas (Basingstoke: Palgrave MacMillan, 2015): 201–18; Raúl Delgado Wise and Mónica Guadalupe Chávez, “¡Patentad, patentad!: Apuntes sobre la apropiación del trabajo científico por las grandes corporaciones multinacionales,” *Observatorio del Desarrollo* 4, no. 15 (2016): 22–30; Míguez, “Del General Intellect a las tesis del Capitalismo Cognitivo.”

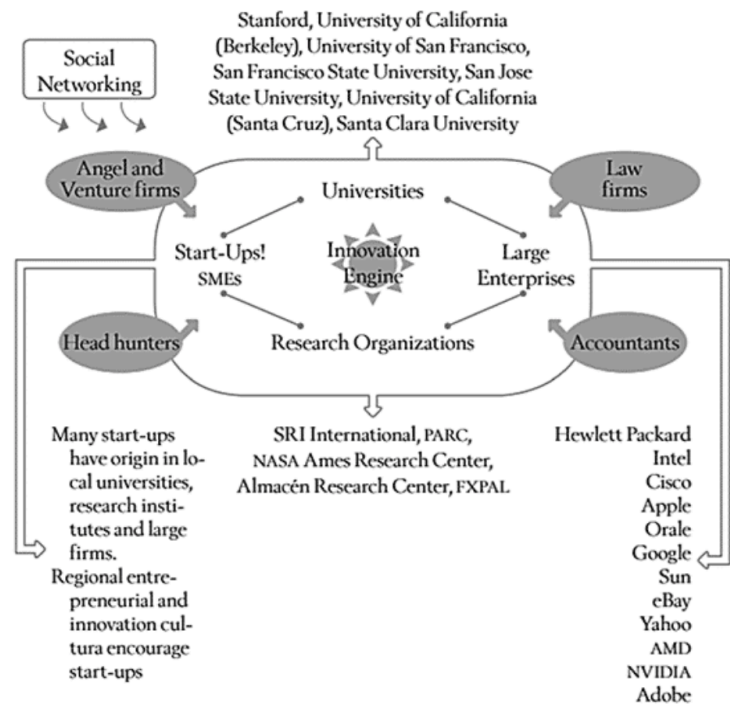
technological inventions produced outside the boundaries of multinational corporations, which involve the opening and spatial redistribution of knowledge-intensive activities, with the increasing participation of partners or external agents to large corporations, such as startups that operate as privileged cells of the new innovative architecture, venture capital, clients, subcontractors, head hunters, law firms, universities, and research centers.²⁶ This new form of organizing the general intellect has given way to the permanent configuration and reconfiguration of innovation networks that interact under a complex interinstitutional fabric commanded together by large multinational corporations and the imperial state (see Chart 1). This networked architecture has deeply transformed previous ways of driving technological change.

It is worth noting that, in this context, scientific and technological labour carried out by startups is not formally subsumed to capital as inventors are not direct employees of large corporations. Hence, subsumption is subtle and indirect, backed by an institutional framework established

Silicon Valley has become the pivot point of a new global architecture of innovation, around which multiple peripheral links are woven, operating as a kind of scientific maquiladora located in regions, cities and universities around the world. This gives rise to a new and perverse mode of unequal exchange.

by the Patent Cooperation Treaty of the World Intellectual Property Organization (WIPO) and a sophisticated ecosystem network that fosters the collective development of products emerging as part of the general intellect on a planetary scale and its private appropriation through patents and other proprietary mechanisms mediated by law firms responding to large multinational corporation interests. As a result, accumulated social knowledge—a collective drive accelerated by networks of scientists and technologists—ends up in corporate hands through juridical mechanisms.²⁷

Chart 1. Graphic Representation of the Silicon Valley Innovation System



Source: Produced based on information gathered from Strategic Business Insights.

- (2) The creation of scientific cities such as Silicon Valley in the United States and new “Silicon Valleys” recently established in peripheral areas or emerging regions, mainly in Asia, where collective synergies are created to accelerate innovation processes. As Annalee Saxenian highlights, it is a new georeferenced paradigm that moves away from the old research and development models and opens the way for a new culture of innovation based on flexibility, decentralization, and the incorporation, under different modalities, of new and increasingly numerous

²⁶ ↪ Henry Chesbrough, “Open Innovation: A New Paradigm for Understanding Industrial Innovation,” in *Open Innovation: Researching a New Paradigm*, ed. Henry Chesbrough, Wim Vanhaverbeke, and Joel West (Oxford: Oxford University Press, 2008), 1–14.

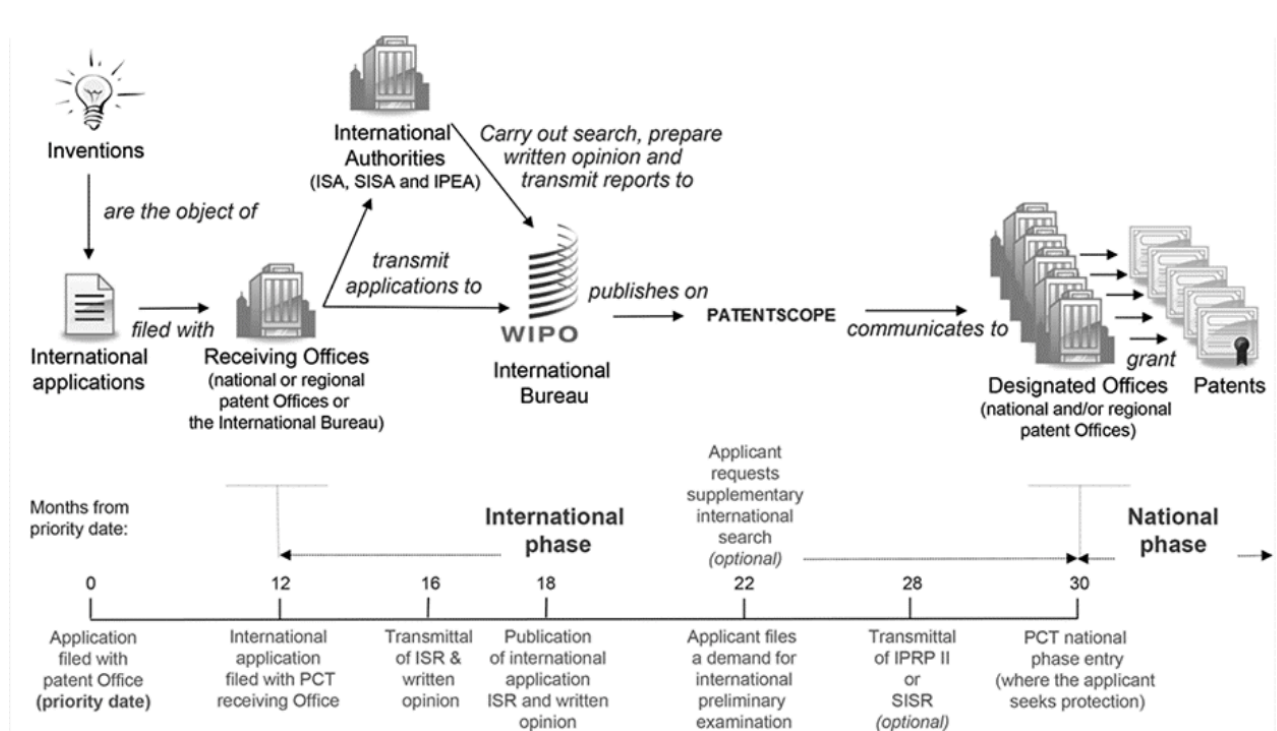
²⁷ ↪ Guillermo Foladori, “Teoría del valor y ciencia en el capitalismo contemporáneo,” *Observatorio del Desarrollo* 6, no. 18 (2017): 42–47.

players that interact simultaneously in local and transnational spaces.²⁸ Silicon Valley became the pivot point of a new global innovation architecture, around which multiple peripheral links are woven to operate as a sort of scientific maquiladora located in regions, cities, and universities around the world. This gives rise to a new and perverse modality of unequal exchange, through which the costs of forming and reproducing a highly skilled workforce involved in the dynamics of scientific innovation are transferred from core economies to peripheral and emerging countries, generating extraordinary profits via monopolistic technological rents.

- (3) New forms of control and appropriation of scientific labour products by large multinational corporations, through various forms of subcontracting, associations, and management and diversification of venture capital. This control is established through a two-way channel. On the one hand, it is established through specialized teams of lawyers thoroughly familiar with the institutional framework and operating rules for patents imposed by the Patent Cooperation Treaty and WIPO, serving the interests of large corporations. Under this complex and intricate regulatory framework (see Chart 2), it is practically impossible for independent inventors to register and patent products on their own. On the other hand, this is done through teams of lawyers who operate as headhunters, contractors, and subcontractors working through “strategic investment” to appropriate and gain control over general intellect products.²⁹

In the era of generalised monopolies, monopoly capital ceases to be a progressive agent in the development of the productive forces and becomes a parasitic entity.

Chart 2. World Intellectual Property Organization Patent Cooperation Treaty



Source: Image adapted from the World Intellectual Property Organization Patent Cooperation Treaty, 2015, www.wipo.int.

²⁸ ↪ AnnaLee Saxenian, *The New Argonauts: Regional Advantage in a Global Economy* (Boston: Harvard University Press, 2006).

²⁹ ↪ Titus Galama and James Hosek, *S. Competitiveness in Science and Technology* (Santa Monica, CA: RAND, 2008).

The way in which large multinational corporations participate in the dynamics of innovation incubated and deployed through the Silicon Valley matrix reveals that, more than development driven to facilitate social productive forces, monopolistic capital operates as a rentier agent that appropriates the products of the general intellect without participating in the production process of its development. In other words, the extraordinary profits that constitute the leitmotif of monopoly capital become technological rents in accordance with the meaning that Marx attributes to ground rent: the possibility of demanding a significant portion of social surplus value by virtue of owning a product, in this case the patent, though not acquiring it through a production process that incorporates value through labour. Hence, in the era of generalized monopolies, monopoly capital ceases to be a progressive agent in the development of the productive forces and becomes a parasitic entity that even decides, as owner of intellectual property, which products are potentially significant in the market and which will remain petrified in the freezer of social history.³⁰

Highly skilled migration from peripheral countries plays an increasingly important role in global innovation processes, generating a paradoxical and contradictory dependence of the South on the North, with patent inventors most often residing in peripheral and emerging countries.

- (4) A North-South horizon expansion of the workforce in areas of science, technology, innovation, and mathematics, and increasing recruitment of a highly skilled workforce from the peripheries through outsourcing and offshoring mechanisms. In this sense, highly skilled migration from peripheral countries plays an increasingly relevant role in global innovation processes, generating a paradoxical and contradictory dependence of the South on the North, where patent inventors more often reside in peripheral and emerging countries. In fact, this trend can be seen as part of a higher stage in the development of global value chains—what we prefer to call global monopoly capital networks—as the new international division of labour moves up the value-added chain to the scientific and technological sphere, and while monopoly capital moves to capture profit derived from productivity and knowledge contributed by a highly qualified workforce from the Global South.³¹ This trend can be found in different sectors of the global economy, including agricultural biotechnology and biohegemony in transgenic crops, as well as the appropriation of Indigenous knowledge related to seed technology.³²

A key piece that supports the new geopolitics of innovation is the creation of an ad hoc institutional framework aimed at the concentration and appropriation of general intellect products through patents under the tutelage and supervision of the WIPO in agreement with the World Trade Organization (WTO).³³ Since the late 1980s, there has been a trend toward generating legislation in the United States, in tune with the strategic interests of large multinational corporations in the field of intellectual property rights.³⁴ Through rules and regulations promoted by the WTO, the scope of this legislation has been significantly expanded. The Office of the U.S. Trade Representative has taken on the role of promoting the signing and implementation of free trade agreements, since intellectual property disputes within the WIPO/WTO tend to

³⁰ ↪ Foladori, “Teoría del valor y ciencia en el capitalismo contemporáneo.”

³¹ ↪ Raúl Delgado Wise, “El capital en la era de los monopolios generalizados: Apuntes sobre el capital monopolista,” *Observatorio del Desarrollo* 6, no.18 (2017): 48–58; Rodrigo Arocena and Judith Sutz, “Innovation Systems and Developing Countries” (DRUID Working Paper 02–05, Danish Research Unit for Industrial Dynamics, Aalborg, 2002).

³² ↪ Laura Gutiérrez Escobar and Elizabeth Fitting, “Red de semillas libres: Crítica a la biohegemonía en Colombia,” *Estudios Críticos del Desarrollo* 7, no. 11 (2016): 85–106; Pablo Lapegna and Gerardo Otero, “Cultivos transgénicos en América Latina: Expropiación, valor negativo y Estado,” *Estudios Críticos del Desarrollo* 6, no. 11 (2016): 19–44; Renata Motta, “Capitalismo global y Estado nacional en las luchas de los cultivos transgénicos en Brasil,” *Estudios Críticos del Desarrollo* 6, no. 11 (2016): 65–84.

³³ ↪ Wise and Chávez, “¡Patentad, patentad!”

³⁴ ↪ Peter Messitte, “Desarrollo del derecho de patentes estadounidense en el siglo XXI. Implicaciones para la industria farmacéutica,” in *Los retos de la industria farmacéutica en el Siglo XXI: Una visión comparada sobre su régimen de propiedad intelectual*, ed. Arturo Oropeza and Víctor Manuel Guízar López (Mexico: UNAM-Cofep, 2012), 179–200.

be enormously complex due to their multilateral nature. The U.S. strategy also includes bilateral free trade agreement negotiations as a complementary measure to control markets and increase corporate profits. The regulations established by the Patent Cooperation Treaty, amended in 1984 and 2001 within the framework of the WIPO and WTO, have contributed significantly to the strengthening of this trend.

In addition, according to the nature and characteristics of the Imperial Innovation System, the United States appears as the leading capitalist power in innovation worldwide, absorbing 23.9 percent of the total patent applications registered in the WIPO from 1996 to 2018. However, in the same period, China surpassed the United States in patent applications, with 23.1 percent compared to the U.S. 21.7 percent (Table 1).

Table 1. Requested and Granted Patents: Total and 10 Main Countries, 1996–2018

Patents Granted	Requested	Distribution %	Granted	Distribution %	Percent Granted	Rank
Total	45,361,224	100.0	19,447,764	100.0	42.9	
Subtotal	37,412,593	82.5	15,696,151	80.7	42.0	
China	10,497,318	23.1	3,138,160	16.1	29.9	3
U.S.A.	9,862,774	21.7	4,646,826	23.9	47.1	1
Japan	8,627,834	19.0	4,093,992	21.1	47.5	2
Korea	3,534,255	7.8	1,811,789	9.3	51.3	4
Germany	1,406,340	3.1	357,246	1.8	25.4	7
Canada	842,421	1.9	388,204	2.0	46.1	6
Russian Federation	831,702	1.8	622,539	3.2	74.9	5
India	652,043	1.4	130,933	0.7	20.1	13
United Kingdom	601,246	1.3	165,056	0.8	27.5	12
Australia	556,660	1.2	341,406	1.8	61.3	8

Source: SIMDE-UAZ. Estimations using data by WIPO, 1996–2018.

In the era of generalised monopolies, the development of productive forces has entered a point of no return in which the contradictions between progress and barbarism embodied in capitalist modernity have become more evident than ever before. The historical mission of progress attributed to capitalism in the development of the productive forces of society has turned into its opposite: a regressive path that threatens nature and humanity. In this context, the current dispute between the United States and China is uncertain. While there are signs that the United States still maintains leadership in strategic fields of innovation, China has been gaining ground and contesting the U.S. scientific-technological preeminence and global hegemony. Under the conditions of this disputed scenario, the COVID-19 pandemic opens a great question, where the only certainty is uncertainty.

In the era of generalised monopolies, the development of productive forces has entered a point of no return in which the contradictions between progress and barbarism embodied in capitalist modernity have become more evident than ever before. The historical mission of progress attributed to capitalism in the development of the productive forces of society has turned into its opposite: a regressive path that threatens nature and humanity.

contradictions between progress and barbarism embodied in capitalist modernity have become more evident than ever before. The historical mission of progress attributed to capitalism in the development of the productive forces of society has turned into its opposite: a regressive path that threatens nature and humanity. In this context, the current dispute between the United States and China is uncertain. While there are signs that the United States still maintains leadership in strategic fields of innovation, China has been gaining ground and contesting the U.S. scientific-

Related links:

- The Jus Semper Global Alliance
 - Monthly Review
 - John Bellamy Foster, Brett Clark and Hannah Holleman: [Capitalismo and Robbery](#)
 - John Bellamy Foster, R. Jamil Jonna and Brett Clark: [The Contagion of Capital](#)
 - John Bellamy Foster: [Marx's Open-ended Critique](#)
 - Intan Suwandi: [Back to Production: An Analysis of the Imperialist Global Economy](#)
 - Intan Suwandi: [Labour Value Commodity Chains — The Hidden Abode of Global Production](#)
 - Intan Suwandi, R. Jamil Jonna and John Bellamy Foster: [Global Commodity Chains and the New Imperialism](#)
 - Samir Amin: [The New Imperialist Structure](#)
 - Álvaro J. de Regil: [Transitioning to Geocratia — the People and Planet and Not the Market Paradigm — First Steps](#)
-

- ❖ **About Jus Semper:** The Jus Semper Global Alliance aims to contribute to achieving a sustainable ethos of social justice in the world, where all communities live in truly democratic environments that provide full enjoyment of human rights and sustainable living standards in accordance with human dignity. To accomplish this, it contributes to the liberalisation of the democratic institutions of society that have been captured by the owners of the market. With that purpose, it is devoted to research and analysis to provoke the awareness and critical thinking to generate ideas for a transformative vision to materialise the truly democratic and sustainable paradigm of People and Planet and NOT of the market.
- ❖ **About the authors: Raúl Delgado Wise** is an academic, activist, and author and editor of numerous books, chapters, and articles. He is the president and founder of the International Network on Migration and Development, codirector of the Critical Development Studies Network, and professor and director of the Doctoral Program in Development Studies at the Autonomous University of Zacatecas, Mexico. He is also the editor of *Migración y Desarrollo* and the UNESCO chair in Migration, Development and Human Rights. **Mateo Crossa Niell** is an assistant professor at the Mora Institute in Mexico City.
- ❖ **About this paper:** This paper was originally published in English by *Monthly Review* magazine in March 2021. This paper has been published under Creative Commons, CC-BY-NC-ND 4.0. You are welcome to reproduce the material for non-commercial use, crediting the author and providing a link to the original publisher.
- ❖ **Quote this paper as:** Raúl Delgado Wise and Mateo Crossa Niell: Capital, Science, Technology – The Development of Productive Forces in Contemporary Capitalism – The Jus Semper Global Alliance, July 2021.
- ❖ **Tags:** Capitalism, Imperialism, Monopolies, Marx, General Intellect, Patents, Intellectual Property, Exploitation, Labour Arbitrage, Unequal Exchange, Ideology, Globalisation.
- ❖ The responsibility for opinions expressed in this work rests only with the author(s), and its publication does not necessarily constitute an endorsement by The Jus Semper Global Alliance.



Under Creative Commons Attribution 4.0 License
<https://creativecommons.org/licenses/by-nc-nd/4.0/>

© 2021. The Jus Semper Global Alliance
 Portal on the net: <https://www.jussemper.org/>
 e-mail: informa@jussemper.org