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COLLABORATION IN THE MAKING: INNOVATION AND THE STATE IN ADVANCED MANUFACTURING

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This Article builds on the growing body of work examining how state action can promote technological innovation through intellectual property interventions beyond models in which the state plays a minimal role. In both the traditional model of private intellectual property rights and the copyleft alternative of the intellectual property commons, the state is conceived of as having minimal potential to actively contribute to innovation. This has limited the legal imagination for state-based alternatives that could promote development in many technological fields, particularly those that are more capital-intensive. Case studies illustrating a more "capable state" vis-à-vis intellectual property are thus needed to explore new conceptual issues in intellectual property theory and new practical possibilities for industrial policy. This Article offers one such case study in a recent federal innovation program in the United States, "Manufacturing USA," which aims to catalyze technological development in advanced manufacturing. The program is comprised of fourteen "Innovation Institutes," each assigned a unique area of technological focus, and each given the freedom to develop an approach to intellectual property and knowledge sharing that best suits their focus area. Across the various strategies employed by these institutes, three different forms of state action vis-à-vis intellectual property can be observed: (1) the creation of intellectual property commons; (2) the production of industry-wide technical platforms that can spur further innovation; and (3) the direct coordination of firms into joint research ventures in which intellectual property and know-how are shared. Institutes have generally prioritized either platform-production or coordination, and which of these they choose appears to depend largely on the technological characteristics of their manufacturing subfields. While both the commons and platform models have been previously discussed in the IP literature,

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the coordination-based role for the state is novel. This Article examines the theoretical basis for this form of state intervention, drawing from work on industrial policy and innovation theory, and concludes by discussing some of the normative challenges that it raises.

I. INTRODUCTION

Scholarship on intellectual property (IP) and innovation has suffered from an impoverished view of the state. In the traditional model of private IP rights, the state is conceived of as playing a minimal role, restricted to grantor of monopoly rents that protect particular innovations.[1] Under this conception, the state sits idly by

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1. For the canonical defense of the traditional model, see, for example, Peter S. Menell & Suzanne Scotchmer, *Intellectual Property Law*, *in* HANDBOOK OF LAW AND ECONOMICS 1473, 1476-77 (A. Mitchell Polinksy & Steven Shavell eds., 2007); *see also* William M. Landes & Richard A. Posner, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 294-334 (2003); Christopher M. Kalanje, *Role of Intellectual Property in Innovation and New Product Development*, WORLD INTELLECTUAL PROPERTY ORGANIZATION, https://www.wipo.int/export/sites/www/sme/en/documents/pdf/ip_innovation_development.pdf (last visited Apr. 20, 2020) (noting that one common

while private actors innovate and rely on the state only to protect their ideas upon creation.[2] The major decisions of what new technologies to invest in and when are made by private innovators acting in the shadow of market signals, with the state providing only the broad institutional framework in which true dynamic activity takes place.[3]

Strikingly, a dominant alternative to the traditional model in IP scholarship—the copyleft movement advocating for IP commons—shares with the traditional model a pessimistic view of the state. Though it breaks with the traditional model in its suggested institutional arrangements and normative claims, the copyleft approach also imagines a minimal state, one that maintains an open domain of IP for private innovators to use and further develop.[4] Amy Kapczynski has fittingly labeled this point of convergence the "neoliberal conception of the state" in IP scholarship.[5] As Kapczynski points out, both the traditional model and its open-IP alternative conceive of the state as "inertial, heavy, bureaucratic, ill-informed, and perilously corruptible and corrupt."[6] Leading advocates of the copyleft movement describe the state in pessimistic language that could be borrowed from a law and economics textbook.[7] Though both the traditional and copyleft models rely on sophisticated state capacities, these capacities are treated as necessary inputs to be tolerated rather than sources of dynamism to catalyze further innovation.

The failure of IP scholarship to articulate a "capable state" is not just a conceptual shortcoming.[8] The practical result of an

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justification for private IP rights is to "encourage creative intellectual endeavor in the public interest").

2. *See, e.g.*, ROBERT P. MERGES, PETER S. MENELL & MARK A. LEMLEY, INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 18 (6th ed. 2012) ("Intellectual property rights have the advantage of limiting the government's role in allocating resources to a finite set of decentralized decisions: whether particular inventions are worthy of a fixed period of protection. The market then serves as the principal engine of progress. Decentralized consumers generate demand for products and competing decentralized sellers produce them."), *cited in* Amy Kapczynski, *Intellectual Property's Leviathan*, 77 L. & CONTEMP. PROBS. 131, 134 (2014).

3. *See id.*

4. *See* Kapczynski, *supra* note 3, at 137-38.

5. *Id.* at 131.

6. *Id.* at 131-32.

7. As catalogued by Kapczynski, prominent copyleft advocates have described the state at best as "relatively suspect," and at worst as "unable to govern for the long term, captured by commercial interests and hobbled by stodgy bureaucratic structures." *Id.* at 137-38.

8. Kapczynski labels the alternative to the neoliberal state as the "capable state." *Id.* at 132, 140.

underdeveloped conception of state capacity in IP scholarship has likely been an overly narrow focus on technological fields that may flourish in the absence of IP rights and meaningful state action.[9] IP-free development of certain technologies is, of course, worth examining on both functional and normative grounds. Certain areas of technology may benefit from open-source or IP-free institutional arrangements, and the free culture normative underpinnings of these arrangements should be defended.[10] But a realistic assessment of these alternatives to the traditional IP model suggests that they are not well-suited to many technological fields of social value, particularly those that are more capital-intensive and have higher barriers to entry.[11] Yochai Benkler, one of the leading advocates of the copyleft movement, has recognized that the commons model works particularly well for technology development that is highly decentralized and involves creative input from a large number of producers.[12] Software is the key example of such a field.[13] How these kinds of mutualist alternatives could function in fields like manufacturing, green energy technology, and the like raises a fundamental challenge.

The task then is to examine and assess possibilities for *statist* alternatives to the traditional IP model, and in doing so, to build out a new conception of IP's capable state. This can be done through case studies of technological fields in which the state successfully contributes to development in more active ways, as in Lisa Larrimore Ouellette's discussion of the nanotechnology industry.[14] It can also be done by examining failures of state-minimal IP approaches to development of certain fields, and by identifying what kind of capable state activity would have avoided those failures. David Singh Grewal has provided an analysis of this type in the

9. *See* Lisa Larrimore Ouellette, *Nanotechnology and Innovation Policy*, 29 HARV. J.L. & TECH. 33, 34-35 (2015).

10. For discussion of the normative justification for commons-based and IP-free models, *see infra* Part IV.C.

11. Benkler himself has also noted in several of his works that commons-based models may not translate well to capital-intensive fields. *See, e.g.*, Yochai Benkler, *Sharing Nicely: On Shareable Goods and the Emergence of Sharing as a Modality of Economic Production*, 114 YALE L.J. 273, 339-40 (2004) (noting that when a "larger-scale physical-capital requirement is a threshold of effective action" the peer production may be more difficult to sustain, and that "technology imposes *threshold* constraints on effective sharing").

12. Yochai Benkler, *Coase's Penguin, or, Linux and* The Nature of the Firm, 112 YALE L.J. 369, 374-77 (2002) (discussing the suitability of "peer production" in the context of software).

13. *Id.*

14. Ouellette, *supra* note 10, at 34 (demonstrating that governments across the world have played essential roles in promoting the nanotechnology industry through R&D policy and various other innovation-supporting measures beyond basic patent protections).

context of synthetic biology.[15] Grewal focuses on the efforts of the BioBricks Foundation, a non-profit organization that promotes the open development of synthetic biology in a manner akin to open-source software.[16] He finds, however, that the principles of the copyleft movement are not so easily applied to emerging "wetware" technologies like synthetic biology, in which collaborative production can only proceed once a minimal technical "platform" has been constructed.[17] Though inspired by copyleft's normative claims, the BioBricks strategy has struggled in practice due to a lack of a key industry-wide platform infrastructure.[18] The source for that infrastructure, Grewal suggests, must be the state.[19] In emerging technological fields characterized by high upfront capital costs and barriers to entry, only the state may be capable of consistently making the necessary investments of resources to establish platforms—and their constitutive IP—that can be shared across collaborating producers within technological fields. For Grewal, then, one major role for the capable state is that of platform-builder.[20]

This Article builds directly on this work by examining a case study in the field of advanced manufacturing. In recent years, federal innovation policy in the United States has started to focus on manufacturing. In response to years of unprecedented decline of the American manufacturing industry, the Obama Administration in 2014 launched the National Network for Manufacturing Innovation, now called Manufacturing USA. Since its founding, the program has grown to 14 "Innovation Institutes" set up in various locations across the country, each tasked with a different subfield of manufacturing as their technological focus.[21] Each institute performs multiple roles as a research consortium, technical advisor,

15. David Singh Grewal, *Before Peer Production: Infrastructure Gaps and the Architecture of Openness in Synthetic Biology*, 20 STAN. TECH. L. REV. 143 (2017).

16. *Id.* at 149, 166-87.

17. *Id.* at 149-50, 200-04.

18. *Id.*

19. *Id.* at 205 ("[T]he work of building platforms will generally fall to a public agency, even if that agency is made effective in partnership with private actors. More particularly, the possibility of achieving openness in emerging technical domains may depend on favorable public support to enable the production and distribution of infrastructural prerequisites for peer production. However, the recognition of the state as the dispositive context for innovation—apart from its familiar role in granting and enforcing intellectual property rights—has been largely neglected in contemporary legal scholarship.").

20. *Id.* at 208 ("Recognition of the state as the ultimate provider of platforms is essential to synthetic biology in particular, owing to the infrastructure gaps inhibiting the field. Public power is needed to build platforms—which is to say, to regulate, finance, coordinate, and support the networked construction of them—for the sake of the downstream innovation they enable.").

21. For an extended discussion of the program, see *infra* Part II.

and workforce developer. Among these tasks, one of the most significant is to manage the IP issues involved in catalyzing innovation in their respective subfields.[22] This Article focuses on the various forms of IP-based interventions that these institutes have developed, and how these interventions can inform a conception of IP's more capable state.

In several instances, what the state is doing in this program goes beyond both the traditional IP and the commons models, and can be understood, in Grewal's terms, as constructing a platform upon which later technological development can proceed. Several of the institutes are deeply engaged in building out a new product or process that can function as industry-wide technological infrastructure. In other instances within the program, however, the role of state action goes beyond Grewal's platform-building state. In these cases, the institutes are actively planning discrete research projects that require IP and knowledge-sharing, and are coordinating firm collaborations that would not have been initiated in the absence of the state's activity. Here, the state is acting as co-creator, planner, and manager of IP institutions in ways that transcend the logic of public infrastructure. This coordination-based activity offers a different version of the capable state, one which perhaps requires even greater state capacities than platform-building and in which the line between public and private action is blurred. Understanding this type of state activity, I will suggest, requires importing concepts from the literature on innovation theory and industrial policy, domains that have long understood the state itself as a dynamic agent capable of driving economic development.

The Article will proceed as follows. Part I offers an overview of recent developments in American manufacturing leading up to the establishment of the Manufacturing USA program, and discusses the dominant arguments for and against state intervention to reverse the decline of the industry. Part II discusses the policy history leading to the establishment of Manufacturing USA, as well as the program's technological focus areas and basic organizational paradigm. Part III describes the different approaches taken by the Manufacturing USA Institutes to managing IP sharing between firms, identifying three distinct forms of state action within the program. Part IV discusses in greater depth the coordination-based form of state action that can be observed in the program, its theoretical and practical significance, and its impact on an emerging view of IP's capable state. This Part concludes by noting some of the

22. For a discussion of the role of IP Management Plans within the program, see *infra* Part II.D.

normative problems that this approach entails and offers some suggestions for how these might be addressed.

II. THE CONTEXT

The American manufacturing industry faces an uncertain future. Through the popular press, we are reminded daily of the manufacturing industry's inevitable disappearance, or we read of a coming industrial renaissance in the United States ushered in by a set of new, highly automated technologies.[23] It is recognized by many observers, however, that the future of American industry is not predetermined, but actively shaped by a range of current policies. The most visible of these policy areas in the current debate has been trade: critics of American trade policies have cited, with some evidence, China's entry into the World Trade Organization and other trade effects as key drivers of industrial displacement in the US.[24] There is another area of policy, however, that may be equally important to the long-run stability of American industry: the role of the government in directly promoting manufacturing technology development.

In general, the federal government's technology programs play a key role in determining the long-term success of certain sectors.[25] Many technologies that have been transformative in the

23. For the former view, see, for example, Eduardo Porter, *The Mirage of a Return to Manufacturing Greatness*, N.Y. TIMES (Apr. 26, 2016), https://www.nytimes.com/2016/04/27/business/economy/the-mirage-of-a-return-to-manufacturing-greatness.html. For the latter view, see, for example, Jordan Weissmann, *Get Ready for Manufacturing's Big Comeback*, ATLANTIC (Dec. 21, 2011), https://www.theatlantic.com/business/archive/2011/12/get-ready-for-manufacturings-big-comeback/250291; Chip Cutter, *More Americans Are Back at Work Making Stuff*, WALL STREET J. (Mar. 1, 2019, 5:30 AM), https://www.wsj.com/articles/more-americans-are-back-at-work-making-stuff-11551436201.

24. The past several years have seen a resurgence of criticism of American trade policies from both the political left and right. *See, e.g.*, John Brinkley, *Why Is Trade Such a Big Deal in the Election Campaign*, Forbes (Mar. 3, 2016, 10:19 AM), https://www.forbes.com/sites/johnbrinkley/2016/03/03/why-is-trade-such-a-big-deal-in-the-election-campaign/#6a5ff6bf331d. Academic economists have also entered the fray, in some cases suggesting that the American workforce suffered from a massive "China Shock" upon China's entry into the WTO in 2001. *See, e.g.*, David H. Autor, David Dorn & Gordon H. Hanson, *The China Shock: Learning from Labor Market Adjustment to Large Changes in Trade*, 8 ANN. REV. ECON. 205, 231-34 (2016); *see also* David H. Autor, *Trade and Labor Markets: Lessons from China's Rise*, IZA WORLD LAB. (Feb. 2018), https://wol.iza.org/uploads/articles/431/pdfs/trade-and-labor-makets-lessons-from-chinas-rise.pdf.

25. For an overview of R&D-oriented industrial policy programs run by the federal government, see, for example, STATE OF INNOVATION: THE U.S. GOVERNMENT'S ROLE IN TECHNOLOGY DEVELOPMENT (Fred L. Block & Matthew R. Keller eds., 2011) (providing a series of case studies on federal government technology development programs, focusing in particular on the

overall trajectory of the American economy trace their origins to these programs.[26] The internet is one obvious case: while many private firms and research groups would make important later contributions to the development of the internet, its origins lie in the Department of Defense's ARPANET project in the late 1960s.[27] Beyond their role in creating entirely new technological areas, federal technology programs are also deeply involved in maintaining the global competitive position of certain American economic sectors.[28] Some scholars have argued, for example, that the dominant position of US-based pharmaceutical firms in the global market owes a great deal to federally-funded R&D and other interventions.[29]

In recent years, scholars from a wide range of disciplines have labeled the collective set of these technology development programs as an American version of industrial policy, a form of state intervention once considered the exclusive purview of developing countries during periods of economic catch-up.[30] Sectorally-focused

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1980s onward). *See also* MARIANA MAZZUCATO, THE ENTREPRENEURIAL STATE: DEBUNKING PUBLIC VS. PRIVATE SECTOR MYTHS (2015) (arguing that much of the American economy's innovative capacities originate in state-led technology programs).

26. A particularly striking example is the Apple iPhone, which is made up entirely of subparts that originated in US government-led technology programs, primarily those within the military. *See* MAZZUCATO, *supra* note 26, at 108-13.

27. ARPANET was established by the Advanced Research Projects Agency (ARPA), now known as the Defense Advanced Research Projects Agency (DARPA). For an extensive history of DARPA, see SHARON WEINBERGER, THE IMAGINEERS OF WAR: THE UNTOLD STORY OF DARPA, THE PENTAGON AGENCY THAT CHANGED THE WORLD 56-65 (2017).

28. *See, e.g.*, MAZZUCATO, *supra* note 26. For a critical case study on the contributions of federal R&D toward maintaining the American pharmaceutical industry's global edge, see MARCIA ANGELL, THE TRUTH ABOUT THE DRUG COMPANIES: HOW THEY DECEIVE US AND WHAT TO DO ABOUT IT (2004).

29. *See* ANGELL, *supra* note 29, at xv-xvii. *See also* Lisa Larrimore Oullette, *AOC on Pharma & Public Funding*, WRITTEN DESCRIPTION (Feb. 3, 2019), https://writtendescription.blogspot.com/2019/02/aoc-on-pharma-public-funding.html (suggesting a more mixed view of the role of public and private actors in pharmaceutical development).

30. Industrial policy has a controversial history in the United States since WWII. It was once generally accepted that since federal R&D interventions are not organized under a single comprehensive plan, these activities did not amount to an industrial policy. *See, e.g.*, OTIS L. GRAHAM, JR., LOSING TIME: THE INDUSTRIAL POLICY DEBATE 73 (1992). In recent years, however, this position has been reassessed by scholars from a number of fields. *See, e.g.*, Fred Block, *Swimming Against the Current: The Rise of a Hidden Developmental State in the United States*, 36 POL. & SOC'Y 169, 170-71 (2008) (economic sociology); LINDA WEISS, AMERICA INC.? INNOVATION AND ENTERPRISE IN THE NATIONAL SECURITY STATE 75-95 (2014) (political science); MAZZUCATO, *supra* note 26, at 91-92 (economics). It is now common to describe R&D-oriented industrial policy interventions in the US by other terms, including "innovation policy." I use the

industrial policy in the US has a very long tradition, however, and post-WWII technology programs are only the latest variant of that tradition.[31] The Manufacturing USA program is thus one of the most recent in a long line of federal programs aimed at promoting the development of specific sectors. This section will briefly outline the key events that led to the program's creation and the problems it was designed to address.

A. The Landslide

The Manufacturing USA program emerged in a climate of deep concern over structural weaknesses in the American economy in the aftermath of the Great Recession. The financial crisis prompted discussions on how to reform the features of the economy most directly linked to the causes of the recession, with financial markets and the terms of the federal bailout as the primary focus.[32] The most significant action taken by the federal government during the peak months of the crisis linked directly to manufacturing was the bailout of General Motors and the automotive industry.[33] The auto bailout itself was deeply controversial, with many critics questioning why the US needed domestic car manufacturers at all.[34] Once the dust had settled, however, attention in policy circles turned to notions of American competitiveness. As some observers suggested, avoiding a drawn-out and incomplete recovery would require new policy to upgrade the technical capacities and skill base of key sectors, with the manufacturing industry as a potential focus.[35]

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term industrial policy in this Article because I believe the kinds of state action that these programs involve are comparable to those of classic case studies of industrial policy in developing countries, which I discuss in Part IV below.

31. As Michael Lind suggests in his "Hamiltonian" retelling of American economic history, "[i]ndustrial policy is not alien to the American tradition. It is the American tradition." MICHAEL LIND, LAND OF PROMISE: AN ECONOMIC HISTORY OF THE UNITED STATES 465 (2012).

32. The literature on the causes and immediate consequences of the Great Recession is vast. For a review of the crisis focused on the role of financial deregulation and risk, see, for example, JOSEPH STIGLITZ, FREEFALL 27-57 (2010).

33. *See* STEVEN RATTNER, OVERHAUL: AN INSIDER'S ACCOUNT OF THE OBAMA ADMINISTRATION'S EMERGENCY RESCUE OF THE AUTO INDUSTRY 2 (2010) (calling the auto bailout the "largest government intervention in Industrial America since World War II").

34. For an overview of the arguments for and against the bailout, see *The Auto Bailout 10 Years Later: Was It the Right Call?*, KNOWLEDGE@WHARTON (Sept. 12, 2018), http://knowledge.wharton.upenn.edu/article/auto-bailout-ten-years-later-right-call.

35. *See, e.g.*, GARY P. PISANO & WILLY C. SHIH, PRODUCING PROSPERITY: WHY AMERICA NEEDS A MANUFACTURING RENAISSANCE (2012).

Though the 2008 recession was the key event in bringing manufacturing capacity to the fore in policy circles, the decline of American manufacturing was not a new phenomenon. Global production in the post-WWII era had been marked by a gradual shift of complex manufacturing—spanning from textiles to electronics—out of the US and other already-developed countries and into the "late developers" like Japan, South Korea, and others.[36] Relative decline in the national employment share in manufacturing has been particularly prominent since the early 1980s.[37] This broad trend obscures acute place-specific crises, with many formerly booming areas suffering from sudden economic decline.[38]

Gradual change through the 1980s and 90s gave way to sudden and dramatic decline in the 2000s. During that decade, the country lost one-third of its manufacturing jobs, and fixed capital investment declined in over 75% of industrial sub-sectors, a sharp reversal from a steady increase in manufacturing investment in the 1990s.[39] Net output from the same share of the industry also declined, and productivity growth dropped from over 4% per year in the 1990s to 1.7% per year in the 2000s.[40] Clearly, something had changed for US manufacturing years before the recession hit.

Analyses of this "lost decade" have pointed to many causal factors, including the effects of labor-saving—or labor-replacing—technologies.[41] While technological advancement may have had some effect, it does not offer a convincing account as the primary cause of job decline, since technology-driven productivity rates in manufacturing have actually been quite slow for several decades. Moreover, there were no obvious manufacturing technology breakthroughs leading up to the 2000s.[42] A more likely culprit was the rising capacities of global industrial competitors in higher-value-added forms of manufacturing, most importantly China. With China entering the World Trade Organization in 2001 at the precise

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36. *See, e.g.*, WILLIAM B. BONVILLIAN & PETER L. SINGER, ADVANCED MANUFACTURING: THE NEW AMERICAN INNOVATION POLICIES 37-63 (2017).

37. *See* Susan N. Houseman, *Understanding the Decline of U.S. Manufacturing Employment* 5 (W.E. Upjohn Inst. for Emp't Research, Working Paper 18-287, 2018).

38. *See* BONVILLIAN & SINGER, *supra* note 37.

39. *Id.* at 52-53.

40. *Id.* at 53-54.

41. *See* Robert Atkinson, *Why the 2000s Were a Lost Decade for American Manufacturing*, INDUSTRY WEEK (Mar. 14, 2013), https://www.industryweek.com/the-economy/article/22006840/why-the-2000s-were-a-lost-decade-for-american-manufacturing.

42. *See id.* (discussing the decline in total manufacturing output in the 2000s).

moment that Chinese-based production became capable of competing on the global market in complex manufactures, many American-based firms either sent production off-shore or saw themselves outcompeted by the new industrial superpower.[43]

B. The Argument Against State Action

Many observers did not see the decline of the US manufacturing sector as a problem. The decline of manufacturing as a share of American employment, some suggested, was an inevitable consequence of further development toward a service-based economy. Indeed, predictions of manufacturing's dramatic decline as a fraction of total employment had been made long before the 2000s landslide. Forecasts of advanced capitalist countries making the transition to "post-industrial societies" had been popularized as early as 1974.[44] These predictions foresaw an inevitable reduction in manufacturing employment and the eventual realization of a "knowledge-intensive" service economy.[45] Due to advances in labor-saving productivity, the manufacturing industry would eventually go the way of agriculture: once one of the largest sources of national employment, agriculture is now under 2% of the country's total, with no shortages of output.[46]

Some observers denounced concerns over potential weaknesses in the economy linked to industry as the return of a "manufactures fetish" long held by production-oriented economists.[47] Staunch free trade advocates such as Jagdish Bhagwati argued that the US should not interrupt global market signals that transfer manufacturing to lower-wage countries with a comparative advantage.[48] Bhagwati dramatically claimed that it did not make a difference whether the US produced "potato chips or semiconductor chips"—consumptive capacity completely trumped productive prowess.[49]

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43. *Id.* at 56; *see also* AUTOR, *supra* note 25, at 9.

44. DANIEL BELL, THE COMING OF POST-INDUSTRIAL SOCIETY: A VENTURE IN SOCIAL FORECASTING, at x (1973) ("The thesis advanced in this book is that in the next thirty to fifty years we will see the emergence of what I have called 'the post-industrial society.'").

45. *Id.* at 107-08.

46. *See* H. Plecher, *Distribution of the Workforce Across Economic Sectors in the United States from 2009 to 2019*, STATISTA (Feb. 11, 2020), https://www.statista.com/statistics/270072/distribution-of-the-workforce-across-economic-sectors-in-the-united-states.

47. Jagdish Bhagwati, *The Manufacturing Fallacy*, PROJECT SYNDICATE (Aug. 27, 2010), https://www.project-syndicate.org/commentary/the-manufacturing-fallacy.

48. *Id.*

49. *Id.* ("I have argued, on the other hand, that you could produce semiconductor chips, trade them for potato chips, and then munch them while

Prominent voices close to the Obama Administration also declared a manufacturing recovery policy unnecessary. Following repeated mentions in President Obama's speeches of the need for a policy to address industrial decline, Christina Romer, formerly one of the President's key economic advisors involved in the bank and automotive bailouts, suggested in a public opinion piece that manufacturing deserved no "special treatment" from the Administration.[50] She advocated against a manufacturing-specific industrial policy on the grounds that market failures in the industry could not be firmly identified and that the industry itself did not have characteristics that set it apart from others in justifying sectoral intervention.[51] The discussions to save the manufacturing industry, Romer suggested, amounted to nothing more than "sentiment and history," and she urged the Administration to focus on economy-wide policies aimed at boosting aggregate demand.[52]

C. The Argument for State Action

Proponents of a government response made several counterarguments. First, as noted above, productivity rates and output in the industry actually declined during the steepest drop in manufacturing employment.[53] The notion that technology and automation were the primary job-replacers during this period was therefore suspect, and the sense of inevitability invoked by many critics of state intervention did not seem convincing. These proponents relied instead on several variations of the same fundamental argument: that, contrary to an orthodox Ricardian view of specialization and trade, there were indeed special qualities

watching TV and becoming a moron. On the other hand, you could produce potato chips, trade them for semiconductor chips that you put into your PC, and become a computer wizard! In short, it is what you 'consume,' not what you produce, that influences what sort of person you will be and how that affects your economy and your society."). The "potato chips vs. microchips" quip has a long history in policy debates over American economic competitiveness, dating back to a statement by George Bush Sr.'s economic advisor Michael Boskin in the 1992 presidential election. *See* Robert Atkinson, *Manufacturing Policy is NOT "Industrial Policy,"* INNOVATION FILES (Feb. 6, 2012), https://www.innovationfiles.org/manufacturing-policy-is-not-%E2%80%9C industrial-policy%E2%80%9D.

50. Christina D. Romer, *Do Manufacturers Need Special Treatment?*, N.Y. TIMES (Feb. 4, 2012), https://www.nytimes.com/2012/02/05/business/do-manufacturers-need-special-treatment-economic-view.html.

51. *Id.*

52. *Id.*

53. *See* BONVILLIAN & SINGER, *supra* note 37, at 53-54.

to manufacturing that distinguished it from other sectors and that justified targeted state support.[54]

Gary Pisano and Willy Shih, for example, suggested that though the manufacturing sector may never return to its once high share of national employment, the sector itself was still critical to the success of the entire economy due to its contribution to overall productivity gains and high degree of interconnectedness with other sectors.[55] The industry also requires a thick set of linkages to other sectors on both the supply and demand side: manufacturing was not to be understood as an isolated economic silo but rather a thread "woven together into complex webs" with other industries and broad economic capabilities.[56] Allowing the manufacturing sector to decline further, therefore, would pose major risks for large parts of the American economy that rely on the manufacturing sector in fundamental ways.[57]

Similarly, Suzanne Berger argued that the broad capacities of the American economy to innovate depended in large part on its capacities to actually produce goods.[58] Advances in processes and product design often required close associations between the productive and innovative branches of firms. The strategy to "invent it here, make it there" that many American firms had chosen in recent decades thus jeopardized the capacity of many of these firms

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54. Erik Reinert has defined this orthodox Ricardianism as having two basic assumptions: (1) It regards all units of labor time across countries as fundamentally the same; and (2) it assumes a static system of bartering under current equilibrium constraints. Erik S. Reinert, *Emulation Versus Comparative Advantage: Competing and Complementary Principles in the History of Economic Policy*, *in* INDUSTRIAL POLICY AND DEVELOPMENT: THE POLITICAL ECONOMY OF CAPABILITIES ACCUMULATION 79, 80 (Mario Cimoli et al. eds., 2009).

55. PISANO & SHIH, *supra* note 36, at 47. Similar arguments were made during the previous national debate about the need for a manufacturing-led industrial policy in the 1980s. *See, e.g.*, ROBERT H. HAYES & STEVEN C. WHEELWRIGHT, RESTORING OUR COMPETITIVE EDGE 3-4 (1984) ("Companies too often have treated manufacturing decisions on an ad hoc basis, as a series of technical problems that can be surmounted one by one without regard for the linkages between them."); STEPHEN S. COHEN & JOHN ZYSMAN, MANUFACTURING MATTERS: THE MYTH OF THE POST-INDUSTRIAL ECONOMY, at xiii (1987) ("Manufacturing is critical to the health of the economy."). Ha-Joon Chang has been a leading proponent of an economic structuralist view of the manufacturing industry primarily in the context of developing countries. *See, e.g.,* HA-JOON CHANG, 23 THINGS THEY DON'T TELL YOU ABOUT CAPITALISM 92 (2010) (arguing that developing countries cannot become post-industrial without first being industrial).

56. PISANO & SHIH, *supra* note 36, at 49.

57. *Id.*

58. SUZANNE BERGER, MAKING IN AMERICA: FROM INNOVATION TO MARKET 3-6 (2013).

to develop and implement innovations over the long term.[59.] Production abroad also opens up pathways for foreign firms to climb the value-added ladder, eventually graduating from production and moving into process and product design.[60.] While this offered obvious benefits to countries to which production by American firms shifted, it posed concerns for policymakers focused on American competitiveness and productivity. If production continued to leave the US, innovation might eventually go with it.[61.]

III. MANUFACTURING USA

It was in this climate of debate over the future of American industry that the Obama Administration began to formulate its policy position. The innovation program that eventually resulted, Manufacturing USA, is a consortium-based model of public-private partnerships that aims to spur technological innovations by facilitating collaboration between industry competitors, and between those competitors and university partners. IP sharing of various forms is a key mechanism through which collaboration operates. This section provides an overview of the Manufacturing USA program, discussing the events leading up to the program's creation, the program's technological focus area, and the general approach taken by the Manufacturing USA institute model.

A. The Obama Administration Responds

In mid-2011, the President's Council of Advisors on Science and Technology (PCAST), an advisory group of academic scientists and industry representatives, issued a report that warned of long-term structural weaknesses in the American economy if manufacturing continued to decline and promoted a role for the federal government to support the industry through advanced manufacturing policies.[62.] The report began to outline a concrete policy message, calling for the creation of an "Advanced Manufacturing Initiative" that would "support innovation in advanced manufacturing through applied research programs for promising new technologies, public-private partnerships around broadly-applicable and precompetitive technologies, the creation

59. Martin A. Schmidt & Phillip A. Sharp, *Preface* to *id.*, at xi, xi; BERGER, *supra* note 59, at 5-6.

60. BERGER, *supra* note 59, at 14.

61. Pisano and Shih make a similar version of this argument. PISANO & SHIH, *supra* note 36, at 61-65.

62. PRESIDENT'S COUNCIL OF ADVISORS ON SCI. & TECH., EXEC. OFFICE OF THE PRESIDENT, REPORT TO THE PRESIDENT ON ENSURING AMERICAN LEADERSHIP IN ADVANCED MANUFACTURING (2011), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/pcast-advanced-manufacturing-june2011.pdf [hereinafter PCAST 2011].

and dissemination of design methodologies for manufacturing, and shared technology infrastructure to support advances in existing manufacturing industries."[63.]

The report listed three basic justifications for a targeted government response: revitalizing the manufacturing industry would (1) help stabilize a meaningful share of the economy's well-paying jobs; (2) prevent the broader innovative capacities of the economy linked directly to production from declining; and (3) ensure that the US could keep domestic manufacturing products necessary for national security.[64.] While this was not a full-throated endorsement of an economic structuralist view, it drew directly from the arguments discussed above and represented a major step in legitimizing direct state intervention in the sector.[65.]

In response to PCAST's 2011 report, the Obama Administration created the "Advanced Manufacturing Partnership" (AMP), a temporary council of business leaders and academics tasked with formulating a new policy approach to support the manufacturing industry.[66.] Over the next year, the AMP held four regional workshops across the country for industry representatives, academics, and government officials to offer input into what a concrete government response should look like.[67.] In a report summarizing the input from these meetings, the AMP recommended that the federal government create a series of "Manufacturing Innovation Institutes" that would encourage collaboration between industry competitors, academic research groups, and federal agencies.[68.]

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63. *Id.* at Introductory Letter. No doubt with political considerations in mind, the report's authors were careful to distinguish innovation policy from industrial policy, though that distinction remained highly elusive. *See id.* ("We do not believe that the solution is *industrial policy*, in which government invests in particular companies or sectors. However, we strongly believe that the Nation requires a coherent *innovation policy* to ensure U.S. leadership support new technologies and approaches, and provide the basis for high-quality jobs for Americans in the manufacturing sector.").

64. *Id.* at ii.

65. The report cites Gary P. Pisano & Willy C. Shih, *Restoring American Competitiveness*, 87 HARV. BUS. REV. 114 (2009), several times on the "co-location" of manufacturing and manufacturing-related R&D activities argument.

66. PRESIDENT'S COUNCIL OF ADVISORS ON SCI. & TECH., EXEC. OFFICE OF THE PRESIDENT, REPORT TO THE PRESIDENT ON CAPTURING DOMESTIC COMPETITIVE ADVANTAGE IN ADVANCED MANUFACTURING 3 (2012), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/pcast_amp_steering_committee_report_final_july_27_2012.pdf [hereinafter PCAST 2012].

67. *Id.* at 4.

68. *Id.* at 16, 21-24, 33.

The primary problem that these institutes would address would be the "investment gap" between government and university research and private sector-driven product development.[69] In many past instances, US-based researchers had invented a new technology that had not been successfully taken up by American firms for market deployment.[70] The innovation gap resulted in these innovations being manufactured elsewhere. The Innovation Institutes would fill this gap by subsidizing collaborative research between firms and university partners, providing shared research spaces for these partners, constructing industry-wide technological "roadmaps" to chart out step-wise technological goals, and offering workforce development programs.[71] The initial report was largely silent on IP issues, aside from a general recommendation that the Innovation Institutes develop "a strong [IP] protocol that favors manufacturers."[72] In total, AMP called for 15 institutes to be created, each one tasked with a different sub-area of advanced manufacturing. An initial funding proposal called for $1 billion in federal funds, to be matched or exceeded by state governments for particular institutes.[73]

For this model to be implemented at the scale the AMP suggested, the Administration looked to create an initial pilot institute with already-available funds. In August 2012, the Department of Defense created what would later be called the "America Makes" institute in Youngstown, OH, which focused on 3D printing.[74] The institute-driven approach, which up to this point had been limited to policy discretion within the executive branch, received legislative backing in late 2014. The Revitalize American Manufacturing and Innovation (RAMI) Act authorized the establishment of the "Network for Manufacturing Innovation" under the monitoring of the National Institute of Standards and Technology (NIST).[75] A number of institutes had already been

69. *Id.* at 21.

70. *Id.* The report asserts that the innovation gap has resulted in many potentially commercializable inventions getting lost in "the valley of death" that exists between research and commercial development.

71. *Id.* at 15.

72. *Id.* at 24.

73. NAT'L SCI. & TECH. COUNCIL, EXEC. OFFICE OF THE PRESIDENT, NATIONAL NETWORK FOR MANUFACTURING INNOVATION: A PRELIMINARY DESIGN 2-3 (2013), https://www.manufacturing.gov/sites/default/files/2018-01/nnmi_prelim_design.pdf.

74. Office of the Press Sec'y, *We Can't Wait: Obama Administration Announces New Public-Private Partnership to Support*, WHITE HOUSE (Aug. 16, 2012), https://obamawhitehouse.archives.gov/the-press-office/2012/08/16/we-can-t-wait-obama-administration-announces-new-public-private-partners.

75. Revitalize American Manufacturing and Innovation Act of 2014, H.R. 2996, 113th Cong. § 3 (2014). The justifications listed in the RAMI Act included (1) improving the competitiveness of U.S. manufacturing and increasing

created with discretionary agency funds, but the RAMI Act secured funding for a full scale-up of the program. By the end of 2017, 14 institutes had been created, some of which had been up and running for several years.[76]. The following table lists each of these institutes, including their technological area of focus, location, and date of establishment:[77]

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DMDII	Digital manufacturing and design	Chicago, IL	February 2014
LIFT	Lightweight metals	Detroit, MI	February 2014
PowerAmerica	Wide bandgap power electronics	Raleigh, NC	January 2015
IACMI	Reinforced polymer composites	Knoxville, TN	June 2015
AIM Photonics	Integrated photonics	Albany, NY	July 2015
NextFlex	Flexible electronics	San Jose, CA	August 2015
AFFOA	Smart fabrics	Cambridge, MA	April 2016
CESMII	Smart manufacturing	Los Angeles, CA	December 2016
BioFabUSA	Biofabrication	Manchester,	December

production of manufactured goods in the US; (2) stimulating U.S. leadership in advanced manufacturing research, innovation, and technology; (3) accelerating the development of an advanced manufacturing workforce; and (4) creating and preserving jobs. The suggested technology focus areas included in the Act included nanotechnology, advanced ceramics, photonics and optics, composites, biobased and advanced materials, flexible hybrid technologies, and tool development for microelectronics.

76. For a more detailed account of the creation of Manufacturing USA, see BONVILLIAN & SINGER, *supra* note 37, at 131-86.

77. Adapted from ADVANCED MANUFACTURING NAT'L PROGRAM OFFICE, NAT'L INST. OF STANDARDS & TECH., MANUFACTURING USA ANNUAL REPORT 2017, at 5 (2018), https://nvlpubs.nist.gov/nistpubs/ams/NIST.AMS.600-3.pdf.

		NH	2016
ARM	Robotics	Pittsburgh, PA	January 2017
NIIMBL	Biopharmaceuticals	Newark, DE	March 2017
RAPID	Chemical manufacturing	New York, NY	March 2017
REMADE	Sustainable manufacturing	Rochester, NY	May 2017

B. Advanced Manufacturing

A few decades ago, the manufacturing industry might have seemed an odd target for a government-led technology development program. Technological progress in manufacturing was once achieved through steady improvements made on shop floors, and the bulk of manufacturing employment was generally lower-skill.[78] National competitiveness in manufacturing was certainly linked to the sophistication of plant and equipment within industry, but more important factors for overall competitiveness were organizational elements and production strategies within firms.[79] This is perhaps why the federal government's previous large-scale industrial policy program focused on the manufacturing industry was not oriented toward R&D and the technological frontier. Established in 1988, the Manufacturing Extension Partnership, also based within NIST, has focused primarily on improving the productivity of small-to-medium-sized manufacturers by offering a variety of consulting and support services.[80]

78. Alice Amsden has suggested that manufacturing innovation was once largely based on steadily accumulated improvements made on the shop floor. This had major implications for industrial policy: for example, it dictated that state interventions should be oriented less toward R&D and the technological frontier and more toward stepwise productivity-based improvements using already-developed technologies. For a discussion of this phenomenon in the context of South Korea during its high developmental years, see ALICE AMSDEN, ASIA'S NEXT GIANT: SOUTH KOREA AND LATE INDUSTRIALIZATION (1989).

79. *Id.* at 4-5.

80. For an extended case study of the Manufacturing Extension Partnership (MEP) Program, see JOSHUA WHITFORD, THE NEW OLD ECONOMY: NETWORKS, INSTITUTIONS AND THE ORGANIZATIONAL TRANSFORMATION OF AMERICAN MANUFACTURING 135-54 (2005) (discussing the Wisconsin MEP). *See also Manufacturing Extension Partnership: How the Network Helps*, NAT'L INST. STANDARDS & TECH., https://www.nist.gov/mep/mep-national-network/how-network-helps (last updated Nov. 15, 2019).

The manufacturing industry today looks very different, a result of a steady accumulation of new products and processes that have transformed the sector into an increasingly science- and engineering-heavy field.[81.] The term "advanced manufacturing" is now used to capture this transformation. Advanced manufacturing refers to forms of production involving a high degree of information technology and automated processes, usually requiring labor with higher skills than older forms of production do.[82.] These new forms of production often make use of newly developed synthetic materials, which incorporate breakthroughs from the physical and biological sciences.[83.]

A key feature of these changes, and a primary driver of renewed interest in state intervention, is that these newer forms of manufacturing are likely to be less threatened by competition from low-cost labor abroad than more traditional forms of manufacturing.[84.] Given sufficient technological advances, it is no longer fantasy to imagine a process of "reshoring" highly automated and complex forms of manufacturing back into the US.[85.] Manufacturing has thus become an industry for which state-led innovation programs are well-suited. The industry's significant upfront costs of applied research and high risk of undertaking new projects are now characteristic of the technological areas in which

81. *See, e.g.*, Elisabeth B. Reynolds, *Innovation and Production: Advanced Manufacturing Technologies, Trends and Implications for US Cities and Regions*, 43 BUILT ENV'T 25, 26-32 (2017). *See also* Darrell M. West, *How Technology is Changing Manufacturing*, BROOKINGS: TECHTANK (June 2, 2016), https://www.brookings.edu/blog/techtank/2016/06/02/how-technology-is-changing-manufacturing (documenting the increasing role of technology in the manufacturing sector).

82. Reynolds, *supra* note 83, at 27.

83. The PCAST and AMP reports were cognizant of this transformation. *See, e.g.*, PCAST 2011, *supra* note 63, at ii. ("[A]dvanced manufacturing [refers to] a family of activities that (a) depend on the use and coordination of information, automation, computation, software, sensing, and networking, and/or (b) make use of cutting edge materials and emerging capabilities enabled by the physical and biological sciences, for example nanotechnology, chemistry, and biology. This involves both new ways to manufacture existing products, and especially the manufacture of new products emerging from new advanced technologies. We believe that advanced manufacturing provides the path forward to revitalizing U.S. leadership in manufacturing, and will best support economic productivity and ongoing knowledge production and innovation in the Nation.").

84. *See* Astrid Krenz et al., *Robots, Reshoring, and the Lot of Low-Skilled Workers* 2-3 (Ctr. for Eur. Gov't & Econ. Dev. Research, Discussion Paper No. 351, July 2018), http://dx.doi.org/10.2139/ssrn.3208886 (finding that increased automation is positively associated with the reshoring of production, defined as the return to the home country of production that had been previously offshored).

85. *Id.*

the US government has been deeply involved in promoting, including the defense and pharmaceutical sectors.

C. The SEMATECH Precedent

A government-backed consortium approach to industrial recovery was not an entirely new model in the US. A close parallel to the institute model within the Manufacturing USA program is the SEMATECH program created in the late 1980s.[86] SEMATECH was a federal initiative aimed at reviving the competitiveness of the American semiconductor industry.[87] Unlike the Manufacturing USA program, however, SEMATECH was an industry consortium created at the initiative of a select group of large firms.[88] By the mid-1980s, the US semiconductor industry faced a serious threat from Japanese firms, which had by that time captured the bulk of global market share and improved the quality of their products beyond those of American firms.[89] In response, Intel, Texas Instruments, and twelve other large US-based semiconductor manufacturers formed an organization to lobby the federal government for a technical assistance program that would bring the industry back up to the global competitive frontier.[90] The result was a five-year, 500 million dollar federal program that sought to increase the speed and quality of chipmaking by US firms. The consortium was considered a success, having quickly reduced the cost of research and development for new processes of chip production by over fifty percent.[91] Many observers have suggested that SEMATECH played a key role in the return of US semiconductor firms to global leadership by the mid-1990s.[92]

SEMATECH's goal of promoting "horizontal" collaboration between leading firms, however, was largely a failure. The consortium's initial strategy centered on precompetitive research projects in which firms would use a common research space owned by SEMATECH and share IP for the purposes of those

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86. The name "SEMATECH" is short for "Semiconductor Manufacturing Technology." *SEMATECH*, DEF. ADVANCED RESEARCH PROJECTS AGENCY, https://www.darpa.mil/about-us/timeline/sematech.

87. For a detailed history of SEMATECH, see LARRY D. BROWNING & JUDY C. SHETLER, SEMATECH: SAVING THE U.S. SEMICONDUCTOR INDUSTRY (2000).

88. *Id.* at 21.

89. Robert D. Hof, *Lessons from Sematech*, MIT TECH. REV. (July 25, 2011), https://www.technologyreview.com/s/424786/lessons-from-sematech.

90. *See* BROWNING & SHETLER, *supra* note 89, at 7-30.

91. *See* Hof, *supra* note 91.

92. *See* BROWNING & SHETLER, *supra* note 89, at 7-30.

projects.[93] The basic problem with this strategy was that SEMATECH's member firms differed substantially with respect to technological know-how. Some of the leading firms within the group, like Intel, were concerned that less-advanced firms would free ride on the contributions of the industry leaders. By joining with their industry competitors on collaborative projects, industry leaders risked revealing trade secrets that had set them apart from their competitors.[94] For these firms, the risks of collaboration outweighed the potential gains of new chip production processes. A similar situation can be observed at the AIM Photonics institute within the Manufacturing USA program, as will be discussed below. In response to these difficulties, SEMATECH shifted its focus toward "vertical" cooperation between member firms and suppliers, which benefited all member firms without threatening any proprietary capabilities.[95]

D. The Institute Model

The Innovation Institutes were designed to do many things at once, reflecting the Obama Administration's view that promoting technological development in manufacturing would require a multipronged approach. Each institute acts primarily as an R&D consortium for a given manufacturing subfield, but also offers workforce development programs and, where necessary, provides physical space for industry and university members to carry out research projects.[96] The institutes are encouraged to engage with firms of varying scale, emphasizing in particular small businesses that lack in-house R&D capacity to compete with industry leaders.[97] In their capacity as workforce development programs, the institutes partner with research universities, community colleges, and vocational high schools. The following diagram from AMP's original call for the creation of the institute network illustrates the variety of linkages between the institutes and other actors:[98]

93. *See* Peter Grindley et al., *SEMATECH and Collaborative Research: Lessons in the Design of High-technology Consortia*, 13 J. POL'Y ANALYSIS & MGMT. 723, 731, 734-35 (1994).

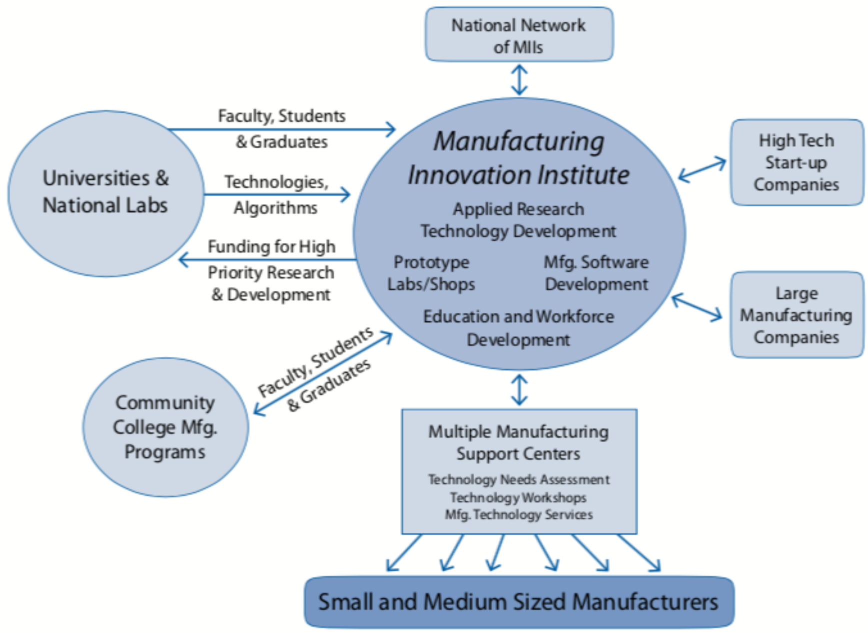
94. *Id.* at 730 ("Process technology expertise is central to the competitive advantage of individual semiconductor manufacturers, and member firms were reluctant to share such sensitive information. The sophistication of the manufacturing technology of SEMATECH member firms also differed considerably, raising the danger that some firms could 'free ride' on the contributions of technology leaders.").

95. *Id.*

96. *See* NAT'L SCI. & TECH. COUNCIL, *supra* note 74, at 4-7.

97. *Id.* at 7, 10.

98. Figure taken from PCAST 2012, *supra* note 67, at 23.



Across the entire program, each institute has been given leeway to develop its own approach to facilitating collaboration between its member firms. In 2014, after the program received official congressional backing, NIST issued general guidelines on how the institutes should approach IP issues.[99.] NIST formed an "IP task team" that reviewed the experience of the recently created America Makes institute and also drew explicitly on the government's experience in SEMATECH twenty years earlier.[100.] The task team recommended that each institute construct its own "IP Management Plan" that addressed how IP resulting from institute-subsidized projects would be handled, and what kinds of IP sharing obligations member firms would be asked to take on.[101.] The guidelines asserted, however, that "the IP strategy for large consortia is difficult to develop in advance," and that each institute would need to craft a strategy appropriate to the demands of its particular technological area and the needs of its member firms.[102.]

This institutional setup thus offers a unique opportunity to link particular approaches to IP sharing with field-specific technological architecture: the program is a kind of natural experiment in which the approaches to IP management taken by the

99. Advanced Mfg. Nat'l Program Office, *Guidance on Intellectual Property Rights for the National Network for Manufacturing Innovation*, NAT'L INST. STANDARDS & TECH. (Michael F. Molnar ed., 2014), https://www.manufacturing.gov/sites/default/files/2018-01/nnmi_ip.pdf.

100. *Id.* at 1-2.

101. *Id.* at 3.

102. *Id.* at 5.

institutes may reflect particular features of their manufacturing subfields. A synthesis of the types of state action vis-à-vis IP and knowledge sharing these institutes have developed and the technological architectures of their subfields may point to some general principles about what kinds of state action can promote the development of what kinds of technology.

IV. THREE FORMS OF STATE ACTION IN THE MANUFACTURING USA PROGRAM

Across the institutes examined in this study, there are three basic forms of state activity that appear significant with respect to IP and knowledge sharing, each of them distinct in their approach and goals. These three forms are: (1) generating an IP commons and making it available to a group of institute members; (2) constructing an industry-wide technological platform, with all its constitutive IP; and (3) coordinating firms into discrete research projects in which know-how is shared and IP is jointly held by participating firms. This section outlines these three forms and situates each within the existing literature on IP and technology development. While efforts within the program to construct versions of IP commons have been largely unsuccessful, institutes have effectively pursued the platform-based and coordination-based approaches. Which of these latter two approaches a given institute pursues, I suggest, will generally depend on the technological characteristics of that institute's subfield.

A. Building the Commons

The commons is a familiar institutional concept in IP scholarship, with its most potent application in the context of software development. Benkler, among others, has spearheaded a defense of the commons as an alternative institutional choice for the development of software projects on both practical and normative grounds.[103] When production in a particular technological field is decentralized across a number of producers, and involves a high degree of "creative" content, as Benkler describes the field of software development, producers can engage in "commons-based peer production," in which they collaborate through the use of an open pool of IP.[104] Peer producers engaged in this mode of

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103. For the functional defense of the commons in the context of software development, see Benkler, *supra* note 13, at 375-78. For the normative exploration of the commons, see Yochai Benkler, Lecture, *Freedom in the Commons: Towards a Political Economy of Information*, 52 DUKE L.J. 1245, 1256 (2003).

104. *See* Benkler, *supra* note 13, at 375-76 ("Commons-based peer production . . . relies on decentralized information gathering and exchange to reduce the uncertainty of participants. It has particular advantages as an information process for identifying and allocating human creativity available to work on information

production draw from a number of motivations separate from the hierarchical commands that characterize work within firms and from price signals of the market.[105] For software development, commons-based peer production may be superior to standard models of IP ownership because it exposes a greater number of producers to a greater number of potential projects. The result of this arrangement is "improved information about, and allocation of, human creativity," allowing development of the technology to flourish.[106]

Benkler is careful, however, to stress the importance of low costs, returns, and physical capital requirements for the commons model to be functionally defensible. The low barriers to entry characteristic of software development, a result of the lower price of personal computing and widely available information for producers, have "inverted the capital structure" of production in this field.[107] For a commons-based model to work, the technological conditions must surpass a critical "threshold" characterized by "technologically contingent physical-capital requirements for effective action."[108] A criticism of the IP commons model, then, is that it does not translate well to more "traditional" capital-intensive fields.[109] Perhaps, though, if the fully developed version of commons-based peer production that Benkler describes is unlikely to succeed in capital-intensive fields, alternative versions that retain some form of a commons may still succeed.[110]

The experiments to develop versions of IP commons within the Manufacturing USA program thus speak directly to this possibility. When the program was in its earliest planning stages, the hope of some of the program's architects, particularly representatives from academia, was that each institute would create

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and cultural resources. It depends on very large aggregations of individuals independently scouring their information environment in search of opportunities to be creative in small or large increments.").

105. *Id.* at 406.

106. *Id*. at 377.

107. *Id. See also* Benkler, *supra* note 12, at 278.

108. Benkler, *supra* note 12. This point is also noted in by Grewal, *supra* note 16, who identifies industry platforms as these thresholds. *See* discussion in Part III.B.

109. *See* Benkler, *supra* note 12, at 339-40.

110. It should be noted that IP commons within the Manufacturing USA program are conceptually distinct from the "industrial commons," a concept frequently used in the literature on manufacturing in the American economy. The industrial commons is a broader concept meant to include the collective set of production-oriented capacities and knowledge-based assets that provide network externalities to individual producers. An IP commons available to many firms could perhaps be a component of an industrial commons. *See, e.g.*, PISANO & SHIH, *supra* note 36.

its own common pool of IP which could be used by all industry members non-exclusively. Prospective industry members quickly expressed reservations about this approach, however, and plans to develop patent pools across the program were abandoned in favor of the institute-specific approach described in Part II.D.[111]

At the individual institute level, one experiment with an IP commons has been developed at the Advanced Functional Fabrics of America institute (AFFOA). AFFOA is one of the newest institutes, founded in 2016 with a grant from the Department of Defense and based in Cambridge, Massachusetts.[112] Its technological roadmap aims for "the transformation of traditional fibers, yarns, and textiles into highly sophisticated integrated and networked devices and systems."[113] Advanced fabrics offer a wide range of potential applications, including new types of wearables, in which digital technologies are embedded in clothing. AFFOA's membership profile spans a wide range of companies, most of them smaller startups rather than industry giants, and several universities.[114] Since advanced fabrics is a very early-stage technology, the institute itself has found that it has to invest heavily in proving up the commercial potential of the technology to its member firms.[115] To this end, AFFOA has built a large facility that its own researchers use to carry out new projects.[116] It has not yet been able to convene its member firms for major projects, though representatives from AFFOA believe that it will once the potential of the technology has been demonstrated.[117]

AFFOA's IP strategy reflects the early-stage character of advanced fabrics. Currently, most of the IP that may be relevant to creating new products and processes for advanced fabrics is owned by universities, which are not often engaged in pursuing spinoffs because the commercial potential of the IP is not obvious. At the same time, many of AFFOA's industry members are not aware of the dormant IP under university ownership or are reluctant to negotiate with multiple university rights-holders to support risky

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111. Interview with Krystyn J. Van Vliet, Professor, MIT, in Cambridge, Mass. (Oct. 19, 2018).

112. *See About AFFOA*, AFFOA, http://go.affoa.org/how-affoa-works (last visited Apr. 26, 2020).

113. *Id.*

114. *Building a Fabric Innovation Network*, AFFOA, http://go.affoa.org/members/#section01 (last visited Apr. 26, 2020).

115. Interview with Aimee Rose, AFFOA, in Cambridge, Mass. (Oct. 8, 2018).

116. *Id.*

117. *Id.*

projects.[118] AFFOA has sought to overcome this impasse by creating a common pool of university-based IP available to industry members. Upon joining the institute, AFFOA's university members agree to commit all of their IP related to advanced fabrics into an IP commons from which industry members can draw in order to develop new products.[119] The institute itself also scans this "IP Aggregate" and assesses how the separate IP rights in the pool might be combined in productive ways.[120]

What makes the commons approach a workable solution for AFFOA's technological area is its highly fragmented profile of currently developed IP. As one representative from academia working with AFFOA described, the commons approach is "something that is only worth doing where you've got a highly active field with decentralized ownership of foundational IP. It's not for every situation."[121] Since the value of the current IP held by university members of AFFOA is low, these members are not making a prohibitively large sacrifice by entering their IP into AFFOA's commons. At this stage, however, the experiment for non-exclusive use of the IP commons has not yet proven successful: early rounds of negotiations with industry members established that firms were uninterested in non-exclusive licenses because they did not perceive that they were worth the costs of joining the institute and of investing in the commercialization of the IP.[122] Moreover, given the commercial uncertainty of advanced fabrics, firms wanted to ensure that they would not have to worry about competitors if they were going to commit the resources to new lines of R&D. AFFOA has thus shifted its initial strategy and now plans to offer the university-based IP on exclusive terms.[123]

The abortive attempts within the Manufacturing USA program to establish versions of IP commons should come as no surprise. The type of production involved in advanced manufacturing has many of the opposite characteristics of technological fields that are the focus of Benkler and others in the copyleft movement. First, advanced manufacturing projects are extremely capital-intensive, with equipment highly concentrated in particular spaces and controlled by a limited number of actors.

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118. David Schwartz, *Fabric Institute's One-stop Licensing Initiative Bundles Background University IP*, TECH TRANSFER CTR.: U.-INDUST. ENGAGEMENT (Apr. 17, 2018), https://techtransfercentral.com/2018/04/17/fabric-institutes-one-stop-licensing-initiative-bundles-background-university-ip.

119. *Id.*

120. Interview with Aimee Rose, *supra* note 117.

121. Schwartz, *supra* note 120.

122. Interview with Aimee Rose, *supra* note 117.

123. *Id.*

Second, they can be roadmapped with some degree of precision. Finally, they offer potentially substantial direct returns to individual contributors. Even in the case of AFFOA's IP Aggregate, which requires no major up-front investments from industry members, these members were still uncomfortable with this limited degree of openness. Most of the institutes, AFFOA included, have therefore turned to alternative institutional strategies.

B. Filling Infrastructure Gaps

One of these alternatives is the institute-generated industry platform. The concept of the "platform" has permeated economic policy discussions, yet remains somewhat elusive because of its many applications in different contexts.[124] For example, recent years have witnessed the rise of "platform firms" like Uber and Lyft, which provide platforms in the form of algorithm-based apps that link drivers and passengers.[125] In contrast, the type of platform relevant to the Manufacturing USA program is the "industry platform," which Annabelle Gawer defines as "products, services, or technologies that are developed by one or several firms, and that serve as foundations upon which other firms can build complementary products, services or technologies."[126] The structural logic of a platform-based industry is modular, in which a set of stable core elements of an industry's technology support variation in other technological components linked to the core.[127] One example of an industry platform is the internet itself: once created, the internet provides the foundational threshold that allows for a massive variety of further productive activity and collaboration.[128] In Gawer's view, technologies may become platforms when they meet two key conditions: "they must (1) perform a function that is essential to a technological system; and (2) solve a business problem for many firms in the industry."[129] The internet meets both of these conditions for a number of industries by

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124. For a general overview of the various types of platforms in the management and economics literatures, see PLATFORMS, MARKETS AND INNOVATION (Annabelle Gawer, ed., 2009).

125. *See, e.g.*, NICK SRNICEK, PLATFORM CAPITALISM (2017) (offering a critical examination of the role of platform firms like Uber and others in contemporary capitalism).

126. Annabelle Gawer, *Platform Dynamics and Strategies: From Products to Services*, *in* PLATFORMS, MARKETS AND INNOVATION, *supra* note 126, at 45, 54. *See also* BRETT M. FRISCHMANN, INFRASTRUCTURE: THE SOCIAL VALUE OF SHARED RESOURCES 3-10 (2012).

127. Gawer, *supra* note 128, at 56. *See also* Grewal, *supra* note 16, at 151-52.

128. Gawer, *supra* note 128, at 54. It is noteworthy, in light of the discussion below, that the creation of the internet was largely rooted in state-based programs, including DARPA's "ARPANET" program in 1968 and others. The internet may be a prime example of a product of the platform-building state.

129. *Id.* at 56.

providing the basic technological means for efficient communication and information sharing.

Which economic or institutional actors can be counted on to create industry platforms? In some cases, incentives in a given industry make it economically rational for an individual firm to create a platform and then open it up for use by other producers. In allowing its platform to be used by other producers, these "platform leaders" can recoup their initial investment in generating the platform if the value of the returns from the use of the platform outweigh the resources required for its initial construction.[130] Apple, for example, has benefited enormously by opening up its iPhone operating system for use by app builders and users. By doing so, Apple is able to expand its market share and tap into the innovative capabilities of external agents.[131] Bottlenecks to innovation can emerge, however, when these incentives do not align. When the returns from the widespread use of a platform cannot be appropriated by the platform's maker, or, similarly, when those returns do not outweigh the up-front investment into the platform, it makes little sense for an individual firm to generate one.[132]

Technological domains that require platforms for further development can thus be stifled by incentive structures that discourage private platform-creation. One way out of this dilemma, then, is for platforms in these fields to be created by the state. The potential for the state to fill "infrastructure gaps" by building platforms is precisely the institutional choice examined by Grewal in the context of synthetic biology.[133] In explaining why efforts to develop commons-based collaborations in synthetic biology have been largely unsuccessful, Grewal suggests that the capital-intensive character of "wetware" production may render the commons-based model less effective.[134] Before commons-based production could conceivably take place in an emerging field like synthetic biology, a shared technical platform must be constructed from which all would-be peer producers can build.[135] In the case of synthetic biology, this platform is a set of standardized biological products and techniques that allow for their cheap and accurate mass

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130. *See generally* ANNABELLE GAWER & MICHAEL A. CUSUMANO, PLATFORM LEADERSHIP: HOW INTEL, MICROSOFT, AND CISCO DRIVE INDUSTRY INNOVATION (2002).

131. Gawer, *supra* note 128, at 54.

132. Strikingly, this is the same appropriation problem that the traditional model of IP aims to solve. See *infra* Part IV.A for an in-depth discussion of this parallel.

133. *See generally* Grewal, *supra* note 16.

134. *Id.* at 149-50.

135. *Id.* at 200-04.

production.[136] Once this threshold is passed, the barriers to entry for producers might be low enough to sustain a commons-based model. Grewal suggests that the only institutional actor likely to create such a platform is the state:

> [D]ecentralized peer production will . . . prove generally incapable of producing fundamental infrastructure because it presupposes the sharing of incremental innovations among *peers* working on a common platform. If one party has the capacity to produce a new platform for others, it may best be conceived as an extraordinary gift by an exceptional individual, not the collective product of a network of equal contributors . . . For these reasons, the work of building platforms will generally fall to a public agency, even if that agency is made effective in partnership with private actors.[137]

In contemplating potential state-based institutions that could be the model for a synthetic biology platform, Grewal refers to programs that are strikingly close to several of the Manufacturing USA institutes. He suggests, for example, that a consortium-based "biofab" facility created in partnership with the state could generate an industry platform, and points to the SEMATECH program as an example of the general type of state activity required.[138]

Indeed, Grewal correctly anticipates a dominant feature of what many of the Manufacturing USA institutes appear to be doing. For those subfields of advanced manufacturing in which further technological development requires the initial construction of an industry platform, several of the innovation institutes have taken on the role of platform-builder. An illustrative example is the American Institute for Manufacturing Integrated Photonics (AIM Photonics). AIM Photonics is based in Albany, New York, and focuses on improving the speed and quality of photonic chip production in the

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136. *Id.* at 200-01 ("[I]nfrastructure gaps more than any other factor have so far limited the much-anticipated success of synthetic biology. The most immediate infrastructural prerequisites for its successful development are scientific and technical, though background social and institutional norms are vitally important . . . . At a foundational level, it may be helpful to conceive a keystone collection of standard biological parts and associated assembly protocols as constituting a *platform* for further innovation. Borrowing from the platform theory outlined above, the immediate focus in synthetic biology should be on developing 'core components' and stable 'interfaces' at the genetic level—as, for example, in the use of bicistronic architecture to control gene expression.").

137. *Id.* at 204-05.

138. *Id.* at 202, 206.

US.[139] Integrated photonics is a promising subfield of manufacturing that uses light as the key signal transmitter in a range of applications.[140] Photonics technology has already been used in a number of products on the market, including LED lights, flatscreen TVs, and fiber-optic cables.[141] The industry is now moving toward the use of photonics technology in computer circuits, which currently rely on electrical signals rather than light. Photonic circuits offer the potential to process and transmit circuit signals much faster and with greater integrity.[142]

Currently, the bottleneck to further progress for this technology is not the development of new photonics products themselves, but rather faster and cheaper fabrication methods for already-established products—a critical infrastructure gap requiring a new platform.[143] Exacerbating this bottleneck is the competitive structure of the industry: the photonics sector is predicted by some to be an almost $800 billion global market by 2022, and it is currently dominated by a small group of large firms.[144] The integrated photonics sector and the role that this institute may serve in pushing the field forward is thus highly reminiscent of SEMATECH in the late 1980s. Like the photonics sector today, the bottleneck to growth of the semiconductor industry at that time was the quality and speed of manufacturing.[145]

It is not surprising, then, that AIM Photonics has faced many of the same challenges to promoting horizontal collaboration between firms as SEMATECH faced in its day. The problem, once again, is that industry members of AIM Photonics are unwilling to come together to share know-how on particular projects when the stakes are so high.[146] For industry members, the risk of revealing potential trade secrets to competitors outweighs the benefits of collaborative projects.[147] This has caused AIM Photonics to shift its

139. *Powering the 21st Century with Integrated Photonics*, AM. INST. FOR MFR. INTEGRATED PHOTONICS, https://static1.squarespace.com/static/55ae48f4e4b0d98862c1d3c7/t/5b291c4f2b6a28153b88d0ad/1529420879363/AIM+Overview_3.pdf (last visited Mar. 15, 2020).

140. *What Is Integrated Photonics?*, AM. INST. FOR MFR. INTEGRATED PHOTONICS, http://www.aimphotonics.com/what-is-integrated-photonics (last visited Mar. 15, 2020).

141. *What is Integrated Photonics?*, AM. INST. FOR MFR. INTEGRATED PHOTONICS ACAD., https://aimphotonics.academy/about/what-integrated-photonics (last visited April 16, 2020).

142. *Id.*

143. Interview with Lionel C. Kimerling, Am. Inst. for Mfr. Integrated Photonics, in Cambridge, Mass. (Nov. 16, 2018).

144. *Powering the 21st Century with Integrated Photonics*, *supra* note 141.

145. *See* discussion *supra* Part II.C.

146. Interview with Lionel C. Kimerling, *supra* note 145.

147. *Id.*

focus toward constructing a platform in the form of new industry-wide methods for the mass production of photonics chips.[148] But even getting member firms to support institute-driven research has been a challenge: member firms would like to see industry-wide fabrication methods develop in ways that play to their already-existing strengths. As a planner of AIM Photonics' strategy describes, "all member firms want to see a platform developed, but they each want to pull the platform in their own direction."[149] This has stalled inter-firm collaborative work at the institute. Meanwhile, the institute has taken on a greater role in advancing its own research, constructing and operating a large photonics fabricator that is making steady progress toward low-cost chips.[150]

The platform-building strategy of AIM Photonics has been adopted by several other institutes within the program. One of these is the Clean Energy Smart Manufacturing Innovation Institute (CESMII), based in Los Angeles, which focuses generally on improving the use of cyber-physical systems in manufacturing techniques to radically reduce the time and energy consumption of standard tasks.[151] To that end, the institute is developing the "SM Platform," an open cloud-based software system that manufacturers will be able to use to analyze signals produced by their machines and sensors in order to spot points in manufacturing processes that could be made more efficient.[152] The infrastructure gap that such a platform aims to fill is the lack of an accessible industry-wide method for manufacturers to analyze the complex array of data generated by their machines.[153] This platform will also offer the basic infrastructure for software developers to create and sell systems

148. *Id.*

149. *Id.*

150. *Test Assembly and Packaging Facility (TAP)*, AM. INST. FOR MFG. INTEGRATED PHOTONICS, https://static1.squarespace.com/static/55ae48f4e4b0d98862c1d3c7/t/5a85f75471c10b9bde6fd845/1518729047506/TAP+One-Pager_3.pdf (last visited Mar. 15, 2020).

151. *Our Approach to Innovative Manufacturing*, CLEAN ENERGY SMART MFG. INNOVATION INST., https://www.cesmii.org/what-we-do (last visited Mar. 15, 2020).

152. *SM Platform and Marketplace*, CLEAN ENERGY SMART MFG. INNOVATION INST., https://www.cesmii.org/sm-platform-and-marketplace/ (last visited April 16, 2020).

153. Ellen McKewen, *What is Smart Manufacturing? (Part 1B)*, CAL. MFG. TECH. CONSULTING, https://www.cmtc.com/blog/what-is-smart-manufacturing-part-1b-of-6 (last visited Mar. 15, 2020). ("Today, although many manufacturing processes rely on control contributions by computers, the systems and data on these computers exist in silos with little or no connectivity. The SM platform will allow processes to be integrated to support informed decision-making. . . . Companies of all sizes will be able to gain easy, affordable access to run simulations and gain analytical data for their particular needs.").

analytics software applications to manufacturing firm users.[154] The SM Platform could reduce the need for manufacturers across the industry to maintain large in-house IT support staff, and the hope is that the open use of the platform by software developers and manufacturers will lead to the dispersion of new techniques for improving productivity and reducing energy use.

The experiences of these institutes and others[155] suggest that Grewal's framework is well-suited to this element of the Manufacturing USA program. In some respects, the hardware-based platforms that serve as some of these institutes' focus, like AIM Photonics, may require more state intervention to establish platforms than software or wetware. It may be the case that the greater the investment of resources needed to build the platform, the greater the need for the platform-building state.

C. Coordinating Collaboration

A third mechanism of intervention vis-à-vis IP and knowledge sharing can be observed in many of the institutes in the program. In this capacity, state action goes beyond filling infrastructure gaps and involves instead the active planning of potential collaborators into discrete projects in which know-how is shared and IP is jointly owned. The technologies resulting from these projects are not industry platforms but often represent significant advances toward the technological goals laid out in institute roadmaps. In order to form these project "teams," the institutes must take stock of the unique capacities and non-disclosed IP of institute members, assess which of these members could productively contribute to which research projects, and bring members together on projects that the institutes themselves help plan and execute.[156] This is a form of *coordination-based* intervention in which it is difficult to identify where state action ends and exclusively private activity begins.

An institute that well illustrates this form of state action is the Institute for Advanced Composites Manufacturing Innovation (IACMI), located in Knoxville, Tennessee. IACMI focuses on developing new composite materials that are generally lighter, cheaper, and more energy-efficient than the currently available

154. CLEAN ENERGY SMART MFG. INNOVATION INST., *supra* note 154.

155. The other institutes within the program that seem to be focused, at least in part, on building platforms include AFFOA, DMDII, NIIMBL, and BioFabUSA.

156. Telephone Interview with Zack Gardner, Assistant Gen. Counsel, Inst. for Advanced Composites Mfg. Innovation (Oct. 15, 2018).

industry standards.[157] These composites have the potential to be used in a wide range of production techniques, including 3D printing and new recycling processes.[158] IACMI has over one hundred member firms, with IP relevant for institute-backed projects fairly evenly distributed between them.[159] Thus far, IACMI has been extremely successful in bringing together member firms for research projects, with over ninety of the member firms having already participated in at least one joint project.[160]

Under IACMI's IP plan, each participating firm in a given project has exclusive rights over any IP resulting from that project.[161] In the field of composites manufacturing, firms that collaborate on these projects are typically less concerned with revealing trade secrets and know-how, since the fabrication techniques for composites are not as sophisticated as those in subfields like photonics; rather, what matters most for firms in this area is the "recipe" for the end products.[162] The institute has already seen measurable success resulting from these collaborations. For example, in the last four years, the energy consumption of IACMI-based low-cost carbon fiber composites has been cut by over fifty percent. Before member firms began to collaborate on IACMI-sponsored projects, firms acting alone had seen annual energy reductions of one to two percent.[163]

IACMI officials attribute the institute's success in spurring collaboration between member firms to its "teaming" process, in which the institute actively reaches out to member firms, gauges their particular IP profiles and technical capacities, and brings firms together that the institute believes could each make valuable contributions to a particular project.[164] Member firms divulge to the institute proprietary information about their capabilities and what kinds of projects they are interested in undertaking.[165] The institute keeps this information confidential through conditional non-disclosure agreements.[166] When IACMI officials discover that

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157. *About IACMI*, INST. FOR ADVANCED COMPOSITES MFG. INNOVATION, https://iacmi.org/about-us/ (last visited Mar. 15, 2020).

158. *Composite Materials and Processes*, INST. FOR ADVANCED COMPOSITES MFG. INNOVATION, https://iacmi.org/technology-areas/composite-materials-and-process-technology-area/ (last visited Mar. 15, 2020).

159. Telephone Interview with Zack Gardner, *supra* note 158.

160. *Id.*

161. THE INST. FOR ADVANCED COMPOSITES MFG. INNOVATION, INTELLECTUAL PROPERTY MANAGEMENT PLAN (on file with author).

162. Telephone Interview with Zack Gardner, *supra* note 158.

163. *Id.*

164. *Id.*

165. *Id.*

166. *Id.*

multiple member firms are interested in the same kind of project, and that project aligns with the institute-established technological roadmap for composites, IACMI sets up a joint research venture in which those members work together to undertake the research and share the resulting IP.[167] Without the institute's "teaming" mechanism, these firms would be unlikely to form these joint ventures, since the very process of trying to figure out which firms to collaborate with involves some risk of revealing proprietary information. As one IACMI official put it, "there is nothing really preventing these firms from forming these joint ventures on their own, but without the institute, they just wouldn't do it."[168]

America Makes, the first institute created in the program, has employed this coordination-based strategy to similar effect in the domain of 3D printing. While most mass manufacturing processes today are *subtractive*, meaning that final products are created by manipulating and reducing larger original pieces, 3D printing, also known as *additive* manufacturing, reverses this process by directly creating products from scratch.[169] At this stage, 3D printers can excel at producing custom-designed prototypes, but America Makes and other actors in the industry hope that the technology will eventually be used at an industrial scale and will replace current mass production techniques.[170] The institute has developed a roadmap for advancing the field of 3D printing that focuses on speeding up and reducing the costs of the printing process itself, and improving the quality of the printed products.[171] It has not focused on developing a specified industry platform, but rather a series of discrete and independent technological advances carried out through joint ventures.[172]

Similar to IACMI, America Makes is able to assess the IP and firm-specific know-how of each of its members confidentially, and, once it has a clear picture of the knowledge embedded in these firms, coordinates them into research projects.[173] In some cases, the institute must be careful to arrange the joint projects in ways that reduce the risk of firms "over-sharing" know-how that is not essential

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167. *Id.*

168. *Id.*

169. WOHLERS ASSOCS., WOHLERS REPORT 2017: 3D PRINTING AND ADDITIVE MANUFACTURING STATE OF THE INDUSTRY 10-11 (2017).

170. Interview with Rob Gorham, Executive Director, America Makes, in Youngstown, Ohio (Jan. 25, 2019).

171. *Technology Roadmap Overview*, AMERICA MAKES, https://www.americamakes.us/our_work/technology-roadmap/ (last visited Apr. 19, 2020).

172. *Project Portfolio*, AMERICA MAKES, https://www.americamakes.us/our_work/project-portfolio (last visited Apr. 19, 2020).

173. Interview with Rob Gorham, *supra* note 172.

to the projects.[174] As with IACMI's projects, the actual participants in the research projects at America Makes have primary rights to IP that may result from successful collaborations. Other members of the institute can license project-based IP, which generates additional sources of revenue for firms that participated in those projects.[175] This mechanism is also a way for firms to further commercialize "background IP" that they owned before their participation in projects.[176] Since the commercial use of project-based IP often requires the simultaneous use of background IP owned by project members, these members often sell the rights to their project-based and background IP at the same time.[177]

Through this coordination-based form of state action, institutes like IACMI, America Makes, and others[178] bring together firms that would not, in the absence of the institute, choose to collaborate on research projects. Unlike platform-building, the coordination-based intervention pursued by many of the institutes does not anticipate a clear point at which their function will end and private activity will take over. The state's role here is more continuous, working hand-in-hand with member firms to accomplish stepwise research goals in accordance with the institutes' roadmaps. While platform-building can be analogized to the state building a vehicle which it intends to pass on to other actors, IACMI's coordination-based activity involves the state both building the vehicle and taking the wheel.

Why do some institutes build platforms, while others pursue a coordination-based strategy? The strategies appear to derive from certain fundamental characteristics of the technological domains themselves—namely, whether or not these domains require industry platforms for their further development. In fields such as composites and 3D printing, there are no obvious infrastructure gaps that must be filled to promote further development across the industry. Rather, there are only separate and discrete technological projects that build incrementally to industry-wide progress. These fields are not in need of platforms, either because their technological architectures have never required them, or because the platforms are already built.

Platform-based technologies like integrated photonics are structured differently. Before the further development of the

174. *Id.*
175. *Id.*
176. *Id.*
177. *Id.*
178. These include ARM, PowerAmerica, LIFT, NextFlex, and RAPID.

photonics industry can proceed, a critical technological threshold must be developed in the form of an improved fabrication technique for chips that can be used by the entire sector. The strategies employed by institutes vis-à-vis IP and knowledge sharing thus reflect this basic distinction between technologies with infrastructure gaps and those without them. Institutes in platform-needed fields have found it difficult to get firms to collaborate to build platforms, since firms are often concerned that the result of these collaborations will be used by firms across the sector and not just the firms in a given joint venture. This is the platform-linked free rider problem identified by Grewal, in which no firm or group of firms is willing to commit resources to a platform that may become available to firms that did not make any initial contribution.[179] The result has been that platform-focused institutes have had to take on a more proactive role in directly creating the platform, which institutes can make available to their member firms upon completion. In these fields, the higher degree of collaboration observed in the coordination-based institutes may only take place after the platform is built. For institutes working on technological domains without infrastructure gaps, collaboration has been much easier to facilitate. The experience of IACMI, for example, suggests that when a technological domain of manufacturing can be broken up into discrete projects that do not share a common platform, firms are more willing to collaborate because the up-front investments of resources are lower and free riding is less of a concern.

V. INTELLECTUAL PROPERTY BEYOND THE NEOLIBERAL STATE

Having identified and described the various forms of intervention within the program that promote collaboration-based innovation, the discussion now turns back to the problem of the "neoliberal" state.[180] As Kapczynski has suggested, there is a need for new conceptions of the role of the state in generating innovations through IP and knowledge-oriented institutions.[181] To a substantial degree, IP scholarship across the political spectrum converges on a particular type of minimalist, ineffective state that can only play a passive role in generating innovation. Advocates of the traditional model of private IP rely on this conception of the state to justify stricter and more lengthy enforcement of IP rights: since only private initiative generates new ideas and technologies, the state should limit itself to doling out and protecting monopoly rents in order to spur further private initiative.[182] Progressive-leaning scholars have

179. Grewal, *supra* note 16, at 204-05.
180. For an overview, see discussion *supra* Introduction.
181. *See generally* Kapczynski, *supra* note 3.
182. *Id.* at 132-35.

rejected this conventional view of IP arrangements and developed a new defense of the commons. As Kapczynski notes, however, these scholars are no more receptive to a productive role for the state in innovation as their conservative counterparts.[183.] In conceding the neoliberal vision of the state in innovation, scholars in favor of alternative IP arrangements limit their range to those involving minimal state action, like open-source and even innovation in the absence of IP.

Manufacturing USA program serves as a useful case study in response to Kapczynski's call for a conception of a "capable state." In this case, what the state is doing to generate innovation through IP and knowledge sharing goes beyond the minimalism of the neoliberal state: the state here is an active partner with industry and universities in creating the technical platforms upon which further development can proceed and in coordinating productive collaborations between dispersed actors. The state does not sit by and wait for private actors to innovate, nor does it protect a domain of IP from enclosure and then step away. But how should we positively characterize what the state is doing here, and what are the theoretical bases for this type of activity? This Part analyzes these more capable forms of state activity and offers one way of understanding them in relation to the functions performed by the neoliberal state. It then offers a theoretical grounding, paying particular attention to the coordination-based function, since the basis for platform-building has been dealt with in other work. This Part concludes with a discussion of some of the normative problems raised by the capable state, and offers some preliminary suggestions for dealing with them.

A. Appropriation and Coordination

This Article has noted four separate forms of state action, each geared toward generating innovation through IP and knowledge-based institutions. Two of these forms, the traditional model of private IP and the IP commons, are characterized as variants of the neoliberal state, while the other two, the platform-building and coordination-based activities identified in the Manufacturing USA program, are glimpses of IP's capable state. One useful way of distinguishing between these forms of state action, and understanding their relation to each other, is to focus on the types of problems that they each aim to solve.

The traditional model of private IP, for example, is oriented primarily toward one particular kind of problem: that, lacking

183.*Id.* at 137-44.

expectations of future state-protected rents, individual economic actors are unlikely to make the investments necessary to generate innovations.[184] This is a classic *appropriation* problem, in which innovation is stalled because would-be innovators cannot guarantee that they can appropriate the returns from their individual contributions. Even though certain innovations would be highly beneficial to many individuals in the aggregate, this potential social appropriation may not be enough to motivate self-interested innovators. The standard free rider concern supposedly paralyzes innovation without IP, since those who did not take on initial risk can nonetheless reap the benefits.

Strikingly, the platform-building state solves a problem of basically the same shape. Platforms often do not get built due to uncertainty about those platforms' future use and the concern that free riders may use the platform at a later point to the disadvantage of its builders.[185] The state thus has to step in and fill the existing infrastructure gap so that more productive collaboration might proceed. Although building a platform involves a different state function from doling out rents to individual actors, both of these functions can be seen as means of shielding would-be innovators from the free rider threat. The experiences of some of the Manufacturing USA institutes offer vindication of this view. Though AIM Photonics attempted early on to corral some of its member firms into a collaborative platform-building effort, the institute found this to be a difficult task, since firms were concerned about the future use of this platform on an industry-wide basis.[186] If these firms were to devote resources into building an industry platform from which they could not generate continuous returns, the threat of other free-riding firms using the platform would outweigh the benefits of building one. The institute itself was thus forced to step into the role of platform-builder.

What distinguishes the coordination-based form of state action observed throughout the Manufacturing USA program from both the traditional model and the platform-based model is that the state is solving a fundamentally different kind of problem. In the case of IACMI, for example, the reason firms do not come together on collaborative research projects is not that they are concerned about free riders, but that they lack the necessary information about each other's capacities and interests to explore collaborative possibilities in the first place.[187] Perhaps paradoxically, the IP and knowledge

184. The traditional model is discussed earlier. *See supra* Introduction.
185. See *supra* Part III.B.
186. *See supra* Part III.B.
187. *See supra* Part III.C.

protections that help these firms shield certain innovations from industry competitors also impede collaborative innovations with those same competitors. This is a problem of *coordination* rather than appropriation. The bottleneck to innovation here is the siloed positions of firms within the same industry and the failure of these firms to organize themselves into productive collaborations in the absence of an overarching planning mechanism. While traditional IP institutions solve appropriation problems, they may through the same function create or exacerbate coordination problems: protected knowledge can prevent a given firm from losing its returns to free riders while simultaneously making collaboration with other firms and non-competitive actors more difficult. This is the basis for the coordination-based approach found in the program.

In certain contexts, the IP commons model is also a solution to coordination problems. One way of reading Benkler's defense of commons-based peer-production, for example, is that the commons model overcomes coordination failures in fields that require a high degree of piecemeal collaborative effort:

> Peer production has an advantage over firms and markets because it allows larger groups of individuals to scour larger groups of resources in search of materials, projects, collaborations, and combinations than is possible for firms or individuals who function in markets. Transaction costs associated with property and contract limit the access of people to each other, to resources, and to projects when production is organized on a market or firm model, but not when it is organized on a peer production model.[188]

Benkler appears to be saying that innovation is stifled in these fields due to the atomizing effect of traditional legal forms such as IP.[189] The commons is therefore one method of overcoming this atomization and freeing up collaborative potential. The IP commons is a solution to the same problem addressed by the coordination-based activity of the Manufacturing USA institutes—namely, the problem of coordination that private IP tends to generate. In emerging fields, however, the commons approach cannot solve this coordination problem in the absence of a platform, which is itself a form of appropriation problem.

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188. Benkler, *supra* note 13, at 376-77.

189. *Id.*

We can thus sketch out a taxonomy of these four models of intervention in relation to both the problems that they solve and the conception of the state that they implicate. Both the traditional model and the platform model solve appropriation problems. From this functional perspective, the platform-building state is the capable counterpart to the traditional model. Likewise, both the coordination-based form of state action and the commons model solve coordination problems, and the coordinating state is therefore the capable alternative to the commons. Put somewhat differently, the platform model is the statist solution to the commons model's appropriation bottleneck, while the coordination model is the statist response to the traditional model's coordination problem. The following chart lays out this taxonomy:

	Solves the appropriation problem	*Solves the coordination problem*
Neoliberal State	**Traditional model**	**Commons model**
Capable State	**Platform model**	**Coordination model**

This distinction between appropriation- and coordination-based bottlenecks in the context of IP finds a useful analogue in the literature on industrial development planning. Coordination problems have been a common trope in the literature on development outside the US for some time—indeed, they have been viewed by some as the fundamental problem of economic development. For example, Albert O. Hirschman, one of the pioneers of postwar development theory, famously characterized the lack of economic growth in developing countries as resulting from the lack of a "pacing device" that could coordinate already existing resources and capacities into a self-reinforcing growth process.[190] In developing country contexts, this line of thinking suggested, coordination problems abounded, since distinct economic actors lacked the information and incentives necessary to participate in mutually productive projects.[191]

190. ALBERT O. HIRSCHMAN, THE STRATEGY OF ECONOMIC DEVELOPMENT 1-7 (Westview Press 1988) (1958). For a contemporary overview of coordination problems in development, and the role of state action in overcoming them, see STEPHEN HAGGARD, DEVELOPMENTAL STATES (2018).

191. *See, e.g.*, Dani Rodrik, *Getting Interventions Right: How South Korea and Taiwan Grew Rich*, 10 ECON. POL'Y 53, 79-80 (1995) ("From the perspective of an individual investor it will not pay to invest in the modern sector unless others are doing so as well. The profitability of the modern sector depends on the simultaneous presence of the specialized inputs; but the profitability of producing

An alternative line of development theory emphasizes problems of appropriation as key limits to economic growth. According to this view, potential contributors to economic growth are deterred from making useful investments due to the lack of adequate incentives and protections for those investments.[192.] This problem is analogous to innovation in the traditional model of IP. This distinction between an appropriation-based and coordination-based view of growth bottlenecks has obvious implications for the role of the state in development. If the problem of development is rooted fundamentally in the failure of economic actors to recoup their investments, it follows that the state should orient itself primarily toward offering appropriate incentives for individual investments, establishing and tightening property rights, and generally providing the sort of institutions conducive to individualized entrepreneurial effort.

If, however, bottlenecks to economic growth are linked to failures of coordination between economic actors, a different state may be called for. Coordination-based bottlenecks may only be overcome by a state that takes direct action in guiding investment to productive activities, and in certain cases, in managing the affairs of specific firms.[193.] Such a state is *developmental*, a prominent concept in

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these inputs in turn depends on the presence of demand from a pre-existing modern sector. It is this interdependence of production and investment decisions that creates the coordination problem.").

192. The standard formulation of this view is associated with Douglass North. *See, e.g.*, DOUGLASS C. NORTH, INSTITUTIONS, INSTITUTIONAL CHANGE AND ECONOMIC PERFORMANCE (1990). *See also* Daron Acemoglu, Simon Johnson & James A. Robinson, *Institutions as the Fundamental Cause of Long-Run Growth*, *in* 1A HANDBOOK OF ECONOMIC GROWTH 385 (Philippe Aghion & Steven N. Durlauf eds., 2005). For a critique of this form of institutional thinking see Ha-Joon Chang, *Institutions and Economic Development: Theory, Policy and History*, 7 J. INSTITUTIONAL ECON. 473 (2011).

193. This distinction between appropriation and coordination problems in development, and the implications of the distinction for the requisite state action to spur development, has been developed by Charles Sabel and colleagues in the context of development experiences in Latin America. Sabel and his coauthors find that processes of "self-discovery"– the process in which countries climb the value-added ladder of production – are often rooted in overcoming coordination problems rather than appropriation problems, contrary to what many of the dominant theories of development would suggest. Charles Sabel, *Self-Discovery as a Coordination Problem*, *in* EXPORT PIONEERS IN LATIN AMERICA 1, 41 (Charles Sabel et al. eds., 2012) ("Self-discovery is arduous and costly; it is not simply an incidental and automatic result of well-functioning markets. But neither is it a straightforward market failure that can be remediated by a patent-like tightening of property rights that allows pioneers to capture the positive externalities of their efforts. On the contrary, based on the evidence presented in this research project, self-discovery turns out to be largely a problem of complex coordination, solved by cooperation among diverse actors in the private and public sectors.").

the development planning literature once reserved to state action in countries engaged in rapid industrialization—but now applied equally to state programs oriented to the technological frontier.[194] This type of state does not merely set the dials for economic growth correctly—for example, by ensuring strong contract and property rights—and step aside; rather, it seeks to continuously guide economic growth in partnership with private actors in a more closely managed system.

The analogy to industrial development planning is useful for understanding the distinction between IP's neoliberal and capable states. For Grewal, the state as platform-builder provokes reflection on "what kind of thing a state is" with respect to the innovation process.[195] In his clever formulation, the state is a "meta-platform" or "platform of platforms," since it provides the foundational or "core" legal regime on which varying regimes of coordination can be built in a modular fashion.[196] This characterization invokes a static conception of the state—since a platform is itself an unchanging core foundation—which perhaps describes the institutional vision of the state designed to solve appropriation-based problems. It may not go far enough, however, in capturing the dynamic qualities of IP's capable state in coordination-based capacities. A more accurate view of this developmental form of state action in innovation is not a meta-platform but a *planner*, one that both sets the stage for innovation and directly and actively participates in its realization.

B. Innovation as a Coordination Problem

As discussed above, the coordination-based function found in the Manufacturing USA program aims to bring together normally competing firms to share IP and know-how toward specified research goals. In these cases, firms within the same industry need to both collaborate *and* protect proprietary knowledge. The coordination problem that results from this impasse can be overcome, I have suggested, by the form of state intervention seen in various institutes within the program. For a theoretical grounding of this form of intervention, we can draw on existing work on the state and innovation outside the IP literature.

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194. For an overview of the concept of the developmental state, see HAGGARD, *supra* note 192. Scholars from a range of disciplines now identify a "hidden developmental state" in the highly fragmented and decentralized set of R&D-oriented programs run by the federal government, particularly those created during and after the 1980s. *See, e.g.*, Block, *supra* note 31, at 170.

195. Grewal, *supra* note 16, at 209.

196. *Id.*

It has been long recognized that coordination between distinct economic actors and institutions is fundamental to innovation. Christopher Freeman, the pioneer of modern innovation studies, argued that a fundamental shift in the nature of innovation occurred during the mid-twentieth century resulting from the increased scientific quality, scale, and specialized nature of new technological endeavors.[197] Whereas innovation was once primarily the purview of individual laboratories and large R&D-committed firms such as Bell Labs, this qualitative shift meant that by the second half of the century innovation could only be sustained by a dynamic *system* of interacting institutions, including public labs, universities, private firms, and others.[198] Under this view, the global technology race would be won not necessarily by nations that spent the most resources on R&D, but rather by those able to cultivate a national system of coordinated relations between key actors.[199]

Structural changes in many contemporary industries, in which dominant firms have shed their in-house R&D efforts to focus instead on "core competencies," have made interactive forms of innovation all the more necessary.[200] The past thirty years have witnessed a fundamental shift away from large, vertically integrated "Chandlerian" firms that would rely primarily on internal research and production capacity and toward leaner vertically disintegrated firms.[201] In this post-Chandlerian economy, the organizational domain of innovation has shifted from within firms to *between* them. Firms that compete by maintaining a technological edge are thus forced by market pressures to engage in various forms of "co-opetition," a strategy that fuses collaborative and competitive forms of engagement with industry rivals.[202]

If interactions between disparate actors are essential to the innovation process, then how should those interactions be structured in a way most conducive to innovation? In their study of how private sector actors develop new ideas, Michael Piore and Richard Lester found that innovation involves both an "analytical" dimension, in

197. CHRISTOPHER FREEMAN & LUC SOETE, THE ECONOMICS OF INDUSTRIAL INNOVATION (Routledge 1997) (1974).

198. *Id.* at 1-24.

199. *Id.*

200. *See, e.g.*, Ronald J. Gilson, Charles Sabel & Robert E. Scott, *Contracting for Innovation: Vertical Disintegration and Interfirm Collaboration*, 109 COLUM. L. REV. 431, 433-36 (2009) (describing in the introductory section the changes in industry after the decline of vertically integrated firms). *See also* ADAM M. BRANDENBURGER & BARRY J. NALEBUFF, CO-OPETITION (1996) (describing how firms must engage in new forms of cooperation with competitors in order to sustain innovation).

201. Gilson, Sabel & Scott, *supra* note 202, at 437-44.

202. BRANDENBURGER & NALEBUFF, *supra* note 202.

which already-identified alternatives are narrowed down and chosen from, and an "interpretive" dimension, a more open-ended and creative process of generating entirely new alternatives or "unknown unknowns."[203] For the latter process to take place, what is required is a space relatively isolated from immediate market pressures, in which separate actors can develop new ideas through an interactive mechanism. Piore and Lester focus on the university system as the paradigmatic site of this type of free exchange, but leave open the possibility of other institutions providing this interpretative space.[204] The coordination-based activities of some of the Manufacturing USA institutes may be one such example. By subsidizing collaborative projects, providing shared physical research spaces, and facilitating open-ended interactions between firms, the institutes may work to lessen the intense competitive pressures of the market that normally operate on firms. Whereas the normal workings of the market force firms to engage primarily in the analytical innovative mode, the exceptional environment created by the institutes may open channels for interpretative discourse between firms to flourish.

These forms of coordinated innovation, however, invoke a kind of *emergent* innovation resulting from interactions between actors that may not fully capture the more goal-specific form of coordination practiced by the Manufacturing USA institutes. In both the systems and interpretation-based theories of innovation, the role of the state is primarily to broker the interactions between actors themselves, but not to directly influence the particular outcomes of those interactions.[205] Put differently, the state chooses the musicians and the instruments, but does not conduct the orchestra. An understanding of a more directed form of coordinated innovation is thus required.

We can observe innovation as a result of directed coordination in current cases outside the Manufacturing USA program. For example, a more directed approach has recently become central to the innovation strategy of the premier American industrial policy agency, DARPA. As Erica Fuchs describes in her study of the agency's strategic evolution over several decades, DARPA has recently shifted from a strategy of "bringing the appropriate actors together" to facilitate emergent innovation to identifying and influencing "new technology directions that achieve

203. RICHARD K. LESTER & MICHAEL J. PIORE, INNOVATION–THE MISSING DIMENSION (2004).

204. *Id.*

205. Fred Block posits that one of the key functions of the American "hidden developmental state" is to act as a broker between actors in innovation processes. *See* Block, *supra* note 31, at 173.

its organizational goals."[206] The mechanism through which DARPA influences both the rate and direction of innovation is what Fuchs calls "embedded network governance," a process of simultaneously facilitating interactions between disparate actors and guiding the end goals of those interactions.[207] Fuchs describes this mechanism as directed by the role of "program manager" in the agency:

> Thus, while the DARPA program manager is, indeed, sometimes a broker—acting as the only connection between disconnected researchers or communities . . . his role is much more active than that prescribed to these positions in previous literature. The DARPA program manager is not only a connector, but also a conductor and a systems integrator. . . . [W]hat is most significant, is the deliberate role the DARPA program manager plays in changing the shape of the network once in this position, so as to identify and influence new directions for technology development.[208]

The form of coordination observed in the Manufacturing USA institute may be another example of embedded network governance. The institutes are not just brokering particular collaborations but influencing their outcomes in accordance with a network-defined technological roadmap. It is perhaps fitting that one of the federal government's newest industrial policy programs should come to mimic one of its oldest and most successful.

For fields that benefit from this type of directed coordination, can only the state fill the role of orchestra conductor? Perhaps not. Just as in platform-based fields, in which we could conceive of a platform being constructed as "an extraordinary gift by an exceptional individual,"[209] we might imagine a non-state third party actor such as a private industry association taking on the tasks of coordinating competing firms into collaborative ventures. There are unique features of the state, however, that make it well suited to this role. For example, unlike a private association, the state can raise funds and resources from outside the cluster of collaborating firms, thus reducing the risk taken on by these firms in the process of collaboration. The state perhaps also has a greater capacity than a

206. Erica R.H. Fuchs, *Rethinking the Role of the State in Technology Development: DARPA and the Case of Embedded Network Governance*, 39 RES. POL'Y 1133, 1135 (2010).

207. *Id.*

208. *Id.* at 1145.

209. Grewal, *supra* note 16, at 204.

non-state actor to garner trust in a network of competitive firms, and can be expected to adhere to its commitments of neutrality and confidentiality in dealing with inter-firm collaboration. Finally, there is the matter of motive: as the Manufacturing USA program illustrates, state-backed consortia can be established toward, among other things, goals of job creation and national economic strength, which private industry-specific groups are unlikely to emphasize.

C. Normative Challenges of the Capable State

A realistic view of the capable state opens up new territory for IP and knowledge-based state interventions. When the state is no longer imagined as "inertial, heavy, bureaucratic, ill-informed, and perilously corruptible and corrupt,"[210] but rather as having the capacity to productively contribute to the innovation process and even to direct it at a fine-grained level, analyses can move beyond technological fields in which innovation requires only minimal state action. A solely functional defense of the capable state is incomplete, however. Advocates of alternatives to the traditional model of private IP have often combined functional justifications with normative claims. Benkler, for example, spearheaded a defense of the IP commons based on notions of open democracy and free culture in addition to his functional analysis of the commons as a pro-innovation tool.[211] It is not enough, then, that capable state alternatives deliver technological innovation; they must also do so in ways that serve independent values.

The platform-based model may offer one such justification if platforms are used to serve goals of openness after their creation. Indeed, this is Grewal's suggestion in the synthetic biology domain. With the addition of a state-built platform, synthetic biologists may be able to engage in the same kind peer production that Benkler and the copyleft movement defend on the grounds of openness.[212] But the problem of openness seems more acute in the coordination-based model. Indeed, the very success of the coordinating activity carried out by the Manufacturing USA institutes is premised on an extremely limited conception of openness—namely, shared IP and knowledge only between direct participants in particular projects. If the IP resulting from collaborative projects were made available to all institute members without licensing fees, or to the general public, firms might refuse to

210. Kapczynski, *supra* note 3, at 132.
211. Benkler, *supra* note 105.
212. Grewal, *supra* note 16.

engage in these projects in the first place. A more open alternative might therefore promote project-based collaborations without the resulting IP as a primary incentive. This may require increasing the state's subsidies of these projects beyond Manufacturing USA's 50% level, or offering prize money to successful collaborations. If openness should be a goal, experimentation with the institutional specifics of these state-led consortia is called for.

A further normative challenge concerns the distributional effects of both the platform and coordination-based models. Under the traditional model of IP, the granting of a monopoly to a private innovator is judged to be a fair distributional choice based on the assumption that the innovator mobilized their own resources and took on the initial risk. Interventions of the capable state complicate this picture. Is it fair, for example, for the public to front the necessary investments for an industry platform that will ultimately generate returns for private firms? Perhaps if we begin to consider industry platforms as forms of public infrastructure, we can draw from some of the same normative justifications for infrastructure—but it may be a stretch to equate public goods like transportation with, for example, CESMII's SM Platform. The coordination-based model presents even further difficulties, since, unlike the infrastructure model, there is no point at which we can separate public action from private initiative. In this model, the hand of the state is bound up with private activity through the entire lives of the projects, and the resulting IP thus has a sort of state-private hybrid quality, even though the IP comes to be owned entirely by the participating firms.

Some recent work on American industrial policy has noted this problem of socialized risk and privatized gain. Mariana Mazzucato, for example, has proposed a number of potential reforms that would allow the state to directly recoup some of its investments in R&D, including through public ownership in subsidized companies.[213.] For industrial policy programs that generate new IP like Manufacturing USA, IP institutions may need to be reconfigured along similar lines. The state could, for example, retain certain ownership stakes—for example, running royalty rights in IP—in technologies resulting from these types of programs. Without the potential to resocialize some of the gains from these programs, it is unclear what normative justification could be developed for the capable state's interventions, apart from the basic value of increasing the rate of innovation in certain fields. For fields judged to be of high enough social value, like green and sustainable

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213. *See* MAZZUCATO, *supra* note 26.

technologies, that justification may be enough. For most technological fields, however, reform may be in order.

Another route would be to view the very process of publicly planned innovation as a value in itself. Though often forgotten today, a long tradition of American reformism has placed inherent value in economic planning as a means of transcending the market's own dictates and supplanting them with socially determined ones.[214.] For example, some of the more radical planners of the national-scale recovery efforts under the Roosevelt Administration defended their attempts to plan their way out of the Depression on both functional and normative grounds, emphasizing the potential democratic promise of these planning experiments.[215.] If the state's role in technology development can indeed be seen as forms of planning, for which this case study offers some evidence, then perhaps the normative basis can be located in the process itself. This view assumes, however, that planning is done with a decisive view toward the public interest. Careful examinations of the levers of control over capable state functions in the Manufacturing USA program and others will be needed to check this assumption.

VI. CONCLUSION

This Article has responded to recent calls for case studies illustrating how state action can promote technological innovation through IP institutions beyond models in which the state plays a minimal role, including both the traditional model of private IP rights and the IP commons. The Manufacturing USA program, a federal initiative promoting collaborative R&D projects between industry competitors, offers one such look at IP's "capable state." Within this program, the state performs three distinct functions to catalyze innovation through IP and knowledge sharing. Two of these functions, I suggest, are variants of a more capable state vis-à-vis IP institutions: first, the state constructs industry-wide technical infrastructure that can spur further innovation in fields with platform-based architectures; and second, the state directly coordinates firms into joint research ventures in which IP and know-how are shared. Having pointed to the latter as a novel form of state intervention in the IP literature, this Article drew from work on industrial development planning and innovation theory in order to understand the relation of this form of state action to other forms of

214.*See, e.g.*, THE AMERICAN PLANNING TRADITION: CULTURE AND POLICY (Robert Fishman ed., 2000).

215.Arthur M. Schlesinger, THE COMING OF THE NEW DEAL 45-46 (1958) (Discussing several leading New Dealers' defense of the Agricultural Adjustment Act on grounds that it provided new opportunities for democratic engagement.)

intervention, as well as the theoretical basis for coordination-oriented innovation strategies. It concluded with a brief sketch of some of the normative challenges raised by both the platform-building and coordinating state, and has suggested initial directions for resolving these challenges.