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Mission-oriented innovation policy and dynamic capabilities in the public sector

Introduction:

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[T]he merit of innovation, both in private and public products, ceases to be something that can be assumed. Rather it is something to be assessed. (Galbraith 1973: 154)

Countries around the world are seeking to achieve economic growth that is smart (innovation-led), inclusive, and sustainable.¹ This ambition to achieve a particular type of economic growth (smart, inclusive, sustainable) is a direct admission that economic growth has not only a rate but also a *direction* and, thus, can have multiple *alternative* directions. However, such ambitious goals require *re*-thinking the role of government and public policy in the economy, and the associated organizational forms that can be as dynamic and explorative as the policies themselves. In particular, it needs a new justification of government intervention that goes beyond the usual one of merely fixing market failures.

Governments aiming to *shape* future markets and directions of innovations cannot rely on fixing various failures in markets and institutions as future innovations are by definition clouded in uncertainty that makes failure-driven policies blunt if not misguided change agents. In this context, industrial and innovation strategies can be

critical pillars to achieve transformational change—in particular, identifying and articulating new *missions* that can galvanize production, distribution, and consumption patterns across various sectors. Addressing grand challenges – whether traveling to the moon, battling climate change or tackling modern care problems– requires investments by both private and public actors. The role of the public sector here is not just about de-risking, and levelling the playing field, but tilting the playing field in the direction of the desired goals – creating and shaping markets which increase the expectations of business around future growth opportunities, thus driving private investment.

This mission setting and crowding in process requires rethinking ways in which public organizations design, implement and evaluate (innovation) policies. In other words, in the same way that the private sector requires dynamic capabilities (Teece 2016), what dynamic capabilities are needed in the public sector to deliver mission-oriented policies? This special issue is dedicated to initiating a more extensive scholarly discussion around this question.

The current introduction is structured as follows. First, we will contextualize the re-emergence of mission-oriented innovation policies in the broader search for a new type of innovation policies—and the appropriate organizational forms— that can tackle ‘grand societal challenges,’ and our knowledge gaps in designing and implementing such innovation policies. We identify the concept and practice of dynamic capabilities in the public sector as perhaps the key missing element in the search for the new generation of innovation policies. We offer a brief conceptual and theoretical overview of what constitutes mission-oriented policies, focusing on two key elements of missions: coordinated public investments *and* market shaping policies to ‘crowd in’ private and third sector experimentation and innovation. This is followed, second, by a short history of mission-oriented policies: we show that there are three transformations or generations of mission-oriented policies, each with a distinct set of public sector capabilities and exemplar public organizations. Third, we show that in discussing capabilities, there exist two parallel cultures: Schumpeterian business literature and practice around dynamic *capabilities* of the firm, and Weberian public policy discussion focusing on *capacities* of the state. We propose a new synthesizes of these ‘two cultures’ under the concept of ‘dynamic capabilities in the public sector.’ And, finally, in the

concluding fourth section, we briefly discuss the central public sector dynamic capabilities for 21st-century missions.

1. Searching for the next generation of innovation policies

1.1 Transformations in innovation policy

Over the last decade and a half innovation policy has undergone (at least) two transformations:

First, there is a growing emphasis on non-technological innovation – e.g., user-driven, social, public sector innovation – and in particular in the context of so-called grand societal challenges such as climate change and aging societies such aspects of innovation are receiving more and more attention. (See also Fagerberg 2016 and 2018)

Second, the re-focusing from technology to broader systemic elements of innovation has also brought a shift from ‘fixing’ various ‘failures’ in (sectoral, regional, national) innovation systems to transforming these systems. (Weber and Rohracher 2012)

These transformations matter because, as argued by Lindner et al. 2016, "... established practices and institutions continue to operate with the chief aim of improving innovation capacities by ‘getting the structures right,’ thereby sidestepping the question ‘getting the structures right to achieve what?’" And thus it is not only innovations but increasingly also its spillovers into other areas of life from the environment to social justice that are receiving increasing attention. (See, e.g., Zehavi and Breznitz 2016; and already Rothwell and Zegveld 1981)

In other words, the innovation policy debate is shifting from a focus on the quantity or rate of innovation (e.g., number of patents, jobs) towards quality and direction of innovations (e.g., whether innovations help alleviate climate change). (Mazzucato 2017 and 2018b; Stirling 2014). Thus rather than the focus on levelling the playing field, the focus becomes how to tilt it in a new direction, e.g. one that rewards sustainable growth (Mazzucato and Perez 2015).

This “normative turn” in innovation policy that underlies the search for next generation of innovation policies (Daimer et al. 2012; Kuhlmann and Rip 2018; Cantner and Vannuccini in this issue) is based on much more "distributed agency" that has been the case with previous iterations. Next to governments, academia and the business sector, also large international organizations such as the United Nations and the OECD; philanthropies (e.g., Bloomberg, Gates Foundation and many others) and social movements (e.g., green movement; see Leadbeater in this issue on the role of social movements in missions-driven innovations) play increasingly important role in shaping the innovation policy agenda. (Kuhlmann and Rip 2018)

While the Sustainable Development Goals are the most ambitious expression of such shift in focus, innovation remains in the periphery of United Nations policy activities, and this perhaps shows how difficult it is to 'direct' innovations within the existing conceptual and policy frameworks. European Union, on the other hand, has attempted for more than a decade to re-orient its R&D agenda towards the grand challenges. (See also ESIR 2017) From the Lund declaration in 2009 on EU R&D and grand challenges² to responsible research and innovation agenda as a cross-cutting theme in the EU's R&D program 'Horizon 2020',³ the EU has attempted to tackle what has been called "orientation failure" inherent to its innovation policies. (Daimer et al. 2012) These efforts, however, also show that most countries have in fact already agreed in which direction innovation policy efforts should be steered. (Fagerberg 2018) What is missing is an innovation road-mapping to get there.

The focus on the direction of innovation has also brought attention to the governance of innovation, particularly on the need to reflect on – and not merely measure – innovation systems (see also Lindner et al. 2016). Indeed, we can argue that today innovation policy landscape is in something of a cognitive paralysis: governments increasingly realize the 'wicked' nature of some of the most pressing problems they face and at the same time also realizing that existing policy toolboxes (of design, coordination, and evaluation) are not enough to tackle these challenges. In other words, governments increasingly recognize that they need more dynamic toolkits – capabilities – at their disposal. However, this has also made policymakers, and academics realize that we know relatively little about what makes governments and specific public organizations

dynamic. Over the past half a century we have experienced the emergence of a genuine tradition of analyzing dynamic capabilities in businesses; there is nothing quite similar for the public sector.

It is within this broader context of searching for the next generation of innovation policies that mission-oriented approach to innovation is receiving renewed attention. For its R&D program starting in 2020, the EU is refocusing substantial part of its R&D funding specifically on missions. (Mazzucato 2018a) Similarly, the UK launched new industrial strategy in 2017 that brings out four grand challenges in which policies should focus on specific missions. (BEIS 2017) OECD has cataloged how many of its members are attempting to implement mission-oriented policies. (OECD 2015) Missions have emerged as perhaps the primary approach to tackle grand challenges through innovations.

1.2 Defining mission-oriented policies

Policy missions (and not merely mission-driven organizations) are by definition about direction – about concrete problems to be solved. In brief, mission-oriented innovation policy (MOIP) relies on two pillars:

First, setting *a purpose for public investments*: “big science” meets “big problems” (Weinberg 1967, Ergas 1987);

Second, creating *conditions for new markets*: enabling spill-overs from “big science” in form of new demand and supply (Mazzucato 2017; also Kuhlmann and Rip 2018).

MOIP is a market shaping public investment and policy framework that aims to shift the direction of innovation system(s). MOIP is, thus, a conscious decision not to use the market failure approach as a theoretical foundation for public sector activities. As argued already by Nelson (1959) and in particular by Arrow (1962), welfare economics driven market failure approach is good at identifying problems, such as areas with under-investment in R&D, but quite poor guide in identifying areas with the potential highest “social profit”. (Nelson 1959: 298) As Arrow aptly put it: “Formally, of course, resources should be devoted to invention until the expected marginal social benefit there equals the marginal social benefit in alternative uses, but in view of the presence

of uncertainty, such calculations are even more difficult and tenuous than those for public works. Probably all that could be hoped for is the estimation of future rates of return from those in the past, with investment in invention being increased or decreased accordingly as some average rate of return over the past exceeded or fell short of the general rate of return.” (Arrow 1962; Ryan-Collins et al 2018)

Further, as Hausmann and Rodrik (2006) and Chang (2002) argue, decades dominated by market failure driven policy making have seen weak performance in developing countries applying these instruments. When policy makers use market failure framework as guidance for direction, they focus improving supply-side conditions (e.g., the supply of skills, capital) as firm level “decision rules” are assumed to be about profit maximization and that the most efficient way to do it is through better inputs. (Nelson and Winter 1974: 887-888). And hence neoclassical analysis of (industrial and) innovation policy focuses on complementary market and public inputs. (Hausmann and Rodrik 2006)

Market shaping and creating framework, in turn, assumes that firm level search for new decision rules and for new ways of doing business is influenced by public policy: “academic and governmental research certainly changed the search prospects for firms in the electronics and drug industries, and for aircraft and seed producers.” (Nelson and Winter 1974: 902). As Nelson and Winter argue, markets are never in Pareto optimality. (1974: 900; see [Foray’s excellent discussion of directed innovation policy in this issue](#)) Mission-oriented policies are in the (Schumpeterian) market shaping framework tools to focus policy discussions on which direction should public efforts enlarge firm level search activities.⁴ This idea of structural renewal through directing innovation has found perhaps the most original expression in Albert Hirschman's idea of development through unbalanced growth. (1958)⁵ Hirschman argued that consciously keeping development unbalanced, that means letting some economic activities develop faster than others, keeps development momentum going as it enforces cross-sectoral learning and experimentation. ([See Cantner and Vannuccini on catalytic nature of missions in this issue](#); and [Bonvillian in this issue](#) on mission-oriented agencies as change agents in legacy sectors)

1.3 Missions and public policy: an uneasy marriage?

Ideally, all public policies are mission-oriented, aimed at solving a set of challenges society faces. Indeed, Beveridge himself—the founder of the UK welfare state—argued that it was not enough to set up the welfare state. What was required were new forms of collaborations and engagements (Cottam 2018). And, we argue, new forms of tools and organisations.

The potential of this transformational agenda has been limited by the view of public policies in terms of getting the processes right (e.g., following laws, regulations, and procedures, political agreements of the day, and so forth) and having the inputs for these processes (e.g., finances, human resources). The focus on inputs translates into the way that GDP accounts for public investments: only as input costs, with the public *value* generated being absent or mis-measured (Mazzucato 2018c).

This is because public policies deal with areas where outcomes can be, and are, easily contested (e.g., what policy instruments exactly lead to economic growth or diminishing of crime?).⁶ (Mintzberg 1996) Particularly for modern-day governments, this means that coordination between various policy fields has become perhaps the most 'wicked' issue in policymaking. Indeed, arguably the idea of 'innovation policy' as a separate policy area emerged in the late 1970s and early 1980s as a coordinating policy. (Sweeney 1985: viii) This, however, has failed to materialize, and the reasons for this can be found in what we can call a complexity paradox of modern public policy: the more complex policies issues are, the more compartmentalized policy making becomes. (Sweeney 1985: viii-ix)

Coordination should be, by the very nature of public policies, the paramount task for government organizations. Yet because the results of the coordination processes (policy outcomes) can easily be contested, coordination itself becomes of secondary importance.⁷ And hence, the purpose of public policies can be and is easily drowned in day-to-day processes. (Goodsell 2011)

Mission-oriented policies offer a policy framework that enables the public sector to overcome the endemic policy coordination failures. (Ergas 1987, 194) Indeed, best-known past examples of mission-oriented policies – such as the Moonshot – show exactly that. Such policies succeeded at mobilizing a wide variety of technological and

innovation efforts under a single challenge – get to the moon – and itemize it into a variety of missions. The impact was not only actually to get a man on the moon, but likely every reader reading this text is using some of the innovations that can be traced back to this effort; its spill-overs were massive. (Mazzucato 2013; Mowery 2011) Big investment into big science led to big innovations. Public investments created a technological frontier that coincided with private sector developments and thus created multiple new search opportunities for firms. (Dosi 1981: 10-11) Indeed, the irony is that it has been when public institutions were most mission oriented that the business sector was most able to later commercialize innovations. When instead the focus is on ex-ante economic value, there emerges less frontier led research to commercialize.

However, the Moonshot was not the only mission-oriented policy. As Henry Ergas showed three decades ago, essentially all leading economies at the time used mission-oriented technology and innovation policies, some to a larger degree than others. (Ergas 1987, 192; see also Foray, Mowery and Nelson 2012) Perhaps the most interesting aspect in Ergas' analysis are the reasons for successes and failures of mission-oriented policies at the time. He argues that mission success and failure depend on whether implementing organizations have, first, technical expertise, financial resources, and operational autonomy; second, whether networks with external partners allow for experimentation with alternative solutions; and third, whether mission latitude is not too loosely defined allowing organizations to stray into areas where their capabilities are not strong enough. In other words, Ergas describes – without any specific theoretical and conceptual framework – what how specific public sector dynamic capabilities made MOIP successful.

Importantly, concurrently with Ergas' analysis, most countries underwent massive public sector reforms, so-called new public management (NPM) reforms of the 1980s and 1990s (for an overview, see Drechsler 2005). NPM's main thrust was to introduce market-like incentives in the public sector as well. This was captured in ideas such as decentralizing agencies, contracting out various functions (from the back office to actual service delivery), performance pay for managers and agencies. Put simply, NPM reforms were meant to rein in public costs and make public organizations more efficient. As perhaps the most significant result of these reforms – at least for innovation policy –,

modern governments tend to rely on unified and holistic budgetary and performance systems in which all activities of government are seen through the same lenses, and often these are defined by efficiency, and saving. Such frameworks make it, by definition, rather difficult to justify missions. For public management, however, the reform waves of the 1980s and 1990s created a particularly strongly unified and specific vision of public sector performance. As argued by Bouckaert and Peters (2002), this meant focusing on "visible performance" of lower level activities – “frog view” (230) – and not on higher level (e.g., cross-organizational) policy fields. This frog view manifests itself today in the concern to precision-target government support on the project level and ever more complex and mostly market failure driven policy evaluation tools to understand the impact of such support, mostly with mixed success (Edler et al. 2016). Such an approach assumes that there are correct answers to any policy question that a specific project or proposal can address and that we need to find the proper measurement frameworks through increasingly sophisticated data analytics. This does resemble what happens in many team sports where so-called Moneyball approach to finding talent and best way to play relies increasingly on advanced statistical models. In R&D policy these shifts focus away from political discussions about the broader direction of policies, and towards discussion of single instruments and measurement. However, as important measurement is, not only is innovation inherently open-ended, non-linear and rife with uncertainty, innovations also challenge existing institutional frameworks and values (e.g., sharing economy giants like UBER challenging public transportation systems), that is they challenge the idea of value that should be measured. (Schumpeter 1942)

What we miss in both scholarly and policy debates, is a better understanding of institutional and political ramifications of mission-oriented policies: What kind of political factors are conducive to generate missions with socio-economic acceptance and political legitimacy? What kind of variety of organizational configurations and capabilities are needed to develop, implement and evaluate missions properly? What kinds of forms of democratic engagement best help form legitimacy around mission? To put it most simply: do century missions require 21st-century policy design and implementation processes?

In particular, implementation and organizational issues around mission-oriented policies – and in directing innovation systems in general – have not received sufficient attention in previous discussions of mission-oriented policies. Thus, for instance, Foray, Mowery and Nelson touch upon these issues in an otherwise excellent article only fleetingly by discussing whether a mission-oriented programme is managed through a centralized or decentralized governance structure and stressing the importance of stable funding. (2012: 1701)

Indeed, one can argue that the community of Schumpeterian scholars never followed up the point by Nelson and Winter (1982) for public policy to be matched by bold new organizational structures in the public sector was never met: “The design of a good policy is, to a considerable extent, the design of an organizational structure capable of learning and of adjusting behavior in response to what is learned.” (384; also Kattel et al. 2019)

To move in this direction, we must first learn from the history of mission-oriented policies and then ask what the lessons are for a theory of the dynamic capabilities of the public sector.

2. Camel, lion, child: three transformations of mission-oriented policies

Friedrich Nietzsche famously argued in *Also sprach Zarathustra* that as human beings our spirit goes through three transformations on our way to self-discovery: from camel who can carry heavy loads to the lion who can and will fight everybody to the child who plays by their own rules. The camel denotes the capacity to suffer and sacrifice; the lion symbolizes the power of sovereignty, and the child is about creativity and play. We argue that mission-oriented policies have gone through similar transformations in three generations over the past 150 years.

2.1 Short history of mission-oriented policies

The idea of mission-oriented policies has its root in the idea of modernization, which of course is not a ‘modern’ idea at all. Even if we are today accustomed to equating modernization with Westernization, what we call modern state and bureaucracy have arguably Asian and specifically Chinese origins (Fukuyama 2011). What matters for our

context is the religious-cultural idea of “mandate of heaven” that applied to the rulers, as well as the mandarins, in Imperial China that they must govern well and provide for the people; not fulfilling this ‘mandate’ created a legitimate cause to overthrow the ruler or dismiss the civil servants (Drechsler 2019). The counterpart to mandate of heaven in Western culture is the idea of “reason of state”, originating with Giovanni Botero’s eponymously titled book from 1591 (*Della Ragion di Stato*) – number five on economic bestseller list of books published before 1850 (E. Reinert et al 2017; E. Reinert 2007 and S Reinert 2011) – justifying policies (and Botero explicitly includes economic policies) on the grounds of what today is called ‘national interests’.

These two ideas coalesce around developmental states of the late 19th and early 20th century with (proto-)missions of catching up, finding its practical toolbox in Alexander Hamilton’s *Report on the Subject of Manufactures* in 1791 and theoretical embodiment with Friedrich List’s *Das Nationale System der politischen Oekonomie* (1841). Mandate of heaven and national interest offer ideational backdrops to what can be called a duty to catch up as an overarching policy challenge that subsumed under it a variety of policy missions from building up knowledge base (e.g., reforming universities) to creating trade relations and social policy (the latter is particularly crucial for Bismarck’s Germany, including for the evolution of economics as a science through the debates around the ‘social question’ of the 1870s; Drechsler 2016). Particularly German catching up story is noteworthy not only for its significant investments into development and resulting in impressive actual catching up and in many instances forging head of England and other industry leaders, but also for a wealth of institutional innovations such as central banks as lenders of last resort and multiple welfare state insurance schemes.

The ‘developmental state’ as the **first generation** mission-oriented policies relied on expert meritocracy in public organizations accompanied, however, by constant renewal and rejuvenation of organizational configurations (Karo and Kattel 2015; Kattel et al 2019) As *exemplar institutions* we can look at what is called “System Althoff” in German higher education and research policy (named after Friedrich Althoff, a top civil servant in Prussian Ministry of Culture and responsible for hugely successful university reforms; vom Brocke 1991), and at MITI (Ministry of International Trade and Industry)

in Japan as quintessential development agency of “embedded autonomy” (Evans 1995). While both institutions are often seen as representing Weberian bureaucracy at its finest (with merit-based recruitment and promotion systems and rule-based organization of work), both enjoyed high-level political support but also relied on what can be called wide-ranging charismatic networks, built and nurtured by top civil servants. (See also Karo's discussion of organization renewal in East Asian innovation bureaucracy [in this issue](#))

The camel can represent the first generation of mission-oriented policies in Nietzsche's metamorphosis: the policies were wide-ranging and demanded endurance and sacrifice in the name of national catching up and pride. A version of these policies is also to be found in the Soviet Union and other planning based policies of the post-World War II. (Freeman 1987; Chandrashekar 2016; Chibber 2003) Indeed, the latter can be considered as an intermediary form between the first and second generation of mission-oriented policies, particularly its more successful forms such as Commissariat du Plan in France, with its origins in mixed enterprises of the 1920s and its heyday in 1960s. Schonfield argues that success of French planning was pivotal also for Kennedy's “un-American” fervor for setting targets for long-term economic growth. (1966: 72-73) The French planning culture, with focus on achieving a “more complete view of man” (quoted in Schonfield 1966: 227), makes it clear that the point of “planning is thus in part an ethical one: it imposes choices about the use of resources other than those which the market would produce.” (Ibid.)

The **second generation** of mission-oriented policies are the well-known policies and public agencies from 1940s-1960s in military and space technologies in the US and major Western European economies. (Ergas 1986; Soete and Arundel 1993) As Alvin Weinberg, for 18 years the director at Oak Ridge National Laboratory that was part of the Manhattan Project, argues these mission-oriented policies were about ‘big science’ deployed in the ‘national interests’. (Weinberg 1967: 132) Organizationally such policies were often implemented by single national/public laboratories with a concrete mission to solve particular technological problems, and not engage in basic science; which also meant that these facilities were built up more hierarchically than universities. (Weinberg 1967) Weinberg argues that many of these organizations lost

focus on original missions – partly due to accomplishing missions, partly due to pressure from researchers – and moved towards basic research. (Weinberg 1967: 136; see also Nelson, Peck and Kalachek 1967: 169) Similar problems emerged in the Western European countries where the basic policy assumption was that “research results constitute an undirected potential” (Krupp 1985: 51) – for private sector to ‘find’ the direction of innovation. The basic research policies were in reality supplemented by multiple civilian mission-oriented policies in the form of large-scale funding for nuclear energy and transportation (magnetic trains, supersonic aviation). (See Gummett 1991) This was perhaps the key challenge for the second generation of mission-oriented policies – and specifically implementing agencies –, how to redeploy resources around new, civilian missions.⁸ (Weinberg 1967: 134-135; also Nelson, Peck and Kalachek 1967: 3) While first generation mission-oriented policies – catching-up policies – relied on a wide range and constantly renewed organizations that hired expert civil servants and had strong political support, the second generation of mission-oriented policies had a much more heroic vision of dynamic change. Missions were built around single agencies with high profile managers in charge of them. (Weinberg 1967:134; also Lambright, Crow and Shangraw 1985) This ambition – both in problems the organizations of this era took on as well as in the scale of investment – brought both massive successes and spill-overs (Block and Keller 2011, Mazzucato 2013), but also played a crucial role in the demise of this generation of mission-oriented policies.

As suspected by Weinberg and later documented by Ergas (1987), many mission-driven research laboratories could not create sensitivity and flexibility around their purpose, particularly in taking up new emerging less technological and more social challenges such as pollution and decay of inner cities (also Nelson 1977). Also, the seeming lack of success in translating successes of military R&D and its procurement into the civilian realm played a significant role in changing policy attitudes. (Pavitt and Walker 1976) Similarly, planning exercises, siblings to mission-oriented policies, often did not lead to successful outcomes. As documented by Schonfield, economic and industrial policy failures in the UK and elsewhere in the 1960s, particularly in contrast to its successes in France, were down to both low political commitment to long-term planning (and not just business cycle management) and lack of proper capabilities within planning organizations. (1966) In contrast, the French planning capabilities evolved as

"voluntary collusion between senior civil servants and senior managers of the big business. The politicians and the representatives of organized labor were both largely passed by" (ibid.: 128), with a strong focus on building capabilities within public organizations (and not farming them out to independent commissions; ibid.: 105). The idea was to pick the willing: "deliberately selecting a few promising firms who seem willing and able to move ahead fast, and then giving them every encouragement in the form of large contracts, financial help, and other favours" (ibid.: 111) and with handpicked membership in modernizations commissions. (Ibid.: 98) This contrasted with the UK approach where 'average' companies were in the driving seat for planning commissions which accordingly did not set ambitious plans or develop proper implementation mechanisms.

Furthermore, one of the key factors in the demise of mission-oriented policies and industrial planning in Europe was the emergence of European Economic Community where each country had rather different planning styles and capabilities. (Schonfield 1966) Instead of a common European style of industrial planning and with it of mission-oriented policies to emerge in the late 1960s and 1970s, rather a gridlock of plans and missions, and policy cultures remained in place. (Schonfield 1966: 141; also 133) The results of this could be seen in the fate of European electronics, and semiconductors industries that individually could not compete with the US companies and a European industry could not emerge as national policy cultures remained dominant. (Schonfield 1966: 374-375; Dosi 1981)

Exemplar organization for this period is DARPA for both its internal flexibility and ability to rejuvenate its focus around defense mission, summarized in this by **Bonvillian's** contribution.

The second generation of mission-oriented policies, and organizations have the characteristics of Nietzsche's lion: organizations with enormous ambitions, manned by talented engineers and civil servants, and backed by visionary politicians.

At the end of this era is the emergence of contradicting policy trends:

On the one hand an emerging focus on future (general purpose) technology foresight exercises and search for visions, that in particular for East Asian economies was accompanied by the idea to leapfrog – rather than just catch up – international competitors. In essence, mission-oriented policies were slowly replaced by search for future technologies and preparing economies for their diffusion. (Rothwell and Zegveld 1985)

On the other hand, the emergence of market failure based approach to (innovation) policy that came to dominate the policy arena along with NPM reforms in the late 1980s and resulted in privatization of public laboratories, emergence of new arms-length funding agencies (e.g., research councils), focus on commercializing and marketizing research (e.g., competitive grant systems) and cost-efficiency practices in policy evaluation practices. (Gummett 1991, Boden et al. 1998) This contributed to demise of the directionality of innovation as a policy agenda.

The **third generation** of mission-oriented policies and organizations that is now in its ascendancy has multiple drivers and a somewhat heterogeneous set of actors:

a) **multilateral organizations** such as the European Union have been prominent in urging to develop ‘new’ missions around sustainability and other decidedly socio-economic (as opposed to solely technological) issues. (Soete and Arundel 1993)

b) **large private philanthropies** such as Gates Foundation and others have sought out specific problems (e.g., diseases) to solve and focus not only their funding but also important networks on those problems as missions.

c) **bottom-up social movements** have been able to focus directionality of research, e.g., Act up’s, and other groups’ impact on HIV research and its increased funding.

(Leadbeater in this issue) Similarly, Germany’s *Energiewende* would have never happened without the green movement. (Fagerberg 2018) On the other hand, Kennedy’s Moonshot, in turn, created itself a wave of excitement with a prolonged impact on STEM education in schools.

In contrast to previous generations of mission-oriented policies, the current manifestation does not have a 'dominant design' regarding its governance system. Among the wide heterogeneity of attempts, some key features are emerging:

First, focus on the social responsiveness of science and innovation. Rather than focusing on specific sector (such as energy) or technology (such as nuclear) as was often the case in the previous generation, current attempts can be characterized by *cross-sectoral focus by design*. (Mazzucato 2018a)

Second, with social responsiveness also citizens and social engagement have moved into the focus of mission-oriented policies. Innovation, design and digital agencies are increasingly trying to focus on citizens as 'users' of public services and such organizations experiment with multiple agile feedback mechanism to quicken policy processes under a larger mission that is tied to a specific public purpose. (OECD 2017)

Third, experimentalism is seen as a key feature of mission-driven policies and organizations, this is reflected in embracing randomized control trials by philanthropies and social enterprises at the one extreme, and by service design principles of prototyping at the other. This last feature brings this generation of mission-oriented policies and organizations close to what Nietzsche had in mind by transformation of the soul to child: playfulness in experimentations is part and parcel of current attempts in mission-driven innovation. (See also Kuhlmann et al. 2010 on "innovation policy dance")

As an exemplar organization we can look at UK's Government Digital Service, established in 2011, that was able to create award-winning common government domain, gov.uk, hire top software engineers and designers in the country, break down oligopolistic networks of large vendor companies competing for government IT contracts – and doing so save government £4 billion without actively targeting it. (Birkinshaw and Duncan 2014)

2.2 What can we learn from history of mission-oriented policies?

To sum up our discussion of three transformations of mission-oriented policies, we can draw following lessons from history:

First, there is a *taxonomy* of missions from socio-economic missions of the 1st generation to technological missions of the 2nd and socio-technological missions of the current 3rd generation. Each type of mission-oriented policies implies different capabilities to design, implement and evaluate missions. For each kind, directionality of the innovation systems engenders from different ideational context: 1st generation policies were driven by catching up as a national and often also nationalistic missions; 2nd generation policies were driven by national security needs and technological arms race; 3rd generation policies gain their urgency and purpose from ‘intractable’ socio-economic challenges and social movements connected to these challenged (e.g., green movement).

Second, factors determining success or failure of previous generations of mission-oriented innovation policies had to do both with investments into R&D capabilities (e.g., research laboratories) *and* into market shaping capabilities (e.g., procurement practices of military organizations). This complementarity within mission-oriented policies, and between mission-oriented policies and other economic policies, plays an important role in success of missions.

Third, public sector *capabilities* for developing policy directionality have historically been existing at multiple levels, e.g., high-level political support to legitimize missions; operational level expertise for research; and policy design level for demand-side policies.

Fourth, how can public organisations be structured so to become dynamic learning organisations that welcome uncertainty, exploration and experimentation.

3. Two Cultures: Capabilities and Capacities

As we have seen above, one of the key challenges in designing and implementing mission-oriented innovation policies – and in general innovation policies that are concerned with the direction of innovation rather than with the rate – is the governance context. This includes diverse topics from setting the missions to evaluating them. However, there is no proper conceptual framework to discuss and trace how such capacities and capabilities evolve, why they change (or don't). We contend that there

are two cultures – of capacities and of capabilities – that rarely speak to each other. There is the Schumpeterian tradition of dynamic *capabilities* of the firm, and the Weberian tradition on public sector *capacities* to make policies. In the middle of these two cultures stands public choice theory inspired NPM as a mostly failed attempt to translate some of the private sector capabilities and practices into the public sector.⁹ (See also Kattel et al. 2019) In what follows we propose a way how to synthesize these ‘two cultures’ as *dynamic capabilities in the public sector* and then discuss capabilities that are key for 21st-century mission-oriented policies.

The Schumpeterian tradition of dynamic capabilities focuses on ambidexterity: how to *explore* new opportunities and at the same time keep *exploiting* existing strengths. The idea of organizational ambidexterity was developed by various management theorists from Burns and Stalker (1961) to Duncan (1976) and Mintzberg (1989), and eventually ‘codified’ by March (1991). Teece and Pisano summarize the basic tenets of dynamic capabilities as follows: "The term ‘dynamic’ refers to the shifting character of the environment; certain strategic responses are required when time-to-market and timing is critical, the pace of innovation accelerating, and the nature of future competition and markets difficult to determine. The term ‘capabilities’ emphasizes the key role of strategic management in appropriately adapting, integrating, and re-configuring internal and external organizational skills, resources, and functional competencies toward changing environment." (1994: 1; see further, e.g., Teece 2016; Helfat and Martin 2015; O’Reilly and Tushman 2004 and 2008; Lam 2006) Importantly, these capabilities cannot be immediately imitated or replicated in other firms.

Perhaps the simplest way to summarize this line of research is as follows: businesses have *ordinary* routines and capabilities to exploit existing strengths and business opportunities, but to deal with fundamental future market uncertainty, companies should acquire *dynamic* capabilities.

The Weberian tradition of building capacity has been best expressed in developmental state discussions. Particularly East Asian developmental state scholars – Amsden (1989), Evans (1995; Evans and Rauch 1999), Haggard (1990), Wade (1990) – turned the concept of highly capable bureaucracy, together with a specific notion of embedded autonomy, into a crucial variable explaining the strong development performance of

East Asian economies and beyond. This is best captured by Chalmers Johnson and his concept of *developmental state*: a country with predominant policy orientation towards development supported by small and inexpensive elite bureaucracy centered around a pilot organization, such as the Ministry of International Trade and Industry (MITI) in Japan, with sufficient autonomy (limited intervention by the legislative and judiciary). (Johnson 1982: 305-320).

The developmental state research assumes that public sector capacities can be best developed by best talent recruited and motivated via *Weberian means of meritocratic recruitment and career management* to make working for government either financially competitive and/or culturally even more rewarding/prestigious than working in the private sector. Evans and Rauch (1999) cemented these ideas through a quantitative analysis that tested the importance of some of the 'Weberian' elements (merit-based recruitment and career systems) on a much broader sample of countries as a whole (see also Rauch and Evans 2000; Evans 1998).

Further, Painter and Pierre (2005) distinguish between state, policy and administrative capacity:

- state (or political) capacity is about achieving appropriate outcomes and having legitimacy and consent to do so (e.g., widespread approval around environmental sustainability);
- policy (and analytical) capacity is about making the intelligent and coherent choice to achieve the outcomes (e.g., coordination between regulatory standards, public procurement practices, and R&D tax credits); and
- administrative (and operational) capacity is about effectively managing resources (financial, technical, human) throughout the policy cycle.¹⁰

To summarize, the dynamic capabilities focus on skills within firms that enable change amid uncertain environment, and public sector capacities concentrate on structures within public organizations that enable to become change agents within wider public sector context. (Karo and Kattel 2018)

What is missing in the Weberian framework of capacities are the evolutionary dynamics: why do specific constellations of capacities become more successful than others? In the context of firms, market success provides the selection environment. How can we conceptualize similar dynamics in the public sector?

We propose a new synthesis that includes both ‘cultures’ of capabilities and capacities. Namely, *dynamic capabilities within* each level of capacities provide the drive for change that in turn feeds back into capacities through socio-political feedback mechanisms (from media and social actors to electoral systems and institutional check and balances) that act as selection environment. (Pierson 2004 on feedback mechanisms; Rip 2016 on selection mechanisms). Capabilities are skills and routines ("decision rules," to borrow from Nelson and Winter 1974) within various layers of capacities, and they constitute what kind of capacity is there at any given point in time. (See also Andrews et al. 2017)

To exemplify what we mean, we can again look at the history of mission-oriented policies and dynamic capabilities on three levels:

- **State capabilities:** we argued above that West European electronics industries were not able to compete with the US because they were not able to generate common European planning principles and missions. Instead, all leading countries preferred to remain within their own existing set of rules and principles. (Schonfield 1966; Dosi 1981) We argue that this explained with a lack of legitimacy and consent around the need for such *European* – and not merely national – capabilities to set ambitious goals and plan accordingly. (See also in [this issue](#) Foray’s discussion of smart specialization policies in Europe) On the contrary, East Asian economies show today robust leadership capabilities to rejuvenate developmental state missions towards new 21st century missions that rely on creating new technological frontiers, changing consumer behaviors, and so forth. ([Karo in this issue](#))
- **Policy capabilities:** again, as argued above, US military R&D missions were highly successful in creating spill-overs because there was also a massive creation of demand through public procurement practices. In sum, the broader impact of missions derived from effective policy coordination capabilities. (See also [McKelvey and Saeumundsson in this issue](#)) These capabilities created policy

coherence along the value chain in the defense related innovation. In the European context, we can today think of CERN as an example of such basic research undertaking that seeks to utilize its idiosyncratic public procurement practices to generate larger socio-economic spillovers. And as Florio et al. show in this issue, it does so with considerable success.

- **Administrative capabilities:** incapability to summon technical, planning and administrative capabilities arguably doomed UK's attempts at economic planning and mission-oriented policies in the 1960s and 1970s. The planning remained short-term, it was easily captured by industry, and it did not have proper organizational support and resources. (Schonfield 1966; Ergas 1986). Breznitz et al. show in this issue that organizational capabilities can take various forms to be successful and again create long-lasting administrative capabilities to tackle missions.

Perhaps most importantly, the different levels of dynamic capabilities are interlinked within policy cycles which makes change in existing skills and routines all the more challenging.

4. Conclusion: Public sector dynamic capabilities for 21st-century missions

In order to tackle the grand challenges of the 21st century, innovation policy needs to shift from the existing support-and-measure approach (find market failure; fix it with a support instrument; measure the impact) to innovation policy to lead-and-learn approach (create and shape markets with variety of policy instruments with open-ended impact horizons, and learn through wider social engagement and coordination). As we argued above, many countries and international organizations are embracing the challenge and mission-driven approach to innovation. What are the dynamic capabilities needed for such policies, what does history and the current debates teach us?

We argue that 21st-century missions require following set of dynamic capabilities in the public sector in order to engender mission-oriented policies:

Key to our premise is that grand challenges can only be solved through dynamic public-private partnerships, but these have been constrained by the notion of public actors as at best fixing markets. A market co-creating role requires the state to have capabilities for **leadership and engagement**: missions can all too quickly become either just fashionable labels on 'business-as-usual' practices or too rigid top-down planning exercises. Thus, capabilities to engage with a wide set of social actors, to show leadership through bold vision are vital in times with high 'democratic deficit' in many developed countries. (See also ESIR 2017) Some of the grand challenges contest 'the way of life' as we know it (e.g., suburbanization accompanied by congested transportation systems). Capabilities to encourage bottom-up engagement means that there is a capacity to set mission but also to leave enough space for contestation and adaptability. (See also Daimer et al. 2012)

On the level of policy, the ability to find coherent **policy mixes (instruments and funding) and capabilities of coordination** seem fundamental to the success of today's mission-oriented policies. (See also ESIR 2017) As today's missions are not just about technological solutions but include strong socio-political aspects, experimentation capabilities matter perhaps more than before. Equally important are evaluation capabilities that do not rely only on market failure based approaches (e.g., cost-benefit analysis) but can integrate user research, social experiments and system level reflection. (See also Lindner et al. 2016; Rip 2006)

Administrative capabilities need to rely on **diversity of expertise** and skills, from engineering to human-centric design, organizational forms to mix unrelated knowledge areas (e.g., in urban mobility and planning, lifestyles matter as much as do new energy storage systems; see Grillitsch et al 2017), and organizational fluidity (e.g., cross-departmental teams) seem to be fundamental for managing new missions. (OECD 2017)

These sets of capabilities also point to the directions for future research in mission-oriented policies: we need to understand better how public sector can generate and nurture such dynamic capabilities.

References

Amsden, A. (1989), *Asia's Next Giant: South Korea and Late Industrialization*, Oxford University Press: Oxford.

Andrews, M, L. Pritchett, W. Woolcock (2017), *Building State Capability. Evidence, Analysis, Action*, Oxford University Press: Oxford.

Arrow, K. (1962), 'Economic Welfare and the Allocation of Resources for Invention', in *The Rate and Direction of Inventive Activity: Economic and Social Factors*, NBER, Princeton University Press: Princeton, 609-626.

BEIS (Department for Business, Energy & Industrial Strategy) (2017), *Industrial Strategy: building a Britain fit for the future*, available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf.

Birkinshaw, J. and S. Duncan (2014), *The Government Digital Service (UK)*, London Business School.

Block, F. and M.R. Keller (eds.) (2011), *State of Innovation: The U.S. Government's Role in Technology Development*, London: Paradigm.

Boden, R., P. Gummett, D. Cox and K. Barker (1998), 'Men in white coats ... men in grey suits', *Accounting, Auditing & Accountability Journal*, 11(3), 267-291.

Bonvillian, W. (2018), 'DARPA and its Clones – Challenges to the DARPA Model and to Extending it to Other Sectors', *Industrial and Corporate Change*, 27:5

Bouckaert, G. and B. G. Peters (2002), 'Performance Measurement and Management', *Public Performance & Management Review*, 25:4, 359-362, DOI: 10.1080/15309576.2002.11643672.

Breznitz, D., D. Ornston and S. Samford (2018), 'Mission Critical: The Ends, Means and Design of Innovation Agencies' *Industrial and Corporate Change*, 27:5.

Burlamaqui, L. (2006), 'How Should Competition Policies and Intellectual Property Issues Interact in a Globalised World? A Schumpeterian Perspective', *Working Papers in*

Technology Governance and Economic Dynamics, no. 6, available at
<http://technologygovernance.eu/files/main//2006042407123939.pdf>.

Burns, T. and G.M. Stalker (1961), *The Management of Innovations*, London: Tavistock.

Cantner, U. and S. Vannuccini (2018), 'Elements of a Schumpeterian Catalytic Research and Innovation Policy', *Industrial and Corporate Change*, 27:5

Chandrashekar, C.P. (2016), 'Development planning', in E. S Reinert, J. Ghosh and R, Kattel, eds., *Handbook of Alternative Theories of Economic Development*, Cheltenham, UK; Northampton, MA, USA: Elgar, 519-532.

Chang, H.-J. (2002), *Kicking Away the Ladder – Development Strategy in Historical Perspective*, Anthem Press: London.

Chibber, V. (2003), *Locked in Place: State Building and Late Industrialization in India*. Princeton University Press: Princeton.

Cottam, H. (2018), *Radical Help: How we can remake the relationships between us and revolutionise the welfare state*, Little, Brown: London.

Dachs, B., M. Dinges, M. Weber, G. Zahradnik, P. Warnke and B. Teufel (2015), *Herausforderungen und Perspektiven missionsorientierter Forschungs- und Innovationspolitik*, Studien zum deutschen Innovationssystem Nr. 12-2015.

Daimer, S., M. Hufnagl, P. Warnke (2012), 'Challenge-oriented policy-making and innovation systems theory: reconsidering systemic instruments', in K. Koschatzky, ed., *Innovation system revisited: Experiences from 40 years of Fraunhofer ISI research*. Fraunhofer Verlag: Stuttgart.

Dosi, G. (1981), *Technical Change and survival: Europe's semiconductor industry*. Sussex European Papers No 9.

Drechsler, W. (2005), 'The rise and demise of the new public management', *post-autistic economics review* 33, 17-28.

Drechsler, W. (2016), 'The German Historical School and Kathedersozialismus', in E. S Reinert, J. Ghosh and R. Kattel, eds., *Handbook of Alternative Theories of Economic Development*, Cheltenham, UK; Northampton, MA, USA: Elgar, 109-123.

Drechsler, W. (2019), 'Confucianism and economic performance in Imperial China', in P. P. Rössner, ed., *The Road to Wealth? Ideas, Economic Thought and Global Economic Divergence During the Last Millennium*, Manchester: University of Manchester Press: Manchester, forthcoming.

Drechsler, W., J. G. Backhaus, L. Burlamaqui, H. J. Chang, T. Kalvet, R. Kattel, J. A. Kregel and E. S. Reinert (2006), *Creative destruction management: meeting the challenges of the techno-economic paradigm shift*. PRAXIS Center for Policy Studies: Tallinn.

Duncan, R. B. (1976), 'The ambidextrous organization: designing dual structures for innovations', in R.H. Kilmann, L.R. Pondy and D.P. Slevin, eds., *The Management of Organization Design. Strategies and Implementation*, Vol.1, North-Holland: New York, Oxford, Amsterdam, 167-188.

Edler, J., Cunningham, P., and Gök, A. (eds.) (2016), *Handbook of innovation policy impact*. Edward Elgar Publishing: Cheltenham.

Ergas, H. (1987), 'Does technology policy matter?', *Technology and global industry: Companies and nations in the world economy*, 191-245.

ESIR (Expert group on the economic and societal impact of research and innovation) (2017), *Towards a mission-oriented research and innovation policy in the European Union*. An ESIR Memorandum.

Evans, P. (1995), *Embedded Autonomy: States and Industrial Transformation*, Princeton University Press: Princeton.

Evans, P. (1998), 'Transferable lessons? Re-examining the institutional prerequisites of East Asian economic policies', *The Journal of Development Studies*, 34(6), 66-86.

Evans, P. and Rauch, J.E. (1999), 'Bureaucracy and growth: a cross-national analysis of the effects of 'Weberian' state structures on economic growth', *American Sociological Review*, 748-765.

Fagerberg, J. (2016), 'Innovation Policy: Rationales, Lessons and Challenges', *Journal of Economic Surveys*, <https://doi.org/10.1111/joes.12164>.

Fagerberg, J. (2018), 'Mission (im)possible? The role of innovation (and innovation policy) in supporting structural change and sustainability transitions', TIK working papers on Innovation Studies No. 20180216.

Ferlie, F. and E. Ongaro (2015), *Strategic Management in Public Services Organizations. Concepts, Schools and Contemporary Issues*, Routledge.

Florio, M., F. Giffoni, A. Giunta and E. Sirtori (2018), 'Technological Learning in Big Science: Evidence from CERN Procurement', *Industrial and Corporate Change*, 27:5.

Foray, D. (2018), 'Smart specialisation strategies as a case of mission oriented policy – a case study on the emergence of new policy practices', *Industrial and Corporate Change*, 27:5.

Foray, D., D. C. Mowery and R. R. Nelson (2012), 'Public R&D and social challenges: What lessons from mission R&D programs?', *Research Policy*, 41(10), 1697-1702.

Freeman, C. (1987), *Technology policy and economic performance: Lessons from Japan*, Pinter: London.

Fukuyama, F. (2011), *The Origins of Political Order: From Prehuman Times to the French Revolution*. Farrar, Straus and Giroux: New York.

Galbraith, J. K. (1973), *Economics and the Public Purpose*, Houghton Mifflin Company: Boston.

Goodsell, Ch. T. (2011), 'Mission Mystique: Strength at the Institutional Center', *The American Review of Public Administration*, 41(5), 475-494.

Grillitsch, M., B. Asheim and M. Trippl (2017), 'Unrelated knowledge combinations: Unexplored potential for regional industrial path development', Papers in Innovation Studies, Lund University, CIRCLE - Center for Innovation, Research and Competences in the Learning Economy, 2017/10.

Gummett, P. (1980), *Scientists in Whitehall*, Manchester University Press: Manchester.

Haggard, S. (1990), *Pathways from the Periphery: The Politics of Growth in the Newly Industrializing Countries*, Cornell University Press: Ithaca.

Hausmann, R. and D. Rodrik (2006), Doomed to choose: Industrial policy as predicament. *John F. Kennedy School of Government*, available at <http://j.mp/2oWZa7W>.

Helfat, C.E. and J.A Martin (2015), 'Dynamic Managerial Capabilities: Review and Assessment of Managerial Impact on Strategic', *Journal of Management*, 41, 1281-1312.

Hirschman, A. O. (1958), *The Strategy of Economic Development*. Yale University Press: New Haven.

Johnson, C. (1982), *MITI and the Japanese Miracle: The Growth of Industrial Policy*, Stanford University Press: Stanford.

Karo, E. (2018), 'Innovation policy and mission-oriented public organizations in East Asia', *Industrial and Corporate Change*, 27:5.

Karo, E. and R. Kattel (2015), 'Innovation Bureaucracy: Does the organization of government matter when promoting innovation?', Papers in Innovation Studies, Lund University, CIRCLE - Center for Innovation, Research and Competences in the Learning Economy, 2015/38.

Karo, E. and R. Kattel (2018), 'Innovation and the State: Towards an Evolutionary Theory of Policy Capacity', in X. Wu, M. Howlett and M. Ramesh, eds., *Policy Capacity: State and Societal Perspectives*. Palgrave Macmillan: Cham, 123–150.

Kattel, R., J. A. Kregel and E. S Reinert (2016), 'Classical development economists of the mid-twentieth century', in E. S Reinert, J. Ghosh and R, Kattel, eds., *Handbook of*

Alternative Theories of Economic Development, Cheltenham, UK; Northampton, MA, USA: Elgar, 336-351.

Kattel, R., W. Drechsler and E. Karo (2019), *Innovation Bureaucracy: How Governments Successfully Support Innovation*, Yale University Press: London, forthcoming.

Krupp, H. (1985), 'Public promotion of innovation – Disappointments and Hopes', in G. Sweeney, ed., *Innovation Policies. An International Perspective*, Pinter: London, 48-79.

Kuhlmann, S., P. Shapira and R. Smits (2010), 'Introduction. A systemic perspective: the innovation policy dance', in R. Smits, S. Kuhlmann and P. Shapira, eds., *The Theory and Practice of Innovation Policy. An International Research Handbook*, Elgar: Cheltenham, 1-22.

Kuhlmann, S. and A. Rip (2018), 'Next Generation Innovation Policy and Grand Challenges', *Science and public policy*. DOI: 10.1093/scipol/scy011

Lam, A. (2006), 'Organizational innovations', in J. Fagerberg, D. Mowery and R. Nelson, (eds.), *The Oxford Handbook of Innovation*, Oxford: Oxford University Press, pp. 115-147.

Lambright, W. H., M. Crow and R. Shangraw (1985), 'National projects in civilian technology', in J. D. Roessner, ed., *Government Innovation Policy. Design, Implementation, Evaluation*, Macmillan: Basingstoke, 63-74.

Leadbeater, C. (2018), 'Postscript: Movements with missions make markets', *Industrial and Corporate Change*, 27:5

Lindner, R., S. Daimer, B. Beckert, N. Heyen, J. Koehler, B. Teufel, P. Warnke, S. Wydra (2016), 'Addressing directionality: Orientation failure and the systems of innovation heuristic. Towards reflexive governance', Fraunhofer ISI Discussion Papers *Innovation Systems and Policy Analysis* No. 52.

List, F. (1841), *Das Nationale System der politischen Oekonomie. Der Internationale Handel, die Handelspolitik und der deutsche Zollverein*. Fisher: Jena.

March, J.G. (1991), 'Exploration and Exploitation in Organizational Learning', *Organization Science*, 2(1), Special Issue: *Organizational Learning: Papers in Honor of (and by) James G. March*, 71-87.

Mazzucato, M. (2013), *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*, Anthem Press.

Mazzucato, M. (2017), *Mission-Oriented Innovation Policy: Challenges and Opportunities*. UCL Institute for Innovation and Public Purpose Working Paper, IPP WP 2017-01, available at <https://www.ucl.ac.uk/bartlett/public-purpose/publications/2018/jan/mission-oriented-innovation-policy-challenges-and-opportunities>.

Mazzucato, M. (2018a), *Missions: Mission-Oriented Research & Innovation in the European Union*, European Commission: Brussels, available at https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf

Mazzucato, M. (2018b), 'Mission-Oriented Innovation Policy: Challenges and Opportunities', *Industrial and Corporate Change*, 27:5.

Mazzucato, M. (2018c), *The Value of Everything. Making and Taking in the Global Economy*, Allen Lane.

Mazzucato, M. and C. Perez (2015), "Innovation as Growth Policy: The Challenge for Europe" in Fagerberg, J., S. Laestadius and B. Martin (eds.) *The Triple Challenge for Europe: Economic Development, Climate Change and Governance*. Oxford: Oxford University Press, 227-262.

McKelvey, M. and R. J. Saemundsson (2018), 'An Evolutionary Model of Innovation Policy: Routines and the growth of knowledge in policy-making organizations', *Industrial and Corporate Change*, 27:5.

Mintzberg, H. (1989), *Mintzberg on Management: Inside our strange world of organizations*, Simon and Schuster.

Mintzberg, H. (1996), 'Managing government, governing management', *Harvard Business Review*, 74(3), 75.

Mowery, D. C. (2011), 'Federal Policy and the Development of Semiconductors, Computer Hardware and Computer Software: A Policy Model for Climate Change R&D?', in R. M. Henderson and R. G. Newell (eds), *Accelerating Energy Innovation: Insights from Multiple Sectors*, University of Chicago Press: Chicago, IL., 159–88.

Nelson, R.R. (1959), 'The simple economics of basic scientific research', *Journal of political economy*, 67(3), 297-306.

Nelson, R.R. (1977), *The Moon and the Ghetto: An Essays on Public Policy Analysis*, W.W. Norton and Company: New York.

Nelson, R. R., M. J. Peck and E. D. Kalachek (1967), *Technology, Economic Growth and Public Policy*, The Brookings Institution: Washington, D. C.

Nelson, R. R. and S. G. Winter (1974), 'Neoclassical vs Evolutionary Theories of Economic Growth: Critique and Prospectus', *The Economic Journal*, 84 (336), 886-905.

Nelson, R. R. and S. G. Winter (1982), *An Evolutionary Theory of Economic Change*, Belknap Press of Harvard University, Cambridge, Mass.

Nurkse, R. (1953), *Problems of Capital Formation in Underdeveloped Countries*. Oxford University Press: Oxford.

OECD (2015), 'System Innovation: Synthesis Report', OECD: Paris, available at: https://www.innovationpolicyplatform.org/sites/default/files/general/SYSTEMINNOVATION_FINALREPORT.pdf

OECD (2017), *Systems Approaches to Public Sector Challenges. Working with Change*. DOI: <http://dx.doi.org/10.1787/9789264279865-en>.

O'Reilly, C.A. III and M.L. Tushman (2004), 'The ambidextrous organizations', *The Harvard Business Review*, April 2004, 74-81.

O'Reilly, C.A. III and M.L. Tushman (2008), 'Ambidexterity as a dynamic capability: Resolving the innovator's dilemma', *Research in Organizational Behavior*, 28, 185-206.

Pavitt, K. and W. Walker (1976), 'Government policies towards industrial innovation: A review', *Research Policy*, 5, 11-97.

Painter, M. and J. Pierre (2005), 'Unpacking Policy Capacity: Issues and Themes', in M. Painter and J. Pierre, eds., *Challenges to State Policy Capacity: Global Trends and Comparative Perspectives*. Palgrave Macmillan: Basingstoke, 1-18.

Peters, B. G. (1998), *Managing Horizontal Government. The Politics Of Coordination*, Canadian Centre for Management Development.

Pierson, P. (2004), *Politics in time: History, institutions, and social analysis*. Princeton University Press: Princeton.

Rauch, J. E. and P. B. Evans. (2000), 'Bureaucratic structure and bureaucratic performance in less developed countries', *Journal of public economics*, 75(1), 49-71.

Reinert, E. S., K. Carpenter, F. A. Reinert and S. A. Reinert (2017), '80 Economic Bestsellers before 1850: A Fresh Look at the History of Economic Thought', Working Papers in Technology Governance and Economic Dynamics no. 74, available at <http://technologygovernance.eu/files/main//2017051103164242.pdf>.

Reinert, E.S. (2007), *How rich countries got rich... and why poor countries stay poor*, Constable: London.

Reinert, S. A. (2011), *Translating Empire. Emulation and the Origins of Political Economy*, Harvard University Press: Cambridge, MA.

Rip, A. (2006), 'A co-evolutionary approach to reflexive governance – and its ironies', in J.-P. Voss, D. Bauknecht, and R. Kemp, eds., *Reflexive Governance for Sustainable Development*, Elgar: Cheltenham, UK; Northampton, MA, USA.

Rip, A. (2016), 'The clothes of the emperor. An essay on RRI in and around Brussels', *Journal of Responsible Innovation*, 3:3, 290-304, DOI:10.1080/23299460.2016.1255701

Rothwell, R. and W. Zegveld (1981), *Industrial Innovation and Public Policy. Preparing for the 1980s and 1990s*, Pinter: London.

Ryan-Collins, J., M. Mazzucato, R. Kattel and S. Sharpe (2018), Market shaping, mission-oriented policy and public value: a new approach to policy appraisal and evaluation. UCL Institute for Innovation and Public Purpose Policy Brief.

Schonfield, A. (1966), *Modern Capitalism: The Changing Balance of Public and Private Power*, Oxford University Press: Oxford.

Schumpeter, J.A. (1942), *Capitalism, Socialism and Democracy*, Routledge.

Soete, L. and Arundel A., eds. (1993), *An Integrated Approach to European Innovation and Technology Diffusion Policy: A Maastricht Memorandum*, European Commission.

Sterling, A. (2014), 'Towards innovation democracy? Participation, responsibility and precaution in innovation governance', STEPS Working Paper 78, available at <http://sro.sussex.ac.uk/39718/1/Innovation-Democracy.pdf>.

Teece, D. (2016), 'Dynamic capabilities and entrepreneurial management in large organizations: toward a theory of the (entrepreneurial) firm', *European Economic Review*, <http://dx.doi.org/10.1016/j.euroecorev.2015.11.006i>.

Teece, D. and G. Pisano (1994), 'Dynamic Capabilities of Firms: An Introduction', IIASA working paper WP-94-103.

Sweeney, G. (1985), 'Introduction', in G. Sweeney, ed., *Innovation Policies. An International Perspective*, Pinter: London, vii-x.

Vom Brocke, B. ed. (1991), *Wissenschaftsgeschichte und Wissenschaftspolitik im Industriezeitalter. Das "System Althoff" in historischer Perspektive*, Lax Verlag: Hildesheim.

Wade, R. (1990), *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*, Princeton University Press: Princeton.

Weber, K.M. and H. Rohracher (2012), 'Legitimizing research, technology and innovation policies for transformative change', *Research Policy*, 41, 1037–1047.

Weinberg, A. M. (1967), *Reflections on Big Science*, Pergamon Press: Oxford.

Wu, X., M. Howlett and M. Ramesh, eds., (2018), *Policy Capacity: State and Societal Perspectives*. Palgrave Macmillan: Cham.

Zehavi, A. and D. Breznitz (2016), 'Distribution sensitive innovation policies: Conceptualization and empirical examples', *Research Policy*, 46, 327–336.

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² See <http://www.vr.se/download/18.7dac901212646d84fd38000336/>; also Dachs et al. 2015 and OECD 2015 for an overview of different countries attempting to re-align innovation policies towards grand challenges.

³ See <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>.

⁴ See also Burlamaqui 2006 who argues for a Schumpeterian competition policy that should be based on what he calls market features approach, and Drechsler et al. 2006 on "creative destruction management" as an example of Schumpeterian 'toolbox' for directing innovation.

⁵ Hirschman's main discussion partner was Ragnar Nurkse who argued for balanced growth: development policies should support multiple sectors that can become each other's customers and generate increasing returns in multiple industries simultaneously. See Nurkse 1953; Kattel, Kregel and Reinert 2016 for a broader contextual discussion of development pioneers.

⁶ On policy feedback loops, see Pierson 2004; also Mintzberg 1996.

⁷ See also Peters 1998 on the politics of coordination.

⁸ See also Lambright, Crow and Shangraw 1985 for a discussion of civilian missions from that era, e.g. civilian supersonic transport, nuclear power and synthetic fuels; and Krupp 1985.

⁹ Ferlie and Ongaro 2015 provide a useful discussion of strategic management approaches in public services.

¹⁰ For a more detailed discussion, see Karo and Kattel 2018, and Wu, Howlett and Ramesh 2018.