



The Economics of Incomplete Plan - on Conditions, Procedures and Design of Future Mission - Oriented Innovation Policies

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Abstract

The buzzword in industrial policy and innovation policy circles is *mission-oriented innovation policy* (MOIP) –which means a policy to encourage innovation intended to accomplish a certain mission– whether it be a societal challenge (climate change, global health) or an industrial policy issue (sectoral transition or modernisation, establishment of a new industry). This new category results from what seems a priori to be just a simple qualifying extension of *mission-oriented policies* (MOPs) –very much in vogue in the 70's and 80's and used particularly in sectors like space and defence. However, this 'simple' qualifying extension does in fact cause a significant discontinuity that merits reflection. While a mission imposes a discipline and centralised priorities and decisions, innovation on the other hand can't be planned. Innovation is so uncertain that no plan will ever enable it to be tamed. There is thus a tension between mission and innovation, between a planning logic and a freedom to experiment logic. This tension implies thus advancing our knowledge about MOIP design, which is the goal of this paper.

Keywords: Mission-oriented innovation policy, Grand challenges, Business and social innovations, Economic discovery.

JEL Classification: O25, O31, O38.

1. Mission-oriented innovation policy: an oxymoron?

The buzzword in industrial policy and innovation policy circles is *mission-oriented innovation policy* (MOIP) –which means a policy to encourage innovation intended to accomplish a certain mission– whether it be a societal challenge (climate change, global health) or an industrial policy issue (sectoral transition or modernisation, establishment of a new industry). While a certain rate of innovation may be found sufficient for sustaining productivity growth in the economy in general, it can be insufficient in certain domains in which accelerating

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innovation is an imperative for particular reasons (climate change, health, modernisation or transition of an old industry, etc.)¹. The policy goal then is not merely to address market failure and incentivise innovation in the general economy, but to do so in a specific way within certain domains or *directions*. Thus, the notion of MOIP (Lindner *et al.*, 2021; Mazzucato, 2021).

This new category results from what seems a priori to be just a simple qualifying extension of *mission-oriented policies* (MOPs) –very much in vogue in the 70's and 80's and used particularly in sectors like space (Apollo, etc.), aeronautics, transport, energy or defence (Foray *et al.*, 2012)².

However, this 'simple' qualifying extension does in fact cause a significant discontinuity that merits reflection. A category that was relatively coherent –MOPs as allocation and coordination mechanisms of public resources enabling the attainment of a purely technological objective, decided by a State and executed by a small number of public agencies and firms– has been made into an oxymoron by adding the word "innovation". More precisely, the oxymoron is the result of the clash between the terms mission and innovation.

2. Mission versus innovation

A mission –in economists' jargon– expresses an intentionality not directly linked with the economic incentives of private agents. It therefore imposes a discipline, and centralised priorities and decisions. It consists of goals, sub-goals, deliverables and targets. It is often conducted by an elite corps of scientists and engineers and a small number of dedicated companies.

Innovation by definition eludes all this 'military' terminology. Innovation reflects changes in products, services, processes or models, driven by business opportunities and private incentives. Of course, the role of innovation policy is to manipulate incentives both on the supply side (for instance through R&D subsidies or tax credit) and on the demand side (for instance through an adoption program or a public procurement for innovation approach). However, what matters eventually is how private incentives are aligned with the development and adoption of innovations. And this is a matter of consumer preferences, costs and potential profits. Innovation is thus an economic discovery about whether the new product or service or model works in the economy –that is to say generates economic value (consumer surplus and perhaps profit). If the new idea passes these economic filters, it will be widely adopted and become an innovation. As Phelps (2013) says –“*a new idea which is not adopted on the market is not an innovation*”– even if the technology works. Obviously economic discovery and its outcome –an innovation which is developed, generates economic value and therefore is adopted– are highly uncertain. This is why innovation fundamentally requires *decentralized entrepreneurial search and freedom to experiment*. Here we are adhering to the reflections of authors as disparate as Phelps (2013) or Rosenberg (1992) –but who tend to agree on the fact that innovation (unlike the invention or scientific discovery) is essentially an economic discovery: it is the validation of a new idea, new product or service by the economy, con-

sumers, companies. The uncertainty concerning consumer preferences, costs and potential profits make this validation extremely uncertain. The economic discovery and validation are essential since if they are not achieved the new technology – even if it is green and exemplary from the environmental point of view (for example in the case of a mission concentrating on climate change)– will not be adopted. So we then find ourselves with a mission-oriented policy without innovation. An MOP (without “I”) typical of the eighties but that would inevitably fail nowadays.

Phelps or Rosenberg are very much concerned with business innovation but this framework can be extended to social innovations. Social innovations are innovations which –as business innovations– generate economic and social value but this value goes entirely to society (there is no appropriation of any fraction of the surplus by the innovator) (Cuntz *et al.*, 2020; Phills *et al.*, 2008). The development of social innovation is therefore not profit-driven but impact-driven. However, again adoption is key: consumers or citizens will adopt it or not –depending on how they value the considered innovation for them. Any interesting example of social innovations– such as providing bed nets for free to prevent Malaria or developing microfinance or organizing libraries of things –show that success is not taken for granted. All these innovations can be adopted or rejected by the targeted communities or social groups.

Whether it is business or social –the innovation success always depends on decentralized decisions of potential innovators and adopters, driven by socio-economic incentives. This makes it highly unpredictable, difficult to plan and to organize.

3. Old MOPs were successful because they did not need innovation

A radical concept of innovation and its implications for the analysis of old MOPs

We have just stressed above that the innovation process does not occur in the technical sphere, but in the economic one. It is therefore a question of seeing whether a new idea and its substantiation as a product, process or business model will be adopted by consumers or users, and what will be the costs and profits. A new technology may work in the engineering space but it is not an innovation because it does not create economic value (measured by consumer surplus and eventual profits). The decrease in costs to carry out some activity –a fundamental source of the increase in consumer surplus– is an essential part of innovation. Thus Ridley (2020) writes: “*The innovation translates in a so high decrease of costs that it changes the world*”.

It is this radical concept of innovation that underpins our approach and leads us to analyze the old MOP as *mission without innovation*. Of course, advancing technological and engineering knowledge was a central requirement to achieve these missions but this was not innovation. Let’s take iconic cases of post-war MOPs –such as Apollo or the Franco-British Concorde– to make this point clearer.

Apollo and Concorde

Apollo (or Concorde) had nothing to do with any societal needs and the goal of Apollo was not to achieve any structural transformations of our economies and societies. The Apollo policy goal was just about an extraordinary engineering achievement –made possible thanks to a quite simple institutional framework. We are talking here of a very centralised and top-down organisation involving the US government which acted as both funder and client, an executive and planning agency (NASA) capable of mobilising an elite of scientists and engineers towards the engineering goal and a few dedicated companies. Citizens were not concerned at all (only as taxpayers and TV watchers). Even the economy was not really concerned since the economic logic of Apollo –characterised by a disregard for consumers' willingness to pay and the production and operation costs– made this project very far removed from the normal way innovation projects are managed and conducted within a classic decentralised market economy³.

To summarize, within the context of the old MOPs, the aspects of mission and discipline were all that counted. Indeed, if MOPs excelled at crossing certain technological frontiers, they did not have the same objectives relating to societal transformation as missions do nowadays; they therefore did not need innovations, in the sense that we mean. They only needed science and technology. Disregard for costs and consumers was the rule and thus the accomplishment of these missions was not based on innovation but on the execution of a technological plan by an elite group of scientists, engineers and test pilots. These policies were therefore relatively simple since the solutions to problems only involved the science and engineering domain. Neither the economy nor society was concerned.

This is why incidentally –let us emphasise this in passing– calls for a new Apollo programme or a new Manhattan Project to resolve the climate problem fall completely wide of the mark. The essential difference between the missions *to walk on the moon* or *to invent the atomic bomb* and the mission *to resolve the climate problem* is that, in the latter case, nothing could be accomplished without the private sector and without civil society. In fact, it is private companies that ultimately decide which technology to produce and use and it is consumers who have control over their patterns of consumption and lifestyles⁴.

For old MOPs, the aspects of missions and disciplines were all that counted. This makes these policies quite coherent in the sense that the institutional framework and resource allocation logic were coherent with the engineering and scientific goals of the missions. These policies did not contribute to any economic surplus but, as already said, the relationships between the institutional framework and the engineering goals were coherent and these policies succeeded in achieving incredible engineering performances⁵.

4. Innovation: a new priority for today's missions

Contrasting with the old MOP, the new ones that address current challenges, make innovation essential as the solutions invented by scientists and engineers must be adopted by

the economy and society and because society needs to transform itself through behavioural changes and the adoption of new social practices.

The great economist Thomas Schelling –Nobel Prize laureate in 2005– wrote in 1996: *“Decreasing emission has to be very decentralized, very participatory, and very regulatory. It requires affecting the way people heat and cool their homes, cook, collect firewood, drive cars, consume energy-intensive aluminium, and produce steam for electricity and industrial use. Methane abatement involves how farmers feed their cattle and aerate their rice paddies. Carbon abatement depends on policies that many governments are incapable of implementing because they don’t know how, or they haven’t the resources, or they haven’t the authority, or it is too expensive”*.

Although some of these statements should be updated, what Schelling described here remains very true: the new Grand Challenge is a difficult social problem instead of just an engineering problem. To deal with today’s Grand Challenges, the active participation and contribution of society is indeed an absolute imperative. This is about changing consumer preferences, social practices, perhaps lifestyle. And the economy’s active participation is also strongly required since a key issue is not just about the generation of green innovations but how these innovations diffuse, are adopted by a myriad of firms.

Green technology emerging from the university laboratory still has a long way to go before it has any effect on the accomplishment of the mission: it must enter the economy in order to verify whether it works economically, whether firms or consumers agree to adopt it, at what price and in accordance with which business model; it is this logic of economic experimentation and discovery that creates (or eliminates) the innovation. This is the real economy –in which costs and preferences are central issues; not the Apollo economy– characterised by a fundamental disregard for costs and consumer preferences.

It is therefore obvious that the argument that we need a new Apollo is somewhat misleading. It conveys the wrong message that society is not concerned, does not need to be involved and that an elite of scientists and engineers will do the job. Apollo did not generate any structural changes and NASA, which is often presented as the archetype of ‘mission institution’, is incompetent to contribute to the highly decentralised and socially distributed problems described by Schelling⁶.

However, what is needed today to address the new Grand Challenges, as we all know, are profound structural changes within our economy and society –regarding business models and production modes on the part of firms, consumption patterns and social practices on the part of consumers– in another word, the new Grand Challenges need innovations, massively, in the sense we have defined them –as economic (and social) discovery.

Several recent academic works have suggested interesting typologies of mission-oriented policies (see for instance Wittmann *et al.*, 2021). Our own typology is very simple and obvious. It is based on the fact that the considered challenges need or don’t need innovation as the essential mechanism to address the big problems.⁷

5. Plan and innovation

Mission imposes planning and centralization. The simple fact of designing a mission to be accomplished already represents the embryo of a plan. As wrote very well by Gross and Sampat (2021), it requires a heavier hand, a tighter focus and more explicit coordination. In other words, mission imposes *discipline*. Innovation, in contrast, is about *indiscipline*. It requires freedom to experiment in order to discover in a decentralized way commercial or social opportunities. It is an economic discovery about consumer preferences, costs and business (or social) models. Adoption is never taken for granted.

Within the context of the new mission-oriented policies, innovation is imperative and vital because the adoption and diffusion of technological (or non-technological) solutions are what matters eventually. And yet, by its very nature, innovation is a wild animal reluctant to enter the enclosure of the mission. How to solve such a tension?

A plan is not bad in itself and is inevitable in a way when a policy is oriented towards a mission. It indicates a direction and encourages the coordination of investments and the initiative of firms within the framework of this direction. But the plan can be bad if it fails to acknowledge and take into account two crucial problems –its inability to control the inherent uncertainty of innovation and its inability to know or foresee the specific needs of economic agents with regard to innovation. In acknowledging this dual inability, planners must content themselves with designing an *incomplete plan*. This will form the subject of the following section. For the moment, let's focus on this dual inability of a plan or mission in the face of the problem of the encouragement of innovation.

The plan's inability to domesticate innovation

The question of uncertainty lies at the heart of the works of the founding fathers of the economics of innovation. Rosenberg thus wrote (1992, p.186): *“the essential feature of technological innovation is that it is an activity that is fraught with many uncertainties. This uncertainty, by which we mean an inability to predict the outcome of the search process, or to predetermine the most efficient path to some particular goal, has a very important implication: the activity cannot be planned”*.

Rosenberg wrote it in black and white: *it cannot be planned!* Innovation is so uncertain that no plan will ever enable it to be tamed. We have already described innovation as a wild animal. So let us think of the plan as being like a zoo. The zoo can at best feed and look after the wild animal (at worst it will mutilate and mistreat it) but it will never turn it into a domestic animal. Likewise, the plan –even the best one– will never be able to domesticate innovation.

Let's take the example of the *European Green Deal*. This consists of objectives and road-maps at very fine levels of granularity –thus determining the most specific and detailed areas of operation possible.⁸ But innovation will always elude this ideal structure, conceived in the

offices of the European Commission. This doesn't mean that a plan isn't necessary –it simply means that innovation will not follow the roadmaps drawn up by this plan. Hirschman (1995) had understood this problem well in his writings on industrial policy. He actually said that industrial policy and planning are not bad things in themselves. They are only bad if they are designed and carried out without acknowledging the uncertainty inherent to the unfolding of the plan (ibid. p.73): *“to avoid misunderstanding, it should be added that the above argument is not meant as an attack on planning as such, but as a criticism of the kind of planning that ignores the existence of uncertainties”*.

Innovation requires very detailed and local information on industry-specific inputs

This point is a recurrent argument put forward by Hausmann and Rodrik (2006): whether it concerns production or innovation activities, they require capacities and infrastructures that are highly specific to the sector or industry concerned. An innovation accelerator in medical technologies will not have the same equipment or business model as an innovation accelerator in green technologies.

Problems of coordination to be solved within the framework of an MOIP can arise from the complementarity of investments (each needs the other to be profitable) or from a quasi-unavoidable gap between the emergence of new R&D fields and the supply response in terms of skills and competences (Romer, 2001) or from the difficulty of small entities to join forces in order to collectively produce some industry-specific public goods. All these problems are highly specific to a sector or an industry.

Therefore, encouraging innovation in a specific sector –which is the characteristic of a mission– requires such a detailed level of information concerning the necessary specific inputs and infrastructures that it is not realistic to think that a central planner can attain this level. But the encouragement of innovation within a mission framework cannot limit itself to setting up generic infrastructures and capacities, valid for the entire economy and all companies. Hausmann and Rodrik state brilliantly the political implications of a fact –the sectoral specificity of innovation factors– that all economists studying innovation in a particular industry know by heart : *“The idea that the government can disengage from specific policies and just focus on general framework conditions in a sector neutral way is an illusion based on the disregard for the specificity and complexity of the requisite publicly provided inputs and capabilities”* (Hausmann and Rodrik, 2006).

These two problems –innovation is highly *uncertain* and the actions and inputs required for innovation are highly *specific*– comes from the same fundamental point which is the Hayekian argument that the knowledge regarding what to do and how to do is not obvious. It is knowledge “of time and place”; localized knowledge which is dispersed, decentralized or divided. Above all, the *ex-ante* knowledge is incomplete. These two problems, which do not really arise within the context of MOPs but become central when the “I” of innovation is added, therefore result in a fundamental question asked by C. Sabel: *“What if, as I and many others assume, there are no principals with the robust and panoramic knowledge needed for*

this directive role?” (Sabel, 2004). The basic problem of an MOIP –that is an industrial policy that aims to encourage *innovation* to accomplish this mission– is to define what the plan must do (and how it must do it) and where it must adopt a *laissez-faire* approach to preserve at all costs the freedom to experiment (and how it must do that).

This problem thus implies the elaboration and application of the concept of incomplete plan.

6. The economics of incomplete plan

The notion of incomplete plan is inspired by that of incomplete contract. In modern contract theory, it is acknowledged that it is impossible to perfectly anticipate the future and the behaviour of the two parties, considering all the eventualities that the future may hold in store. Contracts therefore define the general framework of the exchange but do not specify each of the actions required of the co-contracting parties. They are incomplete. However, this incompleteness offers each contracting party opportunities to not entirely respect their commitments. This is why monitoring and protection systems must be designed: the parties will agree to incentive and coercion systems to compel each party to abide by the contract.

Here I am only presenting the incomplete contract framework as a heuristic to search for a useful concept of *incomplete plan*. Much more research will need to be done on the transposition of the main principles of the incomplete contract theory in the area of industrial policy and plan to make this heuristic useful.

For instance, an obvious difficulty to build an incomplete plan to support innovation and achieve a mission deals with designing policy instruments which can work as incentive and coercion systems. The well-known market failure which involves uncertainty combined with the difficulty to observe innovator’s effort (Arrow, 1962) makes the design of such instruments especially difficult and critical (see section 7 for a discussion on this issue).

Combining a planning logic and a freedom to experiment logic

An incomplete plan is designed as a solution to the planner’s dual inability discussed above. The planner who is driving centralized decisions on priorities and transformations can’t predict what should be done by whom and with whom, what are the coordination problems arising from shifting a particular sector towards new goals or targets. As aptly argued by Matsuyama (1997), “*Understanding the basic principles of coordination problems does not take one very far in the direction of useful, practical conclusions about how to construct technology policy. Understanding the basic problems, one is led to a new but not simpler set of questions: what activities in what firms are complementary and need to be coordinated, and in what way? An appropriate choice of policy tools requires a detailed understanding of the externalities and the innovative complementarities involved*”.

The dual inability implies a need to complement the planning logic with a bottom-up discovery process –one where firms and other innovation actors are called to assist the planner to learn about constraints, problems and opportunities and engage in strategic coordination to generate specific and tailored policy initiatives in response (Rodrik, 2004). The goal of the discovery process is to identify what needs to be supported and developed and what are the corresponding policy programs and actions –e. g. a transformational roadmap. This roadmap could under no circumstances have been imagined or predicted by the planner alone.

An incomplete plan is thus marked by a high level of intentionality, centralization of decisions and strategic focus. But, it is also characterised by a high level of discovery and initiative by the actors of the innovation process. It is this combination of two policy logics –a planning logic and a self-discovery logic⁹– that constitutes its trademark. It should be noted that these two policy logics are frequently opposed in the literature as well as in practice. But the fundamental issue of an incomplete plan is to reconcile the two logics in an effective MOIP design.

Prof. Paul A. David¹⁰, at the time of the *Knowledge for Growth* Group of Experts (around 2010) explained that such a tension calls for *building an intermediate process between total top-down and pure bottom-up –a process which aims at enhancing research and entrepreneurial effort and coordination within a framework (mission, priority) structured from the top*¹¹.

Paul David's contribution was quite abstract at the time but critical design features have since emerged based on practice (notably the practice of *Smart Specialisation Strategy* design and implementation)¹² –so that we now have a collection of tools and components to deal with the aforementioned tension, which has been experimented with on a large scale during the most recent operational programme of the European Commission (under the ERDF provision¹³); a collection of tools which should be of great inspiration for the design of MOIPs.

The design of an MOIP faces three types of problems and the issue of the combination between planning and freedom to experiment must be addressed for each of them.

Firstly, this question is posed for identifying and legitimating a certain priority area or mission.

Secondly, for breaking the broad priority area down into sub-domains or sub-objectives. Narrower and more specific transformational goals within a broad priority area will help agents (companies, research) to anticipate future changes, commit resources into the right direction, coordinate with the relevant partners and generate some degrees of relational density among them.

Thirdly, for identifying the specific policy actions to be carried out in order to attain each of the sub-objectives.

Our proposition is that the first type of problem comes under the plan and follows a top-down logic, whereas the next problem of identifying sub-goals can only be resolved

by combining a planning logic and a discovery process and finally the third problem is one where the self-discovery logic dominates: bottom-up and decentralized discoveries is the key mechanism to elicit information about what needs to be done, how to solve most coordination problems, what are the industry-specific public goods which are missing, what programs will help to realize business opportunities, etc.

The planning logic is thus predominant to address the first problem and then decreases in intensity while the self-discovery logic is not present at the very beginning of the process and starts to be activated when the definition of transformational goals need to be more specific and is increasing in intensity as the process unfolds. In a sense, the more specific are the objectives, problems and opportunities, the more dominant is the logic of decentralized discovery.

Priority area and transformation: the planning component of MOIP

The first type of problem that it is important to consider in designing an MOIP could be called “prioritization”. This is almost a truism since it is because there is a *priority* problem that there is a need for a *mission*: innovation does not necessarily happen where it is socially desirable.

Our proposition is that the formulation of the *broad priority area and generic transformation*, in other words, the objective to be attained thanks to innovation, is subjected to a *planning logic* and accomplished *top-down*. Of course, the formulation of a direction in a *top-down* logic does not mean an absence of any consultation between and participation of not only experts but also representatives of the civil sector. Indeed, the subsequent performative power of the MOIP considered will closely depend on the level of social consensus obtained, both in terms of the problem to be resolved and the solutions. It is in fact essential to obtain a certain alignment of the government, the industries concerned and civil society regarding the mission identified and the range of possible solutions (Wanzenboeck *et al.*, 2020). *Top-down* does not mean ivory tower but simply that the final decisions are centralised, even if they have been made in consultation with experts, representatives of the private sector and civil society.

From large priority area to more specific transformational goals

As the problem changes of nature –from the identification of broad and quite generic objectives to the definition of more specific goals - the planning logic needs to be complemented by a bottom-up and decentralized discovery logic in order to determine a certain elementary division of the problem into sub-problems or sub-objectives.

At this stage, the goal of the entrepreneurial discovery process is to explore a broad strategic field in order to highlight more specific and narrow priority areas – each being defined as the association of a specific area within the strategic field with a transformational goal. At this stage, we will talk of a self-discovery process of low intensity because top-down insights and decisions still matter. The mutual influences of *planning and self-discovery* are well balanced.

Two or more transformational goals –within the broad priority area– can have scale and scope economies as well as potential “internal” spillovers effects. For instance, two goals may require the same R&D infrastructure (scale and scope) while some achievements in goal 1 can be used as input for goal 2 (spillovers). These characteristics need to be taken into account at the third stage of the process (below).

Building a transformational roadmap: the discovery component of MOIP

Once these more specific transformational goals have been defined, the next stage of the entrepreneurial discovery process is to elicit information about problems, needs and opportunities which are characterizing a given transformational goal and to propose policy initiatives in response.

Within a determined sub-domain, the question is to know the type of actions to be carried out in order to accomplish the sub-goal that has been defined. What needs to be “discovered” rather than “planned” is the roadmap comprising all the projects and actions necessary for accomplishing the sub-goal. This discovery process is carried out by a decentralised board, specific to the sub-domain and composed of experts and representatives of the private sector and civil society. This collective discovery process will uncover a collection of related actions (all being undertaken and pertinent in relation to the sub-domain’s objective) –covering a multitude of dimensions: R&D, coordination and complementarity between investments to create the commercial conditions appropriate to new activities, education and training, provision of specific technological infrastructures and specialized services, diffusion of new technologies, regulation and management of firms, etc.¹⁴

The bottom-up discovery process is therefore a unique mechanism to build the transformational roadmap. It is unique and unavoidable because –as already said– what is needed to do to meet a specific transformation goal could under no circumstances have been imagined or predicted by the government. It needs to be “discovered” and revealed by practitioners, researchers and other stakeholders.

It is important to observe that such a discovery process has a strong public dimension: its goal is to generate information and insights about problems and gaps, challenges and opportunities which are relevant for the whole population of the relevant actors (e. g. within the sub-domain). In such a spirit, the outcome of the discovery process should not be a list of “privately-owned” projects (as it would be produced for instance by a call for R&D proposals). Rather, the outcome of the discovery process should involve first collective projects or collective goods (such as infrastructure, platform, training programmes) and second policy proposals (such as a call for R&D projects targeting specific developments or a public procurement initiative) which then will make the firm’s private projects possible. To borrow Paul Romer’s insight (Romer, 2007), the discovery process is oriented towards the generation of meta-ideas –which are ideas about how to support the production and transmission of other ideas (i. e. innovations).

Keeping the public dimension logic is a mechanism to avoid policy capture: the discovery process should not aim at taking concrete funding decisions at project levels but rather

at identifying the collective goods and the policy proposals which will make then private projects possible.

Finally, it should be noted that this discovery phase operates as a feedback mechanism to verify the pertinence of the sub-goal identified at the planning stage. If the transformational roadmap comprises only a few projects, projects that are not very innovative or are unconnected, it indicates that the sub-goal was perhaps badly formulated or premature. We should go back to square one and discuss the pertinence of this part of the plan again.

Concrete view –what are the meta-ideas to be put in the roadmap?

If the necessary actions to meet the sub-goal have not been executed spontaneously by firms and consumers before the MOIP has been decided on, it is because a great many obstacles of all kinds are obstructing it. For instance, the standard market failures –positive externalities regarding knowledge, adoption of innovations, networks or training and negative environmental or social externalities, problems of coordination and collective action, questions of credit access for small companies or the difficulty of changing consumption patterns or social practices. Many tools are available to resolve each one of these problems. Establishing a persistent trajectory of structural change towards the desired objective then requires the coordinated implementation of a wide variety of (sub-domain-specific) public goods and policy proposals.

Sub-domain specific public goods involve a variety of specialized infrastructures and programs designed to provide critical resources for innovation that potential innovators need but cannot produce and maintain by themselves. Such critical resources involve R&D and technological infrastructures (for instance to establish development and pilot lines accessible to small firms), training programs for specific and specialized skills, high-density accelerators, incubators or science park as well as institutional arrangements to organize and support public-private partnerships for transfer of technologies and collaborative R&D. The goal of this part of the roadmap is to provide a rich innovation ecosystem, an *innovation ecology* capable of providing all complementary capabilities which are needed by potential innovators within the specialized innovation area defined by the sub-goal.

Policy proposals encompass all instruments designed to reward successful innovators (pull mechanism such as *ex ante* prizes or advanced market commitment), address innovation costs (push mechanisms such as subsidies, R&D tax credits) or stimulate innovation demand, adoption and diffusion (adoption subsidies, procurement for innovation, information and nudge)¹⁵. Policy proposals can include also the provision of mechanism –based on a system approach to innovation. The point is to organize efficiently research, innovation and the provision of critical resources around a technology-related objective or a set of overarching goals –which involves many complementary innovative investments to be made simultaneously (including R&D, infrastructure, training, process innovation and diffusion). In such a case, there is a need for some kind of strong coordination mechanisms in order to capture all these complementarities. This is what can be achieved through a so-called ARPA mechanism (Azoulay *et al.*, 2019).

The transformational roadmap and the transformative activities which are included in it are, therefore, the essential outcome of the entrepreneurial discovery process.

The following example provides a fascinating illustration of the whole process as it was designed and implemented in Skåne (Sweden).

Box 1
FROM ESTABLISHING A PRIORITY TO BUILDING A TRANSFORMATIONAL
ROADMAP - THE CASE OF SKÅNE

The Region Skåne (Sweden) has putting in place a process to develop a series of MOIPs which follows quite well the logic of an incomplete plan.

At a first stage, large priority areas have been identified:

- *Innovation for a sustainable food system.*
- *Life science and health.*
- *Tech sector.*

At this stage, the logic of centralized and top-down decisions is dominating, even if all relevant stakeholders were involved in the decision process.

At a second stage, each of the three large priority areas were sub-divided into more specific transformational goals. For instance, within the large priority area of innovation for a sustainable food system, seven sub-goals were identified:

- *Build a circular development centre in Skåne.*
- *Realizing unique opportunities for knowledge-based innovative product and processes development in the food and packaging sector.*
- *Expanded possibilities for testing, demo and small-scale production.*
- *Increases genuine recycling of plastics from food chain packaging.*
- *Public meal as an innovation-driven arena.*
- *Increased cultivation and production of plant-based foods.*
- *Development effort for AI, data and sustainable high-tech in the food chain.*

It is obvious that this second stage is very important. Breaking the broad priority areas into more specific transformational goals is key to enhance coordination between decentralized agents (in particular firms, research partners and public agencies), to provide the specific collective goods (infrastructures, services) and increase relational density. At this stage, the planning logic is complemented by an entrepreneurial discovery logic. Indeed, the level of specificity which is appropriate to define the transformational goals makes entrepreneurs and other stakeholders central in eliciting information and knowledge about the specific capacities and opportunities of their sector (here the agro-food industry).

Finally, at a third stage, the entrepreneurial discovery process is activated again to identify problems and gaps which need to be addressed to reach each transformational goal and the tailored policy initiatives in response. For example, within the framework of the transformational goal –*Realizing unique opportunities for knowledge-based innovative product and processes development in the food and packaging sector*– the following activities have been defined:

- *Strengthening private-public partnerships on food research and applications.*
- *Starting concrete pilot projects for research and process development in the area of advanced X-ray and neutron technology in food contexts.*
- *Development of an infrastructure for recycling packaging materials.*
- *Scheme for new technology adoptions by SMEs.*
- *Projects to increase accessibility of research infrastructure to accelerate innovation.*
- *Supporting industrial doctoral students in the area of nutritional life, innovation and interdisciplinary science.*
- *Creating training and courses to widely increase interest, spread knowledge and share experiences.*

This collection of activities is the transformational roadmap for a specific goal within the broader priority area. The Skåne example provides an excellent illustration of the right way of thinking of the logic of an incomplete plan : a *discovery process* –one where firms, researchers and the government learn about constraints, problems and opportunities within a very specific area and engage in strategic coordination to generate unique and tailored policy initiatives in response.

Source: Tillväxtverket - Innovation for a sustainable food system - Skåne - draft paper - 2021.

Transformational roadmaps - properties and implementation

A transformational roadmap has three key properties that need to be well understood and exploited so that it can serve as a catalyst for collective action by firms, suppliers, research partners and customers towards the desired structural transformation.

Strategic complementarities

Determinants of productivity/innovation are multiple and the complementarities among them are key. Obvious examples involve the complementarity between the invention of generic technologies (or GPT), the development of applications for several sectors and the adoption of these applications within the concerned sectors; or the complementarity between the investments in some specific R&D fields and the investments in the corresponding specialized scientific and engineering skills and capabilities. When properly managed, such *strategic complementarities among activities* can stimulate the emergence of a persistent pattern of change (Milgrom and Roberts, 1990). A transformational roadmap is designed to capture all these complementarities and makes clear that there is great advantage to be gained in launching activities simultaneously, resulting in even stronger transformative activity.

Spillovers

The second property concerns the notion that all activities that are part of the transformational roadmap have the potential to provide *knowledge and information spillovers*.

When the initial projects and experiments undertaken within an activity are known to be successful, other agents are induced to join the transformative activity. According to Hirshleifer (1971), public information regarding project successes, failures and surprises has high social value in redirecting productive and investment decisions. Thus, the governance of the transformational roadmap –once the activities have been defined and start to grow– should be done in such a way as to maximise the spillovers to all the stakeholders –including potential entrants.

Agregation level

One difficulty is to place the MOIP operations at the right level of aggregation. It is quite obvious that an MOIP is not just a sectoral policy. Rather, it is about *transformation* and it is obvious that not all firms in one sector will be committed to the desired transformation. On the other hand, it should not be a process selecting just individual projects while disregarding relatedness and coordination among projects –because such a policy will fail in generating relational density and agglomeration of actors which are key determinant of innovation success. Between these two levels –a sector as a whole and individual, isolated projects– a collection of complementary activities can be envisaged, all involved in the same transformation process. We have named it a *transformational roadmap*. This intermediate level of aggregation is a key principle of a new generation of industrial policies. It invites us to make explicit the key objectives of MOIPs: focussing on structural transformations BY building systems of complementarities (or systems of innovation).

Implementing the roadmap - discovery again

Beyond this deployment of tools, the breadth and cost of which are questioned below, the implantation and execution phase of the roadmap is a phase full of surprises, successes and failures. It is a *voyage of discovery*, to use Hirschman's expression, which thus requires robust monitoring, evaluation and flexibility mechanisms. Such mechanisms rely largely on evaluation data, which must provide an up-to-the-minute monitoring of the individual project advancements as well as a summarising barometer of the progress in achieving the roadmap. Such a barometer provides a measurement of the degree to which there is progress in the right direction. It can also provide an indication that something warrants further and more detailed investigation (Feldman *et al.*, 2014). Feedback regarding the roadmap must be permanently ensured in order to terminate unsuccessful projects, increase support for projects that are proving their potential or introduce entirely new proposals.

A new way of approaching project funding (Rammer and Klingebiel, 2012) is very much suited to this objective of keeping policy support as flexible as possible: instead of one single financing decision, made at the start of the project, the authors elaborate a multiple and sequential decision model that allows projects that are not working to be discontinued sooner and the volume of financing allocated to those that are progressing to be increased.

These monitoring and flexibility mechanisms make the roadmap a living document.

7. Engineering MOIP

We are still missing serious works in the area of *policy engineering*. MOIP as a combination of planning and self discovery is a great policy concept, which makes sense from a theoretical point of view and is based on a significant body of literature. However, we all know that a sound policy concept can have no impact because failures happen at the stage of concrete design and implementation. The area of *policy engineering* is about the way policy instruments and programs are designed and implemented in order to get what the policy concept ‘promises’ to deliver¹⁶. In the area of innovation policy, the devil is in details and there are many cases of very smart and theoretically-grounded policy concept which just don’t work in reality for one or another reason. In some cases, it is because there are intrinsic problems in the policy idea which makes it almost impossible to work in the real world¹⁷. In other cases, this is because not enough works have been done in the engineering of the concerned instruments so that there is a gap between how the instruments are actually performing and what the policy concept is supposed to do.

In this section, we explore three areas where more scholarly works on the engineering of an MOIP are needed.

Designing policy instruments for the incomplete plan

Dealing with the trade-off between directionality and freedom to experiment

Many of the standard innovation policy instruments can be used non-neutrally, in order to support innovations in specific and desired areas. In other words, they can be sufficiently well specified in order to avoid any abusive exploitation of the tool outside the mission domain¹⁸. However, this specification of the tool will logically increase its design and monitoring cost¹⁹.

Using policy tools in a non-neutral way means that the policy tool will help to attract resources and concentrate research forces in some pre-determined fields or sectors corresponding to the transformation goal. Such direction comes at the expense of the freedom of the innovator. We already highlighted the importance of freedom to experiment as a key ingredient of innovation success. It is, therefore, important to differentiate policy instruments according to the way they can promote flexibility and freedom to potential innovators as searching for solutions, even if they are used in a non-neutral way. The *planning* versus *freedom to experiment* question is, therefore, relevant for designing and selecting policy tools, since different tools can offer larger or smaller scope for freedom to experiment and give more or less leeway to potential innovators for their innovation decisions.

The historical example of the prize offered by the British Government to find a solution to the Longitude problem is highly instructive (Kremer and Williams, 2010). While the prize committee expected astronomers and mathematicians to develop a solution, the invention was actually developed by a clockmaker. This shows that an *ex ante* prize which specifies solutions and not methodologies promotes freedom to enter (the competition) and to exper-

iment. A prize focusing on methodologies or, as an alternative mechanism, an R&D subsidy schema (which would have only accepted proposals by reputed astronomers and mathematicians) would have missed the clockmaker. Policymakers need to use tools that offer the best balance between mission and targets on the one hand and freedom to experiment on the other.

Designing instruments to build systems of incentives and coercion in the framework of an incomplete plan for innovation

There are several important market failures which are likely to generate inefficient resource allocation in the domain of R&D and innovation. Among those, one is of particular significance for a policy aiming at directing innovation towards a desirable area. This market failure involves the fact that research and other innovation inputs only produce knowledge with uncertainty. As observed by Bryan and Williams (2021), in many business contexts, uncertainty does not harm economic efficiency as long as risks can be suitably hedged. But Arrow (1962) noted that the uncertainty of research and innovation is combined with the fact that the principal cannot observe the effort of the agents. This means that innovation involves uncertainty which cannot be fully hedged because success depends on unobservable effort by inventors. This market failure is particularly significant for mission innovation where supported inventors not only are expected to allocate the appropriate level of effort to innovation but also to allocate it in the right direction or domain. Then the design of efficient policy instruments raises new questions. How to get the appropriate level of effort *in* the right domain from potential innovators if the latter cannot be observed and monitored?

Innovation policy tools can be roughly subdivided into two categories (Kremer and Williams, 2010; Kyle, 2020): push programs and pull programs (see above, section 6). Some instruments following the pull approach increase the rewards for developing specific knowledge and products by committing to reward successful innovations *conditional on their development and diffusion*. It becomes clear that in the context of an incomplete plan –where:

- An appropriate level of efforts *in* a certain mission’s area is required;
- the freedom to experiment is preserved as an essential condition of success; and
- the market failure of unhedged uncertainty is highly significant;

these pull mechanisms seem to be very adequate. A mechanism such as advanced market commitment, involving *ex ante* technical specifications and metrics of *ex post* use, identifies targets and objectives and set up a reward conditional on the invention of the specified output and perhaps on its impact (diffusion). Such instrument is likely to solve the problem of freedom to experiment AND unhedged uncertainty by combining well incentives and coercion. Of course, a lot of issues need to be addressed for designing a fully operational instrument which is supposed to strongly incentivize potential innovators to commit resources to innovation in a certain area, while keeping the reward conditional on success. For example, Kremer *et al.* (2020) suggest that the schema should guarantee all firms (not only the winner) partial

reimbursement for R&D sunk costs as they achieve milestones. The partial reimbursement ensures that firms have “skin in the game”, in spite of high probability of not winning the race.

Developing the engineering of “calls for proposals”

It is surprising that policy research scholars do not pay sufficient attention to the issue of *designing calls for projects*. However, designing a call for projects is the most obvious and used policy response to a range of problems and opportunities ; and depending on whether the call is poorly designed or well done, the policy will deliver the desired outcome or not. Policy makers can argue rightly and repeatedly for more *directionality* and *mission-driven innovation*, but if academics and practitioners do not work on how designing a call so as to get the desired transformations, nothing will happen.

From my recent interactions with regional policy makers and EC funds administrators²⁰, it becomes clear that most calls are poorly designed and are typically very broad. However broad calls cannot deliver directionality. For instance, if a regional or national priority is, say, *healthcare transformations*, then the policy process will issue a call for projects in healthcare. This is very broad and it will work like trawling in the ocean : the trawler casts a huge fishing net in the deep sea and the fishermen will see what they will catch. They have no control on the harvest! Through such broad calls, the policy process can’t drive the desired transformations. The need is, thus, for much more specific calls which are tailored according to problems, gaps, opportunities as well as particular classes of agents (e. g. SMEs).

The next obvious question is why most calls are broad? Actually, designing a call in the area of EU regional policy involves a coordination problem between three classes of entities: regional policy makers, ERDF administrators and the industry/research partners. It then appears that all incentives are aligned towards broad calls: for regional politicians broad call means *coffee for all*, for ERDF administrators broad call increases the chance to spend the funds on time (which is a key goal), for industry & research partners broad call increases the chance to be relevant. There is also a popular belief among policy makers that a broad call will be inclusive. Actually the opposite is true. A broad call –with no specifications on problems or class of agents– will essentially attract the usual suspects –research institutions and a few strong firms– but most of the smaller industry partners will just not consider to apply: “*it’s not for us*”! To involve them in the structural transformation, calls need to be specific and tailored to their problems, capacities and opportunities.

In other words, broad and poorly designed calls will not deliver what any mission oriented innovation policy is looking for: addressing specific issues (knowledge, human capital, infrastructures, services, technologies and processes) to drive a transformation following a clear direction. We have here a convincing explanation about why MOIP fails in many cases to deliver directionality, in spite of the fact that the MOIP process explicitly involves prioritization: because the practice of *broad call*, albeit always used, is inconsistent with a MOIP logic.

Moving to more *specific calls* is rising several design issues: how specific a call should be; how to find a balance between more specific calls and the freedom to experiment; how

to find a good trade off between the fact that calls need to be specific and the fact that the number of potential applicants needs to be sufficient?

Tinbergen assignment theorem

Finally, how can we be sure that supporting the execution of the roadmap will not result in a piling up of useless instruments that are poorly coordinated and ultimately costly? Respecting the previously mentioned principle regarding the correct definition of a transformational roadmap for a sub-domain of the mission –that involves supporting not only breakthrough innovations but also actions to solve coordination problems of many sorts– is likely to produce an over-elaborate policy. A policy design principle is essential here. It is the one known as the *Tinbergen assignment theorem* that provides at least first-order guidance on the *number* of instruments or programmes that need to be deployed according to the goals or targets (Tinbergen, 1967). The number of externalities or market failures should determine the number of instruments. Take for instance the case of the mission of the digital transformation of agriculture as a condition for its sustainability. The discovery process has produced a transformational roadmap according to which there is a need for instruments to support research and start-ups, because of knowledge externalities as well as capital market imperfections, and instruments to support technology adoption and skill formation in the agricultural sector because of adoption and network externalities as well as training externalities. Coordination failures can happen at the interface between the high-tech and traditional sectors as well as between SMEs and research. Again, different instruments would be needed to fix this (for example a platform of specialised services to support transfer of technologies). All in all, the execution of the transformational roadmap in this special case should therefore involve a certain (but not uncontrolled) number of instruments to be implemented in a coordinated way.

8. Conclusion

The economics of the incomplete plan provides a framework for reflection on the design of MOIPs. There are of course different types of MOIP. A particular MOIP could correspond to:

- an industrial policy –focused therefore on private companies and technological innovation (for example, establishing a mass production of solar panels in Europe);
- a societal mission –focused on the private economy (regulation), technological innovations and education to support the adoption of new social practices (for example, overcoming obesity in a particular geographical area);
- a techno-societal mission that combines technological, economic and human capital dimensions (for example, supporting digital innovation to promote sustainable agriculture).

However, in all these cases, the design of the MOIP cannot elude the confrontation between the mission logic and the innovation logic. This confrontation can be badly managed

—thus leading to a mission-oriented policy without innovation or an innovation policy without mission. For this confrontation between these two logics to be productive and successful, it must be considered as being inevitable and the appropriate policy design to transcend it must be determined. To do this, we have proposed the concept of incomplete plan which draws upon the inspiring works of D. Rodrik (2004) on industrial policy: *once a framework (a mission, a priority area) has been determined from the top, a discovery process is put in place—one where all stakeholders learn about problems and opportunities within a specific area of transformation and engage in coordination to generate specific policy actions in response.*

It is the combination of two policy logics—a planning logic and a discovery logic—that constitutes its trademark.

The *economics of incomplete plan* is a good narrative for policymakers at both national and global levels. The message is that with such new policy instruments, policymakers are at the forefront of a new generation of industrial policy—which has multiple applications in regional policy (see Morgan and Marques, 2019; Foray *et al.*, 2021), development and industrial policy (see Hausmann and Rodrik, 2006; Sabel, 2004; and Rodrik, 2004), and high-tech policy (see Azoulay *et al.*, 2019, on the US ARPA family of programmes). In observing these different applications, I would like, when all is said and done, to suggest the idea of a collective evolution towards a new vision of industrial policies and mission-oriented policies: that of the incomplete plan.

Notas

1. To some degree, this is attributable to the failure of mechanisms that would otherwise properly gauge the intensity of each item forming the array of society's wants in the way that markets gauge the intensity of demand for the array of privately consumed commodities. This thereby generates price signals that stimulate profit-motivated efforts to satisfy those wants. A quite well-known example of such a failure is provided by observing that pharmaceutical companies respond to large market demand for new drugs to treat ulcers and hypertension, rather than investing R&D in improving the availability of drugs for victims of malaria and other tropical diseases that ravage poor countries (David and Foray, 2002).
2. MOPs were also used in agriculture as well demonstrated by Wright (2012).
3. See Cornet *et al.* (2022) for an in-depth analysis of the program Apollo as not focussed on innovation.
4. See Mowery *et al.* (2010), Brown (2021), Boon and Edler (2018), Elia and Margherita (2018) and Janssen *et al.* (2021) for similar arguments.
5. Of course knowledge spillovers happen: some of the new engineering knowledge generated within the framework of such missions propagate in the economy and provide sometimes great inputs for true innovations. However, we should be careful in not treating knowledge spillovers as a fetish—i.e. a rationale for everything spent in such very expensive programs. When this knowledge is generated within the framework of a program like Apollo, the few which will become inputs for innovations which will be adopted on the market have been produced at gigantic costs.
6. In a recent paper, Larsson (2022) makes the same point, comparing the “feasibility” of a mission such as fly a rocket to land on the moon—which clearly qualifies for the list of achievable mission (although the problem of opportunity costs would remain)—and global warming which is not on the list of problems that are likely to be solvable through missions (p. 89 and 90).

7. I recognize that this typology has a rather limited validity, which is determined by the adoption of a narrow and strict definition of *what is an innovation* (a process of economic discovery).
8. Thus –on the basis of a general mission, the plan determines a first level of intervention domains (clean energy supply– circular economy –energy-efficient building & renovating, etc.). Each domain is then divided into sub-domains (for example for circular economy : decarbonisation of energy-intensive industries –circular product design– transition of resource-intensive sectors, etc.). Each sub-domain is again subdivided (for example for transition of resource-intensive sectors: development of bio-based plastics –release of plastics from textiles and tyre abrasion– all packaging reusable or recyclable).
9. In the course of this paper, the notions of self-discovery, entrepreneurial discovery and freedom to experiment are used indifferently to name the logic of bottom-up and decentralized initiatives by the very actors of the innovation process.
10. Paul David is Emeritus Professor of Economics of Technology at Stanford University.
11. Personal communication, 07-04-2011.
12. See for instance Foray (2018) and Foray *et al.* (2021) for discussions about these critical policy design features and their potential value for designing MOIPs.
13. European Regional Development Fund.
14. Methodologies exist for the drawing-up of such a roadmap based on the active participation of stakeholders. See for example their presentation in Foray *et al.* (2021).
15. See Kremer and Williams (2010) and Bloom *et al.* (2019) for two excellent reviews of the tools available for innovation policies. On the more specific case of the design and use of public procurement for innovation, see Uyarra *et al.* (2020).
16. Examples of such works on innovation policy engineering are given by papers on the design of grand innovation prizes (Murray *et al.*, 2012) or of course on the design of patent.
17. Think for instance of the *patent buy out* policy proposal by Kremer (1998) or the *self-organized investment boards* by Romer (1993). Both cases are examples of a source of potential innovation policy failures that Flanagan and Uyarra (2016) call “too much faith in rational design and coordination”.
18. Some instruments are by definition neutral –they can’t be used to influence the direction of innovation. For example, patent and other intellectual property rights have no directionality effect as they are applied in all invention domains. So they are not taken into account here and are in any case available for practically all economic agents that produce inventions. On the other hand, the negative effects of patents in relation to access to a crucial technology within the framework of a mission must be taken into account –through the setting-up of a special treatment regime. We have clearly witnessed this debate related to the current pandemic crisis.
19. For instance, the case of R&D subsidies corresponding to specific objectives identified in the roadmap and that will imply a detailed control of the compatibility of projects and their subsequent execution in accordance with the mission’s objectives (Foray, 2019).
20. In 2021/22 I have been involved in a series of workshops organized by the Swedish national agency for regional innovation policy (which included regional policy makers and the corresponding ERDF officers and administrators).

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Resumen

El término de moda en el análisis de la política industrial es la política de innovación orientada a alcanzar una misión (MOIP), es decir, una política de fomento de la innovación destinada a cumplir un determinado objetivo, ya sea este un reto social (cambio climático, salud mundial) o un objetivo de política industrial (transición o modernización sectorial, creación de una nueva industria). Esta nueva categoría es el resultado de lo que a priori parece ser una simple extensión calificadora de las políticas orientadas hacia una misión (MOP), muy en boga en los años 70 y 80 y utilizadas especialmente en sectores como el espacial y la defensa. Sin embargo, esta “simple” extensión calificadora provoca de hecho un importante cambio de percepción que merece una reflexión. Mientras que una misión impone una disciplina y unas prioridades y decisiones centralizadas, la innovación, en cambio, no puede planificarse. La innovación es tan incierta que ningún plan permitirá alcanzarla. Existe, pues, una tensión entre misión e innovación, entre una lógica de planificación y una lógica de libertad de experimentación. Esta tensión implica, por tanto, avanzar en nuestro conocimiento sobre el diseño de los MOIP, que es el objetivo de este trabajo.

Palabras clave: política de innovación orientada a la consecución de una misión, grandes retos, innovaciones empresariales y sociales, descubrimiento económico.

Clasificación JEL: O25, O31, O38.