Smart specialization strategies—insights gained from a unique European policy experiment on innovation and industrial policy design

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Abstract

This paper aims to develop a coherent vision and detailed methodology of the policy approach that is evoked by the term "smart specialisation strategy" (S3), and to explore and elaborate the requirements and implications in terms of design and implementation that are consistent with that policy concept. As such, the paper addresses the issue of designing an innovation policy whose goal is the creation and development of networks of innovators in order to generate some desired structural changes within the framework of a regional economy.

Keywords Innovation policy · Smart specialization · Entrepreneurial discovery · Structural change

Classification codes 025 · 031 · 038

Regional innovation policies in Europe have been marked over the past few years by the emergence of a new approach—smart specialization strategies (S3s). Based on a fairly general formulation (Foray et al. 2009), European regions have embarked on the design and implementation of their own S3s.[1] The results of this policy are still only partial and imperfect and it is in any case too soon to attempt a final assessment of them. However, what is certain is that we have already acquired an enormous amount of knowledge! By adopting an "action research" posture and collaborating closely with the regional authorities in order to observe the processes underway, we have learned a tremendous number of lessons from these "natural

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[1]Within the framework of the cohesion policy of the EU, a series of conditions were issued (so called "*ex ante* conditionalities") which had to be fulfilled in order for European regions to access to the European structural funds. *Establishing a smart specialization strategy* was one of these conditionalities—which concerned specifically the allocation of structural funding to R&D, innovation and competitiveness

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experiments" and progressed in our reflection concerning S3 concepts and practices. We have also made more progress generally regarding the relevant concepts of industrial policy that should be adopted today, not only in the area of regional policies but also, for example, that of mission-oriented policies dedicated to the resolution of grand societal challenges. In this introduction, we would like to specifically focus on two essential contributions:

Firstly, the new industrial policies—including the S3 approach—**combine in many cases a planning logic and an entrepreneurial discovery logic.**[2] The planning logic is often indispensable. It seems to us rather pointless to try to conceal it since the objective of these policies is to establish strategic priorities (for the development of a region or the resolution of a grand challenge) and there is nothing there that should shock an economist. And all the more so as the strategic priority with regard to smart specialization is not a sector as such but its transformation. The economist may be shocked on the other hand if the planner considers himself to be omniscient and ignores the existence of uncertainty— particularly the uncertainty concerning the way in which the plan may unfold and the probabilities of success of each selected project. Hence the second logic, that of entrepreneurial discovery: the unfolding of the plan is not known ex ante but is discovered gradually by the actors themselves. This combination of logics, one creating a framework from the top and the other stimulating decentralized entrepreneurial discovery within this framework, is crucial. These logics are complementary and not contradictory, as is too frequently believed. This is **a first underlying conceptual principle** of the new industrial policies.

Secondly, another essential contribution is that offered by the concept of transformative activity. This concept reflects **the appropriate level of granularity at which the S3 must materialize**, once the area of strategic priority has been identified. This level of granularity is neither that of the sector (S3 is not a sectoral policy) nor that of the individual project (since at its very core, S3 is about creating relational density, synergies and complementarities between projects and activities). The appropriate level is therefore that of a set of related projects and activities, covering a multitude of problems to be resolved (research, innovation, infrastructure, training) and all oriented towards the same transformation priority. This intermediate level of granularity is a **second underlying conceptual principle** of the new industrial policies. It invites us to acknowledge the strategic complementarity between projects. This implies that there is great advantage to be gained in adopting all these projects simultaneously, resulting in even stronger transformative activity.

While the identification of a strategic priority is the result of the planning logic, it is during the construction and development of the transformative activity that the logic of entrepreneurial discovery dominates.

In Sections 1 and 2, we will recall the fundamentals of the approach. The details of the process of S3 design and implementation are described in Sections 3 and 4. The

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[2] For an introduction to the current debate on the renaissance of industrial policy, see, for instance, the Economist Debate "Industrial policy: Statements"—involving Dani Rodrik and Josh Lerner—www.economist.com/debate/days/view/541/print

final section concludes the paper by placing the S3 approach into the broader perspective on industrial policy.

1 S3 fundamentals

The S3 approach focuses on the deployment of innovative activity and the creation of new connections among innovation actors within and beyond the region, enabling the region concerned to transform its structures and develop new competitive advantages based on these transformations. To efficiently achieve such transformation, S3 builds on the logics of agglomeration effects in innovation and density of projects. Structural transformations through innovation can lead to various outcomes—including the modernisation of traditional industries, the diversification or transition of such industries towards new emerging markets and the radical creation of new (sub-) sectors.

The other *raison d'être* of S3 is to encourage regions to drive such transformations and thereby build new competitive advantages on the basis of their specific strengths, potentials and opportunities, rather than doing as others do. Following this logic of regional differentiation, regions have a chance to yield results that will be superior to the past tendencies produced by undifferentiated recommendations of undifferentiated "best policy practices". Such non-differentiation had the adverse effect of encouraging countries and regions to set their sights on doing the same "good things" to foster the same forms of innovation, which in the end proved to be inconsistent and unrelated to the region's existing assets and potential and did not provide any comparative advantage (David 2010).

To attain these very general objectives, three fundamental principles play a vital role:

– *Concentrate on specific priorities*. This principle has two purposes:

• First, it aims to generate a certain density of actors and projects that are *related* as they are dedicated to the same priority—an imperative condition to benefit from the resulting synergies, complementarity and agglomeration, which are essential determinants of innovation, creativity and R&D productivity. Concentration achieves increased density (with any given amount of projects).
• Second, this is also an important condition for a government to be able to reach the level of *input specificity* required to innovate in a given industrial or technological domain. This has been a constant argument by Hausmann and Rodrik (2006)—that "the public inputs that innovators require tend to be highly specific in the area in question. There are really very few truly generic inputs for innovation". But governments cannot address all specific innovation infrastructures and specific services for all markets and activities. Government capacities, both in terms of information (what does each industry need in terms of specific inputs?) and resources (can we afford the provision of all industry-specific public inputs for all sectors?), are indeed limited. They need to choose the areas on which to concentrate.

– *Concentrate not on structures (e.g. do not choose the region's three most important industries)* but *on the transformation of these structures.* This principle has one main purpose, which is to allow preferential interventions while minimizing distortions: it is not enough to be part of a targeted structure (one particular industry) to be helped. It is also necessary to be involved in the desired transformation process. Hence, each priority area includes one or several sectors **as well as** a direction of change. If both elements are combined and sufficiently well-defined to create the density effects mentioned above, they build a priority area, a cornerstone of a smart specialization strategy.

– *Favour a logic of bottom-up and decentralized discovery,* which means simply that the targeted transformation process will not follow a path that is decided from the top but will be discovered as the process unfolds. There is therefore no *ex ante* plan; the "plan" will only emerge *ex post* as a result of the process. The importance of this principle is related to the recognition that no one government can acquire innate wisdom or the *ex ante* knowledge about the path to be followed, once a priority area, including the desired transformative directions, has been selected. The fundamental point here is the Hayekian argument that the knowledge regarding what to do and how to do is not obvious. It is a knowledge of "time and place"; this is local knowledge, which is highly dispersed, decentralized and divided. It is hidden and needs to be discovered by entrepreneurs and other actors in the transformation process.

The S3 approach is thus marked by a high level of intentionality and strategic focus. But, it is also characterized 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 logic—that constitutes its trademark. It should be noted that these two policy logics are frequently opposed in the literature as well as in practice. This nature of S3 was noted by Paul David—one of the concept's three authors—who said that S3 is neither totally top-down nor purely bottom-up. "The S3 approach is about designing an intermediate process aiming to enhance entrepreneurial efforts and coordination within a framework (a strategic priority) structured by the government."[3]

2 In search of the right granularity level for S3 operations: the transformative activity

The objective of an S3 as a regional innovation policy is to create a framework (one or a small number of priority areas as defined above) to achieve more focus and coordination among entrepreneurial activities.

One difficulty is to place the S3 operations at the right level of granularity. It is quite obvious from the three principles mentioned above that S3 should not be a process embracing the whole sector—it is not a sectoral policy. Rather, S3 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

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[3] Paul A. David, personal communication, 2012

process selecting individual projects while disregarding relatedness and coordination among projects—because such a policy will fail in generating the necessary relational density and agglomeration of actors. Between these two levels—a sector as a whole and individual, unrelated projects—a collection of related and complementary projects can be envisaged, all involved in the same transformation process. We will call such a collection of related projects *an activity*—and more specifically, a *transformative activity*.

Transformative activity is a key concept. It can be defined as *a collection of related innovation capacities and actions, all oriented towards a certain structural change. These innovation capacities and actions are "extracted "from an existing structure, or several structures, and supplemented with extra-regional capacities.* We will henceforth call such related innovation capacities and actions *projects*.

A critical point is that these projects are not just about R&D but cover many topics and issues, which represent critical steps towards the desired transformation, possibly including human capital formation, R&D infrastructure development, technology diffusion and adoption and network generation.

A transformative activity has two 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.

The first property concerns the notion that all projects selected via an S3 approach are *related*. The wording "collection of related…" is instrumental in capturing the coordination and agglomeration effects stemming from the fact that all projects are committed to the same direction of change. Therefore, a transformative activity is more than a collection of unrelated projects. The crucial common link among projects and actors is that they are all involved in the same direction of structural changes. In this sense, the projects selected are mutually complementary and so should be adopted together, each making the others more attractive. When properly managed, such *strategic complementarities among projects* can stimulate the emergence of a persistent pattern of change (Milgrom and Roberts 1990).

The second property concerns the notion that all projects that are part of the transformative activity have the potential to provide *knowledge and information spillovers*. When the initial projects and experiments 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 transformative activity—once the activity has been defined and starts to grow—should be done in such a way as to maximize the spillovers to all the stakeholders—including potential entrants (Rodrik 2004). The maximization of informational spillovers is a key principle that distinguishes a transformative activity supported by a public policy, as is the case here, from an activity undertaken privately within a large company that tends not to diffuse this information.

Based on this definition of the transformative activity, *designing a smart specialization strategy* means identifying a small number of priority areas and supporting the development of the corresponding transformative activities. This portfolio of activities is managed at a regional level and may be modified as new opportunities for structural change arise.

However, recent experiences show that the identification and development of transformative activities remain a significant challenge in the practical implementation of S3. Current implementation of S3 is indeed often limited to the definition of broad priority areas and lacks focus when it comes to identifying and developing real transformative activities. The systematic identification and development of transformative activities is a complex exercise requiring new tools to support the entrepreneurial discovery and action development process.

This paper introduces a novel focus on transformative activities. It drafts a methodology for regional identification and development of transformative activities and thus supports regional agencies in putting in place a process for establishing priorities, determining the corresponding transformation roadmaps and transformative activities and, finally, building the action plans for each of the selected priorities.

3 Inside the S3 process

The goal of this section is to analyse the process of developing S3.

The process of design and implementation involves three fundamental steps:

A. Identifying thematic priority areas (cf. 31)
B. Translating these priority areas into transformational roadmaps to develop transformative activities (cf. 32)
C. Implementing the transformative activities with an action plan (cf. 33)

In the following, we will discuss these three steps. We will also illustrate the process by providing insights into our most recent observations of practical S3 experiences in the Governorate of Sfax (Tunisia).

3.1 The identification of priority areas

As a starting point, priority areas need to be defined in a way that allows the subsequent development of transformative activities at the right level of granularity. This implies for each identified priority area that sectors or sub-sectors must be associated with an explicit direction of change.

The implication of such a definition is that actors will not necessarily be part of S3 simply because they belong to a given (sub-) sector. Their inclusion in S3 depends on whether they can be involved with the transformation process of sectors or sub-sectors. The underlying transformational goal thus becomes a crucial element in the definition of the priority area.

Beyond the association between a sector and a direction of change, two other criteria need to be taken into account:

First, the delicate balance frequently mentioned previously must be found between a too broad and a too narrow definition of the priority area. Too broad will make it difficult to generate the density and agglomeration effects, which are a crucial objective of S3, while too narrow will result in the exclusion of too many actors that could contribute in some way or another to transformation. Recent experience with S3 in European regions has demonstrated that too broad priority areas are a recurrent

characteristic of current S3 (Kroll 2017). At the same time, too narrow a focus, leading to the exclusion of crucial actors from the innovation process, can also be observed. As an example, the role of potential users or application sectors in the transformation is often overlooked. An excessively narrow focus tends to concentrate resources and effort on a limited number of predetermined champions.

Second, the priority area needs to reflect regional capacities (strengths and potentials) and opportunities (innovation and megatrends). This is the simple concretisation of the second *raison d'être* of S3 (above).

The identification of priority areas naturally relies on a considerable effort being made to acquire statistical knowledge of the economy, assess its competitive position, define the innovation capacities of the region (see below) and understand the regional innovation system. Furthermore, the identification requires a participatory process aimed at bringing together the maximum number possible of public and private stakeholders from the quadruple helix.

3.1.1 Step 1 is more about planning than self-discovery and does not necessarily generate regional differentiation

As mentioned earlier, the S3 design involves two different logics of policy action—a planning mode and a self-discovery mode. Clearly, this first step of the S3 process—the identification of a few priority areas—focuses on the planning aspect.

At this step, it is natural and expected that regional differentiation will be limited and the results will not necessarily be distinct from region to region. After all, the potential for solutions in terms of structural change is not infinite and regions characterized by the same provisions of natural resources and the same economic specializations will tend to aspire to the same types of transformation. This means that under certain conditions priority areas can to a great extent be similar from one region to another. While this contrasts with the key preconception of the S3 approach of recognizing and understanding regional-specific strengths and opportunities, there is no need at this step for promoting unique regional specificities at all costs. Indeed, further regional differentiation will happen later in the process. Even similar priorities will lead to specific solutions and transformational roadmaps because capacities, potential and opportunities are region-specific. The translation of the priority into a transformative activity (the second step) results in a unique regional differentiation.

3.1.2 The Sfax experience I—identifying priority areas

Our recent observation and participation in the S3 elaboration in the Governorate of Sfax (Tunisia) provides an interesting illustration of how the identification of priority areas can be managed. The Sfax economy is characterized by the importance of the medical sector in a broad sense, ranging from public and private healthcare providers to medical research unities and a well-developed ecosystem of medical device manufacturers, largely based on SMEs. This specific ecosystem has been recognized at the level of regional economic development strategies with the creation of a health-tech cluster, uniting actors from the domain- specific quadruple helix (research, industry, policy and society). At the beginning of the S3 process in 2018, the health-tech cluster thus reflected an important existing specialization pattern and represented crucial current

strengths of the economy of the Sfax region. The actors surrounding the cluster were involved as key stakeholders in the S3 process, starting with the identification of adequate strategic priority areas.

The initial approach of the stakeholders was to prioritize the health-tech industry as such. Such a prioritization of existing broad sectors is a recurrent and problematic pattern in S3 across regions. It was thus the first task of the S3 elaboration in Sfax to shift prioritization away from an industry as such towards a more appropriate level of granularity. In a series of workshops with the stakeholders of the strategy, the affirmed political intention to prioritize the health-tech cluster was given a more transformative perspective. Special attention was focused on ensuring the inclusiveness of the approach. Avoiding too broad priority areas does not mean narrowing them down to exclusive product lines (such as digital medical devices, or cancer research, or the development of specialized clinics), but identifying common transformational goals with the potential to spark innovation across the existing ecosystem. These reflections ultimately led to the definition of the priority area in terms of clear transformational goals based on specific regional capacities: "digitalisation, diversification and certification of medical devices".

More important than the pure terminology of this definition, however, was the raised awareness among stakeholders regarding the underlying characteristics of the defined priority area:

- It associates a domain (health-tech cluster) with specific directions of change (digitalisation, certification, diversification).
- It ensures a fine balance between excessively broad (whole sectors) and too narrow (specific product lines or projects) definitions.
- It accurately reflects specific capacities and opportunities in the context of the regional ecosystem.
- It draws on innovation activities across the cluster, not only addressing the intersection between research and start-ups (invention of new digital medical technologies), but also SMEs seeking product diversification or enhancing their certification processes, as well as healthcare operators as essential adopters of medical device innovations.

3.2 The design of transformational roadmaps to develop transformative activities

The concretisation of priorities into transformative activities is certainly the most complicated step of the process. And yet it is the crucial phase: *the conversion of each priority into a more concrete transformational roadmap to develop the corresponding transformative activity*—a set of projects and actors—all committed to contributing to the same direction of change and thus linked by this goal.

This conversion from priority area to transformational roadmap is a complex process. The problem can be expressed thus: our priority is a specific transformation of a certain industry (e.g. the transition of the mechanical and machine-tool sectors towards "industry 4.0"). In the beginning, we are at a given level of technology, employment and qualification, business model and performance. Based on an S3 approach, we are aiming to move to a higher level of technologies, qualifications and economic performance. A key question in the process is: "Why haven't we already reached this new level we are aiming

at? What constraints, market and coordination failures, obstacles of all kinds, etc. prevented this evolution? Some are obvious, or can be deduced by careful analysis, others remain hidden. Here, in the identification and search for resolutions for these obstacles, is where entrepreneurial discovery kicks in. All the projects and actors identified as being part of the transformational activity are going to address these problems and constraints. This concerns not only R&D, but also the need for new skills and qualifications, new forms of management, specific public goods (specialised services), adoption of certain key technologies (diffusion), and so on. The projects identified as being part of the transformational activity can thus address very different issues. Some are following a logic of *pushing* more resources in the innovation ecosystem (such projects include R&D, specialised R&D infrastructures, scientific training, accelerators and incubators, etc.), while others are following a logic of *pulling* the non- innovative actors towards innovation (such projects include technology diffusion, managerial and innovation capabilities, specialised services addressed to small firms, vocational training, etc.). All of these diversified projects constitute the transformative activity. We have defined a transformative activity as *a collection of related capacities, projects, activities and people that have been "extracted" from an existing structure or several structures, to which can be added extra-regional capacities, and that is oriented towards a certain direction of change.*

In Box 1 below, we present an example of a method—the "project mapping" approach—that can be applied to build a transformation activity through an entrepreneurial discovery process.


Box 1 Project Mapping—Basic Methodology

Translating a priority area into a transformative roadmap involves the identification of a set of projects that cover a broad range of issues (R&D, technological infrastructure, training, specialized services, technology diffusion, adoption of innovation, etc.). The basic methodology consists of evaluating projects with respect to existing **capacities** and **opportunities** for transformation.

Assessing existing capacities for projects includes questioning the availability of human resources, specific skills and competences, and the presence of research partners, firms and entrepreneurs interested in and capable of being involved in the project.

Note that a project to be selected need not fully meet the capacity criteria right from the start as S3 is precisely about capacity building. But a minimum is required (particularly in terms of company engagement). Of course, this assessment is certainly quite subjective—this implies careful discussion, controls and evidence-based decisions.

Assessing opportunities for a project is about questioning to what extent a project can contribute to a transformation opportunity (the defined transformative goal).
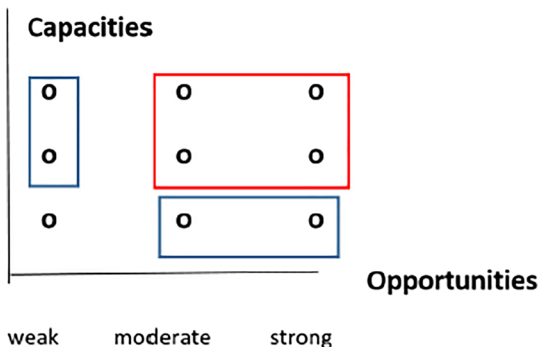
Note: The graphic is highly stylised. The goal is to identify as many projects as possible and position them in the project mapping.

Based on this mapping, **four classes of projects** can be identified:

-Projects with moderate to strong capacities and moderate to strong opportunities are considered as regional priorities for the initial transformative roadmap (marked in red in stylised graphic).

-Projects with strong opportunities but weak/moderate capacities can be considered as options for which capacity building and inter-regional cooperation is critically necessary (to "import" missing capacities) (marked in blue in stylised graphic). If this is possible, they will be considered for the transformative roadmap.

-Projects with strong capacities but not sufficiently concerned by the transformation objective can be redefined in order to allow them to better contribute to this transformation (marked in blue in stylised graphic). If this is possible, they will be considered for the transformative roadmap.

-Projects with weak capacities and weak opportunities should not be considered for the transformative roadmap.

Once a core of projects has been qualified as meeting the capacity/opportunity criteria, their **relatedness** needs to be evaluated. The following questions are useful to guide this process:

-Do the projects share similar critical inputs (such as specialized skills)?

-Do they share the search for similar new business models?

-Do they involve a connection to the same (or similar) research partners?

-Could they use a common platform of specialized services?

-Are these projects complementary?
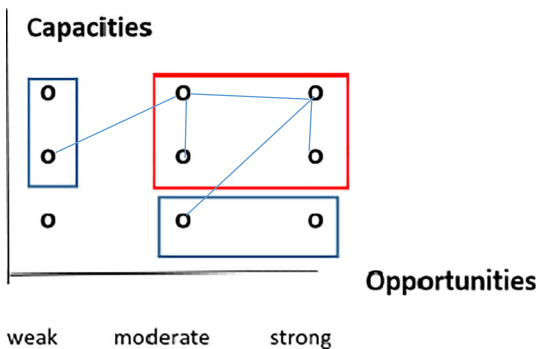
Among the projects that are not eliminated in the first step of project mapping (red and blue), those that manifest relatedness will be considered for the transformational roadmap. Relatedness among projects is a good predictor for synergies and spillovers—and therefore a good predictor of project performance and success within a transformative roadmap.

The example above shows four projects with high regional potential (in terms of capacities and opportunities) plus one for which capacities can be built up and one for which critical assets can be re-allocated towards the identified opportunity. For projects with high scores on capacities as well as opportunities but no relatedness to the strategy should provide ways to build up such relations to make use of these high ranked projects.

All these projects together will form the initial transformative roadmap. The transformative activity consists of a set of related projects all well located in the capacity/opportunity space.

We can add two important effects of this translation phase. Firstly, it operates as a feedback mechanism to verify the pertinence of the priority areas. If the transformative activity comprises only a few projects, projects that are not very innovative or unconnected, it indicates that the priority was perhaps badly formulated or premature. We should go back to square one and discuss the pertinence of the priority in question again.

Secondly, this phase provides a solid basis for inter-regional cooperation issues within the S3 framework. This cooperation is important, as each region must not attempt to do everything on its own and there are many opportunities for inter-regional collective action. However, this will only work if regions carry out the task of converting their priorities into a transformation roadmap. This is the essential condition that enables the implementation of efficient cooperation on precise objectives. If the cooperation is based only on a shared set of priorities without taking the roadmap into account, the foundation for the cooperation would most likely be too broad or vague. In that case, there is a great risk of ending up with a lot of travel and missions yielding very few results.

3.2.1 The 5 Ds

This translation of a priority into a transformative activity is the key transition. It enables the good outcomes of an S3 approach to be achieved, designed to transform the structures of the regional economy, and which we have grouped under the **heading the 5 Ds**.

*D*irection of change.
Relational *D*ensity.
Regional *D*ifferentiation.
Entrepreneurial *D*iscovery.
*D*istributed capacities.

We can explain the significance of each of the 5 Ds in more detail as a desirable property of a transformative activity. Once properly defined, the transformative activity…

– …concretises a certain *direction* of change, initially expressed by the priority, and reveals some initial guidelines concerning the course of action to achieve this change;
– …enables the transition from priorities, which can be similar from one region to another, to a deep regional *differentiation*. In fact, similar priorities across regions will lead to different transformative activities, as the latter are designed as a specific response to problems and opportunities that are specific to the particular region;
– …creates relational *density* and increases the chance of reaping the benefits of a certain coordination between the projects and actors involved in this transformation. This is due to the fact that all projects are related because they all contribute in one way or another to the same structural transformation in the priority area;
– …covers a large number of issues, including of course R&D but also the formation of human capital, corporate management, adoption of new technologies, etc. It is therefore a collection of *distributed* capacities and projects (instead of a single major project such as the creation of a new specialized R&D institute, frequently destined to become the proverbial white elephant);
– …is the preferred framework for entrepreneurial *discovery*. At the end of the priority definition phase, it is impossible to know what the outlines and content of the transformative activities will be. They are built and developed on the basis of the entrepreneurial discovery process.

The example of Sfax below further illustrates how the 5 Ds can be delivered by the design and implementation of the S3 in its regional context.

3.2.2 The Sfax experience II—developing transformative activities

The recent experience from the Governorate of Sfax provides an illustration of how identified priority areas can be effectively translated into a transformative activity consisting of a collection of concrete complementary projects contributing to the same direction of change—and thus linked by a common transformational goal. In the case of Sfax, this was achieved through an entrepreneurial discovery workshop organized in autumn 2019 with regional actors from research communities, start-ups, SMEs and bigger industry players to identify concrete projects that can initiate the process towards digitalisation, diversification and certification of medical devices. The careful prior definition of the priority area (step 1 of the process) was instrumental in identifying the right participants for the workshop, representing specific capacities from the health-tech sector. Project ideas were discussed and mapped according to their strengths in terms of existing capacities, potential to contribute to the defined goals (opportunities) and interrelatedness. This analysis was, again, significantly facilitated by the prior definition of the priority area at the right level of granularity.

A series of related projects was thus selected as building blocks of the initial transformational roadmap for Sfax' S3. The selected projects included the development of specialized infrastructures for start-ups (incubator and fab lab) and the establishment of a medical data centre. These two projects are essentially about pushing more resources into the R&D ecosystem to stimulate digital medical device innovations. In parallel, a few projects with a strong emphasis on pulling actors and capacities towards medical device innovation have been selected, such as a platform to support collaborative SME projects on diversification and certification of medical devices, and a training programme addressing skill development for surgeons, physicists, technicians and nurses in hospitals. Two demand-side projects have been included as well: a digital platform for medical device purchasing tasks of hospitals and a digital platform addressing patients' needs in healthcare coordination. Finally, a project was included to provide the existing health-tech cluster with a governance platform to coordinate the monitoring of the initiated S3 process and ensure the continuation of the entrepreneurial discovery in the defined priority area.

The selected projects reflect key aspects of what transformative activities in S3 should be about; all projects are related and strategically complementary, addressing innovation in its entirety, from innovation supply to innovation diffusion and human capital formation. They are all oriented towards the defined transformational goal. They reflect specific regional capacities and contribute to regional differentiation. They could indeed not have been anticipated as such ex ante without going through the entrepreneurial discovery process of the particular context. Finally, they are well balanced in terms of pushing additional resources into innovative fields and pulling additional actors towards innovation.

In winter 2020, the development of an action plan for the implementation of the collection of projects identified was initiated (see step 3 of the S3 process below). The process was put on hold due to the outbreak of the global COVID pandemic and is anticipated to be recommenced towards the end of 2020. While it is too early to draw

definitive conclusions on the results of the S3 experience in Sfax (which will significantly depend on whether the action plan for the transformative activity can be matched by appropriate funding mechanisms), the case stands as an excellent illustration of a successful application of the S3 process and its basic principles.

3.2.3 The inclusive nature of S3

The example of Sfax shows to what extent the S3 approach can be inclusive, depending on the accuracy of the process of priority area identification and transformative roadmap development. For many regions, priority areas are about transforming, modernizing or diversifying the existing industries. The goal is therefore *to include* some existing structures and capacities in an innovation strategy. Then, as the transformational roadmap is developed, the point is not to invent at the frontier but rather generating innovation complementarities in existing sectors. Such innovation-related activities might include building up human capital, adopting (not inventing) new technologies, diffusing novel management practices or generating complementarities between key enabling technologies and traditional sectors. As Trajtenberg (2010) wrote regarding innovation: "*there is not only one game in town*". The fact that such innovation-related actions ultimately represent the key to economy-wide growth in most regional economies needs to be reflected in the choice of the relevant priority areas and the development of the associated transformational roadmaps for a given region. This is exactly what was accomplished in the case of the Sfax S3.

3.3 Implementation with an action plan

The action plan step centres on the implementation of the transformative activity. It involves mobilizing and coordinating financial instruments, which often have different objectives (R&D, training, infrastructure), as well as evaluating projects regarding their financing, success, and contribution to the transformation. The two properties of a transformation activity identified above need to be fully recognized and exploited as the action plan progresses.

Firstly, one crucial element of the action plan—allowing the plan to fit the profound logic of smart specialization—is that the goal of the funding agencies should not be to select individually the best project for funding and development. Rejecting the second best and other projects, which could strongly contribute to the transformative activity, could be contra-indicative to the logic of S3. S3, as emphasized above, recognizes the value of a simultaneous support of coordinated projects and investments—because potentials for systemic transformation are likely to result entirely from the positive feedback effects that each project has on the others. In other words, the various projects identified and selected through an S3 approach are mutually complementary and so should be adopted together, with each making the others more attractive. Funding criteria must be adapted accordingly.

Secondly, the action plan is characterized by a high level of uncertainty regarding individual projects as well as the whole process of development of the transformative activity. Launching the action plan is like starting a *voyage of discovery*—to use Hirschman's expression (2015). By definition, discoveries involve success, failures and surprises, and it is critical for the action plan to include *feedback mechanisms,*

monitoring principles and flexibility to maximize the informational effects and spill-overs of all discoveries. A new way of approaching project funding (Rammer and Klingebiel 2012) is very much suited to this objective of keeping the action plan 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.

Finally, how can we be sure that supporting the development of a transformative activity 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 priority area—that involves supporting not only breakthrough innovations but also the management and absorption capacities of sectors that are potential users—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. The number of externalities or market failures should determine the number of instruments. Going back to the Sfax case, 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 user sector (hospitals) 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 (e.g. a platform of specialized services to support transfer of technologies). Finally, public procurement for innovation appears to be an effective instrument to stimulate the desired structural transformation from the demand side. All in all, the support of the transformative activity in this special S3 case should therefore involve a certain number of instruments to be implemented in a coordinated way.

3.4 Three procedural steps—between stability and change

We have just defined three procedural steps.

The first step delivers a few priority areas. This is the planning logic of the approach and what is delivered here has a certain degree of stability and continuity. As a coordination device, a priority area must not change continuously.

The second step delivers a transformational roadmap made up of programmes and projects and the third step is where the action plan is undertaken. Decentralized discoveries become the main informational mechanism, and at these stages, things can evolve and change. Projects can be discontinued while new ones can be started at any time. This depends on the knowledge and information (success, failures, surprises) produced as the action plan progresses.

Given these three steps, it is then advisable to leave the regions the freedom to invent their own approach while still insisting on the necessity of adhering to the three stipulated phases. Regions should be given some leeway in the manner they will "invent" and drive their S3. Here we can be inspired by the idea of a script: the three steps approach represents a set of simple rules like those a theatre director gives an actor who is asked to improvise concerning a certain theme.

4 Three crucial points for S3 design and implementation

In the following, we will discuss the role and position of the process of entrepreneurial discovery in the whole S3 approach, the data needed to support the underlying policy process, and the governance mechanisms, which evolve according to the three steps.

4.1 The locus of entrepreneurial discovery

The concept of entrepreneurial discovery has been used from the beginning to highlight the bottom-up component of the S3 approach. It has become very popular in policy-making circles—although it sometimes comes across more as bureaucratic jargon than an effective policy practice. It is certainly time to be more specific about how to use this concept and what its real meaning is for industrial policy.

There are at least three different concepts of discovery in the economic literature on institutions and development. Although connected, they have specific meanings:

- *Entrepreneurial discovery* is a theoretical concept proposed by the so-called Austrian economic tradition as an alternative to standard neo-classical microeconomics in order to understand what happens in market economies (see Kirzner 1997).

- *Self-discovery* is presented by Hausmann and Rodrik (2002) as an important coordination logic in economic development.

- *Voyage of discovery* is proposed by Hirschman (2015) to describe and analyse economic coordination at project level in a context of high supply and demand uncertainty.

As far as the S3 process is concerned—involving the three steps described above—it is obvious that the first step is not really where entrepreneurial discovery will kick in (Foray 2019b). The selection of priority areas is not done through an entrepreneurial discovery process. As mentioned, step 1 involves the planning component of the whole approach. All our observations of actual processes in the EU show very clearly that there is no entrepreneurial discovery at this stage and what is needed is a *simpler* participatory process. Having no entrepreneurial discovery here is not a problem because, as already stated, the S3 approach is structured to involve two logics of policy actions—a planning mode and a self-discovery mode. Clearly, the first step has a planning aspect.

Entrepreneurial discovery is then rightly used to capture what is happening in steps 2 and 3—which involves the discovery of the path to transformation (within a given priority area) and then the discovery of the characteristics and properties of the projects that have been identified and selected. A further nuance could be made to stress that while *entrepreneurial discovery* is fully appropriate for step 2 because step 2 is essentially about opportunity recognition, the Hirschman expression of a *voyage of discovery* is perhaps better suited for step 3 in which projects are developed.

This specification of the locus of the entrepreneurial discovery process is important to help policymakers. Our observations of S3 experience in many European regions show that such recommendations—as *the priority areas should be chosen through an entrepreneurial discovery process*—did not help in the sense that it was very difficult to follow and generate a high level of stress within the community of regional policymakers. And this is not inherent in the S3 concept and can be avoided in the future. The new specification of the process makes it much easier for policymakers to

understand and implement and is more consistent with the concept of S3 as involving two logics of policy actions.[4]

In any case, what matters is that S3—which involves explicitly a planning component (prioritization and strategic intentionality at step 1)—does recognize the existence of great uncertainty regarding the path to meet the priority and the development of the projects—which implies relying on a logic of decentralized and entrepreneurial discovery, at steps 2 and 3.[5]

4.2 Data and evidence

Data gathering and analysis are crucial ingredients in the S3 concept. The second *raison d'être* of S3 is to "encourage regions to build their competitive advantages on their specific strengths, potentials and opportunities, rather than doing as others do". To do so successfully requires a deep knowledge of regional specificities at a fine level of granularity. Moreover, we have insisted above on the Hausmann and Rodrik argument according to which any innovation policy does require interventions at a high level of specificity. Indeed, the biotech innovation process requires the provision of public inputs and the establishment of coordination mechanisms which are very different from what is needed to innovate, say, in the car industry or the tourism sector: the more specialized and specific the innovation strategy, the more granular the knowledge required of governments and their partners.

The analysis of data and gathering of information and evidence is not a separate step in the strategy development as proposed above. Instead, it must form an integral part of each of the steps described above—it interacts continuously with the S3 design process.

Although information, data and evidence are crucial inputs in any phase of developing a S3, its nature changes with the progressing of the strategy development. Indeed, in some way it reflects the policy logic of each step.

4.2.1 Priority area definition needs a structured and analytical approach

For the definition of priority areas, which follows a top-down policy logic, the data analysis and evidence needed can be structured and derived from a centralized analysis—the data and evidence itself follows a kind of top-down structure.

As a starting point, a classical SWOT builds the foundation. This can rely on a *standard framework of indicators* and usually includes fields of analysis:

– Capacity:
  Identifying the "important parts" of the regional economy, the (potential)

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[4] It is perhaps important to stress that no entrepreneurial discovery at step 1 does not mean no participatory process. These two concepts are very different and of course the identification of priority areas has to rely on the participation of many stakeholders—but this is not entrepreneurial discovery. We thank M.Navarro who made clearly this point—based on his observation of the Basque Country S3 experience (personal communication).

[5] As Hirschman said (2015, p.73)—criticisms concerning industrial policy should not be made just because there is a planning logic in it but in cases of a planning doctrine that ignores the existence of uncertainty (see also below, our conclusion)

growth drivers and areas "in need of structural change" (an "inward" looking focus)
– Competitiveness:
  The competitive position of the region (benchmarking, an "outward" looking focus)

– New technologies and megatrends:
  An analysis of general purpose technologies and other societal challenges, including their specific relevance for the region
– Resources:
  An overview of innovative and entrepreneurial capacities and other resources

Regarding the necessary data and information in the priority identification, most requirements can rely on structured and often centralized sources with a high level of comparability and rigidity. Apart from detailed information and knowledge on the regional economy, it is crucial to have a consistent national and international framework to cover competitiveness questions.

4.2.2 The transformational roadmap relies on distributed information

With the transformational roadmap, information, data and evidence demand shifts quite dramatically. The policy logic of the transformational roadmap is bottom up and based on entrepreneurial discovery. The same is true for the information gathering: it will be a discovery process, with a lot of different sources providing inputs of various kinds and formats. Information and data will be less structured, and the demand for evidence will be more ad hoc.

Although such an unstructured and ad hoc approach suits the bottom-up logic of identifying the transformative activity, it is useful to include a more structured and comparable analytical approach as well. Various related elements—projects, actors or resources, to name just the most important ones—will together form the transformative activity. Analysing these elements in a common and comparable framework would help in assessing the credibility and consistency of the transformational roadmap. The concept of "project mapping" (see Box 1 above) is, when implemented in reality by measuring capacities, opportunities and relatedness in a structured framework, such an element.

4.2.3 For the action plan project evaluation data is key

For the action plan, data and evidence demand shifts again. The third step relies largely on evaluation data, which must provide an up-to-the-minute monitoring of the individual project advancements as well as a summarizing barometer of the transformative activity. Such a barometer measuring overall transformative activity 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. At the same time, a commonly used barometer can support the maximization of informational spillovers generated by the entrepreneurial discovery process.

All this must be up to the minute. Only with timely information is it possible to make relevant and immediate decisions, at any time, about the continuity or discontinuity of activities, expansion of support, new projects, etc.

4.3 Governance

As mentioned above, the prioritization phase is determined by a logic of top-down governance—this is the planning component of the S3 logic—which does not exclude a participatory and collaborative process between all the stakeholders and does not in any way detract from the evidence-based character of this prioritization process either. This means simply—as P. A. David wrote (above)—that the framework within which the entrepreneurial discovery will take place is constructed from the top.

On the other hand, the two following phases are extremely decentralized. For each identified priority, there must be a corresponding coordination and investment board that will deal with the execution of phase 2—the conversion of the priority into transformative activity—and phase 3, the elaboration of the plan of action and its implementation. This decentralization is important so that the monitoring, information and flexibility mechanisms can be as efficient as possible. Phases 2 and 3 actually correspond to an ARPA-type of governance (Azoulay et al. 2018), featuring principles such as general organizational flexibility, bottom-up programme design, discretion regarding project selection and active project management—all these features rely on highly talented, independent and empowered programme staff.

To summarize the S3 governance issue, there is a planner (to drive step 1) but not an omniscient planner. As the process is shifting towards steps 2 and 3, the planner disappears and leaves the place for experimentalist governance (Sabel 2004; Morgan and Marques 2019). It is for the governance at steps 2 and 3 that the following quotation makes a lot of sense: "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).

5 A robust and coherent policy concept but design and implementation are difficult

Recent and current experiences in various regional settings—undertaken by the authors of this paper—show clearly that S3 design and implementation are feasible but challenging. It is difficult to identify a relevant priority area, but even more so to translate it into a transformative activity and finally move towards the action plan. The main problem is that the construction of the transformative activity requires from the policy agency a very detailed understanding of the coordination relationships between different types of investments as well as a deep knowledge of the specific inputs, which are needed to innovate within a particular set of industries. These informational requirements are hard to meet and put the S3 approach into a logic of "haute couture" (as opposed to the logic of "ready to wear"). "Haute couture" is by definition costly because nothing is really replicable from one S3 to another. Each S3 approach needs to build its own transformative activity, given the specific constraints, capacities and opportunities in the considered region and sector.

Of course, the logic of entrepreneurial discovery should be considered here as a partial solution to the information problem. This is the role of stakeholders—firms, research, etc.—to discover what needs to be done; the kind of investments required at a very high level of details and specificities. The notion of entrepreneurial discovery should—by no means—be viewed as just an elegant academic trick, theoretically useful to minimize the top-down logic of the process. It is a true necessity to overcome the informational challenge raised by the logic of S3 at steps 2 and 3.

However, S3 is in any case a costly approach. It is difficult to handle. Impact evaluation will be tricky as well. Generating strong evidence about a causal effect of an S3 approach on the economic situation of the region concerned during the subsequent period of time is practically impossible because a specific S3 is a highly complex instrument with no simple treatment effect and no obvious counterfactuals.

We do think, however, that the implementation concept described in this paper has a great future! It could prove helpful not only in the context of regional policies but also in the area of mission-oriented innovation policies which are discussed these days to address various grand and global challenges (Foray 2018a, b). For all such policies, there is always the problem of enhancing entrepreneurial efforts and coordination within a framework, which is structured from the top. For all these policies, the tension between top-down prioritization and bottom- up decentralized actions has to be managed through an efficient and effective policy design (Foray 2019a).

For all such policies, it makes no sense to hide the planning component, which is part of the very foundation of mission-oriented and S3 policies, just because *planning* is not a well-received word today. It makes no sense to deny the fact that there is indeed a planning logic since this is the very nature of S3 to define priorities and transformation targets, which in turn will determine preferential interventions. S3 involves a high degree of intentionality—this is one of its key positive characteristics. However, the planning logic of S3 is not the kind of planning that ignores the existence of uncertainty (Hirschman 2015). *Planning* and *bottom-up discoveries* are the two inseparable logics of a policy, characterized by a high level of intentionality and strategic focus while recognizing both uncertainty and the inability of the planner to decide on the transformational roadmaps and predict a project's success or failure. This provides regional governments and public agencies with an appropriate toolbox to manage *difficult transitions*, such as getting out of what appear today as obsolete specializations (e.g. fossil-based technologies and sectors).[6]

It is the main contribution of this paper to show how the first period of S3 implementation in the EU and beyond and the feedback and learning processes derived from this unique policy experiment allow us to better understand what kind of policy design can be effective to generate structural transitions and strategic initiatives. The policy design and implementation concept presented here makes the S3 approach an effective tool to help regions to succeed in their structural transformations and transitions.

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[6] As a matter of fact, the transition Hub of Climate-KIC (which is supported by the European Institute of Technology) is using the S3 approach to support the transition and transformation of European countries and regions towards sustainable development and green growth (see www.climate-kic.org)

Data availability   NA

Compliance with ethical standards

Conflict of interest   No conflict of interest.

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