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Innovation Policies and Socio-economic Goals: An Analytic-Diagnostic Framework

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Abstract

Quite often, innovation policy is called upon to bring about innovations that could provide solutions to socio-economic problems such as low productivity, regional economic regeneration, environmental, defence or health-related matters. Around the world, governments have outlined ambitious plans to drive innovation and move towards a knowledge driven economy. These strategic plans are comprised of distinct sub-goals related to ICT, education, infrastructure and many other intermediate goals. However, there are obstacles that may prevent policy makers from achieving these goals. Thus, innovation policies are often called upon to effectively solve two “problems”, firstly broad socio-economic challenges, such economic growth, and secondly barriers and constraints associated with achieving socio-economic goals. In effect, these constraints are ‘intermediate problems’ that prevent achievement of socio-economic goals. Once the intermediate problems are identified, standard economic analysis is often deployed to design instruments of intervention such as subsidies, tax breaks or investments. While innovation policy makers have a plethora of tools to resolve these intermediate problems, they lack tools to link these intermediate problems with broader socio-economic problems. This paper introduces an analytic-diagnostic framework to equip policymakers and analysts with a tool that helps them develop innovation policies designed around socio-economic outcomes. This framework has been coined OCRIO- Outcomes, Constraints, Rationale, Intervention and Objectives.
1. Introduction

Broadly speaking, innovation policy can be defined as “any government intervention aimed at solving a socio-economic problem by facilitating the creation or adoption of a new solution that generates new economic or social value”. This working definition assumes that a case has already been made for government intervention and that existing innovation capacity cannot deliver the solution needed without further intervention in the existing innovation system. Thus, all innovation policies have their raison d’etre in the recognition that there is a problem that needs to be solved via innovation. The rationale for public policy intervention is based on the fact that a ‘problem’ has been identified requiring government intervention and that ‘innovation’ is needed to solve or mitigate this problem. If these two conditions are not fulfilled, no policy intervention is called for (Edquist et al., 2009).

The aim of this paper is to provide a practical framework for analysing innovation policies from the perspective of socio-economic outcomes. Existing studies on designing innovation policies have often focused on a single theoretical perspective such as neoclassical economics (Hauknes & Nordgren, 1999; Lipsey & Carlaw, 1998; Metcalfe & Georghiou, 1998), or systems of innovation (Edquist, 2005; Etzkowitz & Leydesdorff, 2000; Lundvall, 2010; Lundvall et al., 2002). Some researchers have attempted to integrate different theoretical perspectives with various levels of success (e.g. see Chaminade & Edquist, 2006; Flanagan et al., 2011; Laranja et al., 2008; Salmenkaira & Salo, 2002). These attempts however did not put socio-economic outcomes at the core of their analysis.

Furthermore, applying a single discipline or theoretical approach, e.g. economics or organisational studies, to a multifaceted problem such as innovation may result in inadequate analysis of the problem at hand. A broader "socioeconomic" approach emulating the complexity of the problem at hand that incorporates political, social, cultural, regulatory and environmental variables would be necessary (Etzioni, 1985). In this regard, Etzioni suggests that a multi-variable incorporation should happen at the practical level and not at the theoretical-disciplinary level (i.e. economics, sociology, psychology, etc) as multi-disciplinary synthesis is not easily attained (Etzioni, 1985: 388). In other words, different approaches need to be incorporated by not necessarily integrated (ibid.).

In the following section, I will introduce a brief and broad overview of major types of policy design and development tools. Secondly, I then introduce the OCRIO framework as a practical policy analysis and diagnosis tool that help develop outcome-oriented innovation policies. Thirdly, I contextualise the tool
in terms of the literature and practical considerations for policy makers, and finally I use the tool to group innovation policies into four outcome-oriented categories.

2. Diagnostic Tools for Public Policy

Despite the existence of various frameworks for conducting policy analysis, very few have made their way to innovation policy analysis. While a review of various public policy analysis tool lies beyond the scope of this paper, it is useful to provide a quick overview of some broad categories. Firstly, there are process-based models, which attempt to analyse policies as a series of steps (e.g. see Bardach, 2000). However, these models have been criticized for being overly linear and simplistic (Graham, 1993). Secondly, there are policy analysis tools designed specifically to determine what is needed to achieve specific targets (i.e. service or function oriented policies), such as minimising ecological impact or reducing traffic fatalities (Simon & Barnard, 1976). These are often based on rationalistic models that define problems as types of market or government failure and then linking the problems to sets of possible solutions (see e.g. Weimer & Vinning, 1999). The majority of these follow sequential steps starting with identifying the problem and intelligence gathering in order to identify the problem.

In many of these tools, however, it is not clear how policy outcomes will be achieved and outcomes are often relegated to the final stages of the process- i.e. the evaluation stages (Earl et al., 2001). Whilst evaluation tools are important for determining whether policies have been successful, comprehensive evaluations are sometimes unfeasible due to complex causal chains as well as due to implementation problems (McLaughlin, 1987). The result is that many policy analysis tools end up having an adverse impact on future policy prescriptions (Salmenkaita & Salo, 2002).

Where innovation policy research has been lacking is in the development of analytic frameworks that give sufficient attention to socio-economic outcomes. This is despite the efforts made by some innovation economists (such as David et al., 2009) to demonstrate the link between innovation and economic growth, with the latter being a socio-economic problem. However, in spite of its importance, economic growth is not the only socio-economic objective that concerns innovation policymakers. Defence, environment, health, security and other varied societal concerns often constitute important parts of innovation policy objectives. In fact, most government supported mission-orientated innovation programmes fall into one of these categories. But even with economic growth, the focus of much of the debate around the link between innovation and economic growth has centred on R&D, technology and economic growth (Ulku, 2004). Yet as a growing body of research is pointing out (Bhide,
more economic growth results from innovation-related activities, such as learning and the exploitation of learning, than from original innovations. The next sections will discuss the theory and literature behind the OCRIO framework to illustrate its applicability for practitioners.

3. The OCRIO Analytic Diagnostic Framework

Governments in the OECD and beyond have adopted broad policies to foster innovation and enhance its economic impact. For example, the United States (US) established its “Innovate America” strategy in 2005 and the EU’s Lisbon Agenda, established in 2000, has also been strengthened (OECD, 2007). In principal, these initiatives are grounded in the rational that innovation activities contribute positively to socio-economic goals at the macro level (OECD, 2010). This strong widely held belief had meant that innovation policymakers did not feel compelled to make use of analytic tools to demonstrate linkages between various innovation policies and socio-economic goals, especially at the meso-level, i.e. between high level policymaking and delivery/implementation agencies.

In this paper I introduce a structured framework for meso level policymakers to weave through the multi-layered nature of problem formulation and policy development is termed here the OCRIO framework. OCRIO stands for an analytic diagnostic framework that embraces the following sequence of analysis: Outcome, Constraint, Rationale, Intervention and Objective. In the following sections, I the five components of the OCRIO framework are defined:

**Outcomes** refer to the desired ultimate outcome of a policy.

**Constraints** refer to obstacles and barriers that may prevent or hinder achieving the desired outcome.

**Rationales** refer to the justification for governmental intervention, as opposed to other players in the innovation system.

**Interventions** refer to the type and nature of the policy intervention, e.g. regulatory, financial, etc.

**Objectives** refer to the change needed to make progress towards the desired ultimate outcome.

The framework takes ‘outcomes’ as its starting point, rather than ‘problems’. This is because the desired outcomes are easier to identify and agree on than problems. Also problems may be hidden, whereas desired outcomes are a matter of subjective expression, collective consensus, or established
by vote. More important perhaps orienting policy development towards outcomes rather than problems leads to different types of policies with different results. The OCRIO framework is an attempt to sway (innovation) policy discussions away from an orientation towards the intermediate problem (constraints) towards one that aimed at the ultimate outcome. While at the micro-level a problem orientation might be indeed a much-needed exercise to help design effective policy instruments, at the policy level a greater orientation towards economic and social value creation is needed. To elaborate this point further, I provide two examples from Canada and the US.

**A Tale of Two Programmes, one that is outcomes oriented and one that is problem oriented**

In Canada, there was a wide perception of the existence of academic brain drain to the US in the 1990s. Policy and media debates in Canada in the late 1990s revolved around the problem of academic brain drain, particularly to the USA, as a key reason behind the erosion of Canadian academic excellence (Polster, 2002). But the problem was circular in nature, stemming from the fact that US universities offered better working conditions, including a stronger academic community. The CRC was designed to respond to the challenge of improving and sustaining quality at Canadian universities rather than merely creating an instrument to attract Canadian academics back from abroad (Siler & McLaughlin, 2008). The CRC provided funds for high-quality academics on the basis of quality research plans submitted jointly with university departments. The programme focused on quality, regardless of whether applicants were in Canada or abroad. Additional focus was placed on the expertise of the applicants, their research proposals and the working conditions that would be available to them. Ten years later, the programme has been regarded as a success, creating around 2,000 chairs across Canada, 30% of whom came from abroad. Thus, in contrast with most of other countries that have developed interventions to halt the brain drain, the Canadian policy orientation towards outcomes rather than problem meant that the programme was designed to support quality of conditions of work rather than on the academics on the move. Most other governments have responded with financial and fiscal incentives to attract back their nationals or to attract foreign nationals. These policies were based on the assumption that by attracting foreign academics to local universities the quality of the latter will improve, but the fundamental constraint of diminished quality of the home institutions as a main factor behind lack of attractiveness was not addressed head on.

The second example is from the US state of Kentucky, which has recently attracted the interest of several researchers (e.g. Ehresman, 2011; McGuinness, 2008) The Commonwealth of Kentucky is a state characterised by the lowest levels of both per capita income and educational attainment in the
United States of America (USA). In 1997, the Kentucky Postsecondary Education Improvement Act was enacted in order to remedy the modest performance of the state in this regard. Subsequently, an ambitious plan was embarked upon to reform the state’s higher education system, with the ultimate aim of elevating the performance of this state to that of the national average by the year 2020. The plan had two objectives, one is to develop a society with a standard of living and quality of life that meets or exceeds the national average and the second to boost the educational institutional capacity of the State. In order to achieve these goals, the reform act established a number of policies. These included the creation of two new entities: a policy leadership and co-ordinating entity, the Council on Postsecondary Education (CPE); and the Kentucky Community and Technical College System (KCTCS). Another set of policies were adopted in order to create a new financing framework, including a strategic investment and incentive funding programmes aligned with the goals.

In 2007, the Kentucky Chamber of Commerce carried out a ten-year evaluation of the reforms. The evaluation framed its work around a series of questions to gauge the progress that had been in the past decade and to identify the challenges that remain. It was concluded that Kentucky had made significant progress towards meeting the capacity goals set in 1997; as enrolments at all higher education institutions have increased (by ca. 40%) and degree production has accelerated. Nonetheless, even as Kentucky was developed stronger and more nationally recognised higher education system, the impacts of this increased capacity on improvements in per capita income and on quality of life were absent. More than ten years after the enactment of the 1997 Postsecondary Education Reform and Kentucky still has a long way to go to reach the national average. In terms of per capita income, the state has witnessed an increase that is slightly less than that for the country as a whole. A closer look reveals that while per capita approaches the national average in the sparse urban parts of the state, it is only two-thirds of the national average in the rest of Kentucky. Furthermore, whereas the economic benefits of earning a degree have significantly increased at the national level, this increase has been less pronounced for the case of Kentucky (McGuinness, 2008).

The Kentucky case is a typical policy case of policy intervention that is problem oriented rather than outcome oriented. For example, had the state government designed its intervention to be outcomes oriented, it would have focused on providing support and incentives to businesses, which direct economic growth generators. Indeed, the data from Kentucky showed that the creation of highly skilled jobs in Kentucky was not keeping pace with the production of highly skilled workers. Moreover, bearing in mind that a telling indicator of the strength of a given economy is the extent to which it has net-
migration of more highly educated people, Kentucky is reported to be a net loser of 22-29 year olds (Ehresman, 2011).

In short, over the past decade, Kentucky’s education attainment and per capita income levels have improved, but not fast enough to match or make progress towards the goal of reaching and/or exceeding the national averages. The policy cannot be said to have achieved the desired outcomes, to the contrary it might have contributed to the acceleration of outmigration of skilled workers from the state, people who have been trained by state funds. The policy programme (i.e. the plan) was designed around the “problems”, and hence the plan called for increased investments in higher education training and consequently the number of graduates did not indeed rise, but living standards did not. In the next paragraphs the five components of the approach are elaborated in a greater detail.

3.1 OUTCOMES: Compatibility of Intermediate and Ultimate Policy Objectives

There are numerous examples where the disjoint between innovation policies and socioeconomic goals have resulted in a negative impact on policy outcomes. For instance, an innovation policy intervention might be successful in removing specific barriers (e.g. high market price) to the adoption of a desired solution (e.g. fuel cell vehicles), but the solution itself does not achieve the ultimate desired outcome (e.g. urban pollution). A more obvious example perhaps is the widespread rise of technology incubators that have been established for the purpose of fostering regional economic development. On this occasion, the desired ultimate policy outcome is regional economic development, which may be measured by a range of indicators including rapid economic growth, higher employment, increased productivity and improved living standards. While many of these incubators can be seen as successful endeavours, only a few of them can claim to have been equally successful in delivering the desired level of sustainable economic development (European Communities, 2007).

Outcomes can be determined in a number of different ways by a diverse range of organisations. Depending on the political system policy outcomes can be determined democratically, “technocratically”, or based on consensus. When outcomes are determined democratically, policy makers are also interested in re-election which can influence the policy process (Burstein, 1991). In technocratic political systems, governments often decide on the appropriate socio-economic goals based on their technical expertise (Forester, 1993). While technocratic policy processes do not explicitly involve the electorate, there is a stronger sense of political leadership that is essential for driving innovation in the long run. Lastly, some socio-economic outcomes are determined based on high-level
committees or planning commissions which interact with businesses, the electorate and governments in order to reach a consensus about the direction of future policies.

However, given the plethora of policy analysis tools available for policy makers, understanding why governments adopt a specific tool is still an enigma. In order to cope with complex problems, policy makers often choose policies that show promise in other countries (Walker, 1969). Hence due to rationality problems, policies are often adopted without a clear rationale (Lindblom, 1965). Often ideology plays an important role in determining the kinds of tools policy makers adopt. However, aside from replicating policies, policy makers also select policies based on their previous experience. Policy entrepreneurs and economic elites can also play a role in influencing policy tools. Lastly, ideology also plays a role in influencing policy choices. Governments often seek policies that closely match the preferences of the state. This ideological compatibility is important because it helps governments predict how the electorate will respond to new policies and subsequently helps politicians assess their chances of re-election (Grossback et al., 2004). All these factors can influence the entire policy process ranging from policy selection to evaluation and hence there is an urgent need for an innovation policy tool, which compels policy makers to link innovation policies, socioeconomic outcomes and to justify their policy rationales.

3.2 CONSTRAINTS: Towards Outcome Orientated Problem Framing

Once outcomes have been determined, policy makers can then identify constraints to achieving these outcomes. Understanding the constraints for achieving desired outcomes is a crucial aspect of the solution finding process. Identifying the constraints implies understanding the restrictions preventing the solution from taking place. Since ultimate outcomes can be broad and involve many actors, institutions and policy sub-sectors, the nature of constraints will vary in accordance with various stakeholders (Yanow, 2000). What is a problem for some is not necessarily a problem for others. The nature of what constitutes a problem thus becomes more fluid. Policy-makers may make use of various evidence-sourcing techniques to provide support for their understanding of the relevant constraints and to ensure that their policy is grounded in evidence.

However, there are two key challenges that policy makers face when breaking down complex problems. Firstly, agreeing on the nature of the ‘problem’; that is the way in which a barrier to the solution is initially structured and stated, which can be critical to later efforts of defined policy action. Policymakers have to make a variety of decisions on a variety of issues in a short amount of time.
Therefore they often lack the time and resources to make thorough investigations of the nature of the barriers at hand. Furthermore, given that the nature of the ‘problem’ can be defined differently by different groups (Yanow, 2000), data collection may be biased by these perceptions and good data does not necessarily lead to good decisions (AbouZahr et al., 2007). ‘Problems’ are often framed in the media, by pressure groups, political forces, or on the basis of the most pressing issues (Dovers, 1995; Young & Mendizabal, 2009). Problems vary not only in definition, then, but also in seriousness and tractability (McLaughlin, 1987).

Therefore, many innovation initiatives fail because they are either not linked to the broader socio-economic outcomes they are meant to help achieve or because they are not linked to any such outcome. For example, in addition to encouraging innovation, governments need to build infrastructure, invest in education and reduce bureaucracy among other outcomes. While each of these outcomes can function as independent goals, policymakers often lack the resources to develop a coherent policy portfolio that address all these outcomes in a linked way to maximise economic contributions. The OCRIO framework is an attempt to help policymakers forge these linkages and frame policy constraints in terms of maximising economic impact, as opposed to value or efficiency based problem framing. By linking desired outcomes to discussions of nature of constraints, the OCRIO framework emphasises the link between a socio-economic goal and the subsequent interrelated decisions that need to be taken (Quinn, 1980).

### 3.3 RATIONALES for Intervention

In addition to problems with linking innovation policies and socio-outcomes, policy makers also need to switch between different rationales in order to achieve different outcomes. While there is consensus that progress in science and technology is essential for innovation and productivity growth in both the public and private sectors (OECD, 2007), there is considerable debate over the role of governments in ensuring scientific and technological achievements and innovations.

Much research has been done on examining rationales for government intervention in support of innovation, yet existing analytic frameworks, such as innovation systems and market failures, fail to place adequate attention on justifying intervention on the basis of intermediate and broader socio
economic goals. More specifically, academic literature distinguishes between two types of rationales for government intervention: market and systemic failures.

According to mainstream neoclassical economics, a government should only intervene in its economy when markets are not efficient, with the underlying assumption that the intervention will improve the efficiency of that national economy. For example, firms will only engage in large-scale technology projects if they can achieve benefits through the sale of new products or cost savings due to improved production processes. However, there are three main problems (Nelson, 1959b). Firstly, it is difficult to fully appropriate benefits from the research process due to the associated risks. Furthermore, there are externalities from the research process which makes it difficult for firms to appropriate benefits (Lipsey & Carlaw, 1998). Lastly, innovating is a high cost and long-term process which requires a commitment from firms. These problems lead to under-provision of innovation activities especially in areas such as energy, large scale science and technology projects and defence where the public rate of return is high and barriers to entry are significant (Chaminade & Edquist, 2006).

On the other hand, systemic failures are better at capturing problems associated with the collective underpinnings of innovation (Lundvall et al., 2002; Edquist, 1997). According to the systems view, innovation occurs through a set of institutions whose interactions influence the innovative performance of the actors (Nelson, 1993). These actors include universities, research institutions and corporate research centres as well as firms. A systemic failure is said to occur when the practices, incentives and priorities of these various organisations are incompatible, resulting in a lack of interaction and coordination (Edquist, 1997; Carlsson & Jacobsson, 1997; Woolthuis, 2005). The OECD (1997) was among the first to popularise the idea that the systems of innovation framework could provide a new rationale for government intervention. Hence, according to the innovation systems approach, governments intervene in order to facilitate knowledge transfer between organisations in the different phases of the innovation process in order to address systemic failures.

Many innovation scholars consider the theory of market failure inadequate for designing government interventions, as the theory tends to ignore the economic structure or institutional frameworks in which innovation policy takes place (Lundvall, 2010; Edquist, 2005; Woolthuis et al., 2005). For example, while information asymmetries are considered a market failure, according to the innovation systems approach, asymmetric information is essential for providing novelty and variety. In this case, a systemic failure would occur when there are limitations to firm differentiation such as stringent laws or regulations that hinder innovation.
However, neither market failure frameworks nor systems of innovation frameworks are used to justify government intervention in innovation from the perspective of the ultimate desired outcome. They are both often used to justify (or object to) government intervention in innovation activities per se. Both frameworks to be useful tools, they need to be applied to a broader context of policy analysis – one that takes into account that innovation itself is an intermediate tool to achieve ultimate desired outcomes. In this regard, the systems of innovation framework can be useful as a mapping and scanning tool to identify the wider environment in which a barrier and a potential solution exist; whereas the market failure framework helps identify whether the nature of the barrier requires government intervention, a private solution, or a combination of both.

3.4 INTERVENTION Instruments

Policy makers can make choices with respect to choosing instruments for intervention and objectives to achieve. Different policy instruments entail different assumptions about policy problems and their solutions. McDonnell & Elmore, 1987 identify four different types of instruments. First, there are instruments based on mandates that are rules designed to create uniformity where the policy contains the necessary information for compliance. Here, policy objectives would be measured based on compliance to the rules stipulated by the intervention instrument. For example, a government may set compliance laws such as health and safety regulations related to the production or consumption of a certain product that dictate how actors are expected to behave. Such instruments can be effective in mobilising resources in certain directions, such as R&D investments to meet certain environmental standards.

Secondly, there are inducements – instruments that are aimed at encouraging individuals and agencies to produce innovations when capacity exists but additional resources are needed to mobilise actors. In this case, objectives would be measured according to the innovation outcomes generated by policy inducements. Thirdly, there are capacity intervention instruments that are designed to build capacity, this is where knowledge, skills and competence are required to produce future value and where such value does not exist. In this circumstance, government will intervene. Fourthly and finally, there are system changing instruments that are utilised to create new incentives which existing institutions cannot produce.
However, the successful delivery of a solution does not mean that the solution was the right policy intervention, nor does success in solving a socio-economic problem reflect the successful choice of intervention instrument. Moreover, it is not uncommon for policy intervention instruments to end up acquiring a *raison d’etre* of their own, and to continue to exist in isolation of the original outcomes they were meant to help achieve. A successful policy outcome might come on the back of an unsustainable policy instrument. For example, tasking universities with supporting innovation activity in the wider economy could help businesses become more innovative, but it may also subject universities to extra costs with little economic return (Abrams et al., 2009). Thus, what is needed is a comprehensive approach that links outcomes to constraints, to rationales and to instruments of intervention to ensure that these are interrelated aspects of one analysis rather than separate activities undertaken by different departments and at different points of time.

### 3.5 OBJECTIVES

Setting objectives is, fundamentally speaking, a process of identifying targets that -in sum- when achieved deliver the desired outcome. Objectives can be linked both to the elimination of constraints and to the direct delivery of outcomes. If capacity is a constraint then improving the capacity by a certain factor will remove the constraint. However, an objective can be linked directly to an outcome, e.g. reducing CO$_2$ emissions by a certain factor delivers the desired ultimate outcome of mitigating climate change. Things become more complicated when objectives are not clearly linked to outcomes even when constraints are removed due to wrong diagnosis of the problem or the restriction at hand or when other implementation barriers come into play. In the next few paragraphs, I shed light on some of these implementation barriers.

Whilst it lies outside the scope of this paper, an OCRIO analytic framework necessitates thinking about the pitfalls of implementation, which may derail the best objective-setting mechanisms and make objectives overlook outcomes. In a paper reflecting on the US experience with regard to implementing various social programmes undertaken within the scope of the Great Society Initiative of the Johnson Administration in 1960s, McLaughlin (1987) concluded that “The consequences of even the best planned, best supported, and most promising policy initiatives depend finally on what happens as individuals throughout the policy system interpret and act on them” (pg. 172). Policies adopted according to rationality-based decision making processes can still be swayed in different direction by the conditions governing their implementation. These include conditions that frame the institutional setting of the implementing system such as environmental stability, competing centres of authority,
contending priorities or pressures and other aspects of the social-political milieu that can influence implement or willingness profoundly (Yin, 1981). McLaughlin (1987) concludes that “Policy at best can enable outcomes, but in the final analysis it cannot mandate what matters” (pg. 188). A lack of buy-in from both policy implementers and the policy target community will inevitably derail implementation and hence these stakeholders need to be made aware of the link between objectives and outcomes and what is that a policy intervention is seeking through its objectives. Thus, the macro-level of policy design and development needs to be linked with the micro-level of policy implementation.

Misalignment between a new set of objectives and existing ones or with the objectives of other government agencies could also affect the successful implementation of a policy. Misalignment can arise from changing political and economic circumstances, which in turn may give rise to new policy goals that make original policy goals seemingly less important. These changing circumstances place pressure on policy makers to serve a new purpose (Beland, 2007). The latter phenomenon is often referred to as ‘drifting’ (Hacker, 2002). Mahroum et al. (2011) expand on the notion of drifting as a form of misalignment to point out two common situations in which drifting occur, namely ‘tactical drifting’ and ‘strayed drifting’. The former takes place when governments are hesitant to undergo widespread policy reform and hence retrofit current policies to meet demands of the new socio-political context. The latter occurs due to structural or political issues such as the rise of a powerful interest group that cause policies to drift unintentionally.

The implementation of innovation policies often takes place within a wider system of government apparatus where innovation per se is only a means towards an ultimate goal that is socio-economic nature. An innovation policy development process that does not take into consideration the wider institutional setting, in which it exists, will likely face implementation problems that, at best, drift the nature of the policy and, at worst, render it irrelevant.

4. Reframing Innovation Policies into Outcome Orientated Categories

Using OCRIO

The sections below use OCRIO to generate new analyses of innovation policies showing how the framework can provide a new defining structure to the overarching rationales behind much of these policies. The examples are then summarised in Table 1 providing a schema of the policy rationales using the OCRIO framework. Accordingly, and broadly speaking, innovation policies can be grouped into four broad outcome-oriented categories, these are the following:
Outcome 1: Developing capabilities to meet critical needs in defence, environment and health.

Since the post-WWII period, OECD countries – in particular the US, France, the United Kingdom (UK) and the Nordic countries – have identified various socio-economic domains as nationally strategic and requiring government support. These have ranged from defence related areas to energy, environment, health and communication needs. These goals can be thought of as ultimate desired policy outcomes. A major constraint was the unwillingness or inability of private economic players, firms and entrepreneurs to make large-scale investments in projects that are risky in terms of cost and return on investment.

The rationale for government intervention hence has been the neoclassical notion of market failure. Accordingly, governments jumped in to shoulder part of the cost of the investment needed (i.e. subsidising the cost) and by guaranteeing a satisfactory level of value capture for private investors. Moreover, government interventions were on the basis of two main presumptions, first that such public policies do not cause market distortion since they are aimed at pre-commercial and pre-market activities and, second, that the benefits of public investment in science and technology related to national missions will eventually lead to positive externalities that will spill-over to the rest of the economy and benefit more than one industry or sector (David and Foray, 1994).

From the large defence and space programmes (such as those of the US, UK or France) to the building of oil and gas exploration fields in the Norwegian North Sea, national mission-orientated S&T and innovation policies have aimed at using government money to stimulate innovation activities and capacity building in national economies. The outcome of these policies have been mixed, the US and Sweden, for example, were regarded as having achieved some success, for example, US superiority in military, space and later the internet, and Sweden’s superiority in mobile telecommunication technologies. These were the results of strong government partnerships in mission-orientated demand-led technology projects (Edquist, 2009). The outcome in other countries was less successful (Chiang, 1990; Ergas, 1987), for example although the UK has succeeded in the aerospace industry, it failed in the computer industry (Hendry, 1989). Like the UK, the French experience with mission-orientated technology programmes has been a mixture of success and failure. The reasons behind the success and failure of these programmes merit investigation along the OCRIO analytic framework, but it goes beyond the limitations of this paper.
Over time, governments have shifted away from large scale mission-orientated innovation policies to a milder form of mission-orientated programmes known more as funding programmes geared towards certain socio-economic objectives. By some counts, government funding for such programmes represents at least 50% of all government funding for R&D within OECD countries, reaching around 90% of US government funding for R&D (Mowery, 2009). Defence and health remain the largest sectors benefiting from mission-orientated funding programmes.

**Outcome 2: Developing capabilities to create higher living standards.**

Taiwan is an example of a country that has experienced high rates of income growth due to a high investment in human capital. This small island economy with few natural resources has experienced a six-fold increase in GDP since 1954. Improvement in education was a major priority for the government and government expenditure on education (and culture) as a percentage of total government expenditure grew from 14 per cent in the 1950s, to 16 per cent in the 70s and to 20 per cent in the 1980s (Tallman & Wang, 1994). Although Taiwan also invested in trade policies, government infrastructure and financial liberalisation, the government’s role in human capital investment was decisive in propelling Taiwan’s status to a high income, diversified and technologically sophisticated economy.

The ultimate desired outcome here is an increased national capability to generate new economic and social value. A constraint is often seen in the lack of economic competitiveness and in lower productivity, which in turn are the result of a weak local knowledge base that is unable to produce knowledge to generate enough positive externalities in the economy (as prescribed by Schumpeter, 1942, or Romer, 1990). The intermediate problem (i.e. the constraint or the barrier) relates to the capacity of universities, human resources, laboratories, R&D centres, as well as infrastructure (areas such as broadband, transport, IT, etc.) in delivering inputs that help achieve the desired outcome.

The rationale for government intervention in this problem area is market failure to provide public or quasi-public goods (Arrow, 1962; Nelson, 1959a). These are investments in knowledge creation that can be used across the economy with an expected high return to investment through positive externalities for all sectors of society (Romer, 1990; Schumpeter, 1942).
To solve the intermediate problem (i.e. constraints), governments typically introduce policy instruments aimed at boosting the flow of new knowledge, skills and resources into the so-called national knowledge base (Bush, 1945). For example, they will provide support for research and training activities, as well as infrastructure and capital for new knowledge development. The main aim of such policies is increasing the rate of knowledge input into the economy and, with it, the chances of generating new avenues for economic growth. It differs from mission-orientated government funding in that such support is not tailored specifically towards the generation of any specific outcomes.

**Outcome 3: Creating Integrated Value-Added Communities**

In some problem domains, despite the existence of strong market potential (or a belief that it exists), the suppliers of the potential solution are too fragmented or are unable to organise in an effective way to deliver the solution. This is where a third breed of innovation policy, called ‘systemic policies’, comes in to play. Here, the aim is to create the necessary links between markets and supply and hence remove existing transaction constraints.

Governments intervene by deploying various policy instruments that link different resources together for the benefit of creating new markets, e.g. supporting interdisciplinary research, university-industry collaborations, business incubators, seed and venture capital funds. These are not supply-push policy mechanisms aimed at simply increasing the rate of discovery and knowledge flow in an economy for the benefit of positive externalities. To the contrary, they are largely market-orientated instruments designed from the market-backwards, i.e. supply is organised along the demand. First, the market potential is recognised, secondly the relevant players are identified and thirdly governments move in with a number of tools to bring the relevant players together with the aim of generating a new solution. An example here would be the many biotech clusters that have mushroomed around the world in the last decade such as the MaRS Discovery District in Toronto, Canada, where the market was identified first. All the relevant actors should then be working together and eventually an instrument is created that will make that happen, namely the cluster.

The rationale for government intervention here is again neither market failure nor unlocking markets, but a system failure (Lundvall, 2010). Different types of players, from universities to small firms, to entrepreneurs are organised accordingly along a value chain that is designed from the market-backwards. The aim is the creation of goods, services and other solutions in specific markets such as energy, health and the environment. But, unlike mission-orientated policies, the exact nature of the
products do not fall within the policy objectives, nor are governments committed to purchase the expected products.

To solve an intermediate problem characterised by the failure of the innovation community to organise, governments act as a catalyst by creating partnerships and engagement between identified social and economic players. They provide the financial resources, infrastructure, legal and tax incentives and facilitate partnerships. Some of the instruments used are, by their very nature, bridging schemes, such as SME voucher schemes, science parks and innovation incubators. Governmental focus is on creating links between supply and demand and in specific domains this is with the aim of creating what some have called ‘economically useful knowledge’ (Carlsson et al., 2009). The aim of systems orientated policies is to remove and lower transactions to follow various players to form an effective innovation system. The difference between ‘Systems’ orientated demand policies and ‘Mission’ orientated ones is that in the former, the government takes a back seat and plays the role of the facilitator of resource allocation for targeted areas believed to have a strong market relevance, whereas in the latter it plays a more active role as a strategic procurer and standards-setter.

Outcome 4: Promoting market uptake or bias for specific technologies or solutions.

For a variety of reasons, including business, strategic or societal factors, at times governments recognise the greater economic and social value that can be achieved from the shift of consumption to certain goods and services (e.g. electric cars, solar panels or open-source technology standards). The solution for environmental challenges can be through a change in consumer behaviour and preferences. Governments might look for innovation as a source for solution, but the innovation community may be facing challenges of its own to deliver such solutions. Market constraints such as the initial costs of consuming such goods and/or services might present a bigger challenge for the developers of the desired solutions. The cost of shifting to new products can cause a serious market barrier, especially for those who face the challenge of so-called ‘locked-in’ consumption. ‘Lock-in’ challenges range from consumer resistance to adopting new products, to infrastructure incompatibility and so-called adverse network economies (where most people are using the incumbent product) (Katz & Shapiro, 1986).

The main objective of innovation policies addressing consumption orientation is to intervene in order to stimulate the consumption of specific goods and/or services in favour of nascent markets. The goal is to cause a ‘market swing’ in certain desired directions. These can, for example, be in favour of electric or hybrid cars, smart buildings or a security product. Within this policy objective, governments may
resort to the numerous policy instruments at their disposal ranging from providing subsidies to suppliers and consumers to the use of regulations and standards. The target of these instruments is to accelerate the uptake and consumption of specific goods and/or services (i.e. boost private demand) and to help new markets to grow. The examples are numerous and can include the use of subsidies to encourage the use of hybrid cars or energy-efficient buildings, or even the use of taxation or regulations to sway consumers from the use of one set of technologies to another and hence creates incentives for firms to provide the desired alternatives.

Another rationale for government intervention here is to ‘unlock’ the market from a perceived ‘locked-in’ situation for goods and services that offers less social and economic value. It intervenes, therefore, to pave the way for new markets (new firms, goods and services) to emerge, particularly those deemed to provide superior social and economic value. Many new goods and services fail to establish growing markets due to resistance from firms and users locked-in to certain technological trajectories and dominant designs (David, 1997; Utterback and Abernathy, 1975). This leads to inertia in certain industrial value chains, both from the suppliers and the users’ side, as well as from the knowledge bases acting as sources of expertise to these industries (Malerba, 2005).

Governments interfere to change these dynamics through creating fiscal, regulatory and other incentives for consumers and producers to cause a shift in behaviour and a market-swing in favour of alternative goods, services and systems. The challenge for governments in this policy area is not to be seen as picking winners but rather paving the way for new players with the potential of creating a greater economic and social return to society. However, sometimes governments do, and according to some justifiably so, make such interventions on the basis of ‘picking winners’ (Etzkowitz and Ranga, 2009).

Regulations and standards are frequently used to channel some social and cultural expectations into the process of introducing new goods and services. In fact, regulations and standards have been widely used policy instruments on the demand-side, often structuring the markets for new goods and services such as in the case of environmental regulations (e.g. zero emissions legislation, end-of-life regulations).
5. CONCLUSIONS

Employing an OCRIO-based approach to innovation policy would take ‘outcomes’ as the core of policy design and analysis and not the innovation process itself. Thus instead of taking the innovation process itself as a framework to tailor innovation policy around, the OCRIO framework focuses the innovation policy agenda on activities that help achieve policy objectives and their desired outcomes. A solution-orientated innovation policy will take the desired outcome as its starting point and create a roadmap for achieving that outcome in the most efficient way possible.

Drawing on the examples provided above, Table 1 provides a summary of how OCRIO can be used to inform innovation policy design. It is important to notice that the starting point of the framework is ‘outcomes’ and not ‘failures’ nor ‘problems’. This is an important distinctive feature of the OCRIO framework, as the desired outcome becomes the focal point for policymaking and eventually coalition building and implementation. Subsequently innovation policies evolve out of an orientation towards outcomes rather than failures.

Table 1: Examples of Innovation Policies using the OCRIO Diagnostic Framework

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<td>Developing capabilities to meet critical or strategic societal needs in defence, environment, health and others.</td>
<td>Supply-constraints preventing solutions from being developed</td>
<td>Market Failure (neo classical economics)</td>
<td>Mission-orientated policies</td>
<td>Removing supply constraints to allow innovation activities to meet specific societal needs.</td>
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<tr>
<td>Broad and diversified capability to create higher living standards.</td>
<td>Capacity-constraints prevent development of the scale and/or</td>
<td>Positive Externalities (Endogenous Growth Theory)</td>
<td>Supply-push policies</td>
<td>Boosting the capacity of the local economy to generate new knowledge.</td>
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In this paper it has been argued that innovation policy is only relevant once (i) the case for government intervention has been made and (ii) the intervention involves using innovation as part of finding the solution. In addition, it has been suggested that innovation policy should be understood, developed and evaluated in terms of the ultimately desired policy outcomes to address socio-economic problems such as defence, environment, economic development, health and security. The theoretical foundations for making the case for, or against government intervention, have to refer firstly to whether government intervention is indeed justified, secondly to whether innovation is needed to provide the most appropriate solution and thirdly to whether there are serious constraints on the innovation capacity to deliver the solutions needed.

These three layers of analysis collectively form the broader policy agenda, but they do not necessarily always follow the same line of theoretical reasoning. Nor are they necessarily conducted within the same offices, departments, or ministries in government. In fact, the three layers of analysis do not always feature in innovation policy analysis and the rationale for government intervention (or not) often skips levels. A case for government intervention in innovation activities might then be made in isolation from the first layer of analysis and thus overlook whether government intervention in this problem area is merited or justified. This is often a reason for contention between innovation systems scholars and public policy analysts.
Furthermore, there is a need for innovation policy to be better linked with the wider policy implementation system and to encompass all sorts of activities that may lead to solving the problem at hand. Linking innovation policy making to outcomes helps policymakers identify the specific stakeholders and capacities that matter the most for a successful implementation of the policy intervention. This is important as most policymakers are under pressure to prioritise their efforts in the face of scarcity.

The OCRIO framework introduced in this paper provides a good structure for linking policy interventions to the various solution-generating capacities. Structuring innovation policy interventions around outcomes makes it easier to capture the relationship between investment in innovation policy instruments and meeting policy objectives. Ultimately, through the OCRIO framework presented in this paper, it is hoped that governments will be equipped to ensure that policies not only engender innovation, but also contribute to the broader society and economy.

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