

Innovation, Sustainability, Development: A New

MANIFESTO



Innovation, Sustainability, Development and Social Inclusion: Lessons from Latin America

Elisa Arond, Iokiñe Rodríguez, Valeria Arza,
Francisco Herrera and Myriam Sánchez

Latin America





About the paper

This paper is one of a series of working papers relating regional experiences to ideas proposed by the New Manifesto, following on round table discussions held in Venezuela, Argentina, and Colombia in 2010.

The paper briefly describes the heterogeneous context and history of the Latin American region with specific attention to STI policies and institutions, as well as the particular challenge of effectively linking STI to social needs. It highlights the important historic contribution of the Latin American School on Science, Technology and Development, and the relevance and synergies of ideas presented by these and contemporary Latin American researchers in relation to the New Manifesto's '3Ds'. The paper documents some examples – from public, private and civil society spheres – of current Latin American initiatives that illustrate regional efforts to develop, in different ways, a 3D innovation agenda, as well as constructing and putting into practice the different New Manifesto 'Areas for Action'. It also questions the relative weight of these efforts compared to conventional priorities of competitiveness and growth, and highlights some of the obstacles to realising 3D aims. In particular, it underscores persistent social and economic inequalities, issues of institutional and political resistance to change, and the role of power relations (at multiple levels) in determining directions of science, technology, and innovation, and STI policy, as topics worth exploring further in the future.

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About the Manifesto project

In 1970 a radical document called The Sussex Manifesto helped shape modern thinking on science and technology for development. Forty years on, we live in a highly globalised, interconnected and yet privatised world. We have witnessed unprecedented advances in science and technology, the rise of Asia and ever-shifting patterns of inequality. What kind of science and technology for development is needed in today's world? The STEPS Centre has created a new manifesto, launched in June 2010, that tries to respond to this challenge. Bringing cutting-edge ideas and some Southern perspectives to current policy, the New Manifesto recommends new ways of linking science and innovation to development for a more sustainable, equitable and resilient future.

For all the papers in this series see:

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About the STEPS Centre

The STEPS Centre (Social, Technological and Environmental Pathways to Sustainability) is an interdisciplinary global research and policy engagement hub that unites development studies with science and technology studies. Based at the Institute of Development Studies and SPRU Science and Technology Policy Research at the University of Sussex, with partners in Africa, Asia and

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INTRODUCTION

Global spending on research and development (R&D) now easily exceeds US\$1 trillion (UIS 2009; Royal Society 2011). Yet the vast majority of this investment neglects the most important challenges facing the planet, and despite progress in some countries toward the Millennium Development Goals, many of these targets are still far from being achieved. For many people across the world, realities of health, hunger and nutrition, child and maternal survival, safe shelter, clean water and other basic needs remain grim (UN 2011). At the same time, humans are using up the world's resources at an alarming rate and, according to some analyses, have likely already surpassed some of the planet's ecological limits (Rockstrom et al 2009), crucial both for human wellbeing and for that of other species.

Science and innovation are important elements of social and economic development, and so have been a focus of public policy since the early 20th century, especially since the Second World War (henceforth WWII).¹ However, a focus solely on building science and technology (S&T) is unlikely to deliver the necessary social and economic benefits. Policies must focus specifically on the contribution that science and technology (and other forms of knowledge) can make to development and sustainability objectives, and on how to build and maintain the necessary capabilities to enable this contribution. In order for such policies to be effective and legitimate, an explicit political engagement with science, technology and innovation (STI) is needed, as well as an agenda that centres on their application to democratically-informed goals of poverty reduction, environmental sustainability and social justice. The 'New Manifesto', published by the STEPS Centre in 2010, calls this a '3D' agenda: that of *direction*, *distribution*, and *diversity* (Stirling 2009).

In the '3D' agenda, *direction* refers to moving beyond the usual emphasis on the scale or rate of innovation to consider questions such as 'which kinds of innovation, along which pathways?' and 'towards what goals?' The concept of direction includes issues of prioritisation across different sectors, such as military, health or energy, but also goes beyond these to include considerations of the different possible choices (or directions) within any given sector.

Distribution refers quite directly to the need to pay closer attention to the distribution of benefits and costs of any particular innovation or innovation pathway across social groups, and even over time (across generations). Exploring distribution means considering questions of equity and justice, such as 'who is innovation for?', 'whose innovation counts?' and 'who gains and who loses?' Consideration of distribution suggests the need for inclusive deliberation at all stages of the innovation process, in order to continuously reflect on social impacts and maintain political accountability.

The concept of *diversity* follows from the requirements of considering *direction* and *distribution*. Diverse contexts and needs (ecological, economic, social or cultural) and plural forms of knowledge signify often divergent and otherwise irreconcilable 'sustainability' and 'development' priorities, and so the only way to effectively take into account concerns of direction and distribution is through pursuing a diversity of innovation pathways. Questions to consider include 'how many social or technological options are available to respond to a given problem?', 'what combination of different kinds of innovation do we need to address any particular challenge?', and 'what other forms of knowledge might be relevant, pointing to different pathways?' Furthermore, by deliberately pursuing

¹ See the wiki timeline on science, technology and development on the New Manifesto website <http://www.anewmanifesto.org/timeline>

a diversity of pathways, we are better able to resist processes of concentration and lock-in that close down some pathways for innovation and crowd out alternative pathways that might better address the needs of more marginal groups. Pursuing a diversity of pathways also helps to enable spaces to support creative experimentation. *Diversity* also fosters resilience – hedging against our uncertainty and ignorance about the future (Stirling 2007).²

To explore how the 3D agenda resonated in other regions of the world, and in particular how it might link with existing parallel initiatives to explore similar ideas, in 2010 the STEPS Centre supported a series of twenty international roundtables as part of the project 'Innovation, Sustainability, Development: A New Manifesto', three of which were held in Latin America – in Caracas, Venezuela; Buenos Aires, Argentina; and Cali, Colombia.³ Based on the 3Ds, the 'New Manifesto' proposed five 'Areas for Action' in order to better link science, technology and innovation to goals of poverty reduction, sustainability and social justice. These are *Agenda-setting*, *Funding*, *Capacity-building*, *Organising* and *monitoring* and *Evaluation and accountability* (STEPS Centre 2010). The ideas presented in the Manifesto have much resonance with existing processes in Latin America, and the roundtables provided a welcome opportunity to revisit these national discussions and highlight their continuing importance while linking local challenges and achievements with international experiences and perspectives. The discussions, though only discrete one-day events, nonetheless served as a valuable space for exchange and reflection, both among people who work in the midst of these debates on a daily basis, and among others who encounter them more marginally.

This paper aims to contribute further to this international project. It is one of a series of STEPS Centre working papers relating parallel regional experiences to the New Manifesto ideas. In order to enrich the discussion, in this paper we provide a historical and contextual background and also document examples of current Latin American initiatives and efforts for directing science, technology and innovation to achieve sustainability and socially-inclusive development. Without being fully comprehensive (given the difficulty in covering a large, complex and diverse region), these examples illustrate how, over the last few decades, policy-makers, academics and grassroots organizations in the region have been working to develop, in their own different ways, a 3D innovation agenda, as well as constructing and putting into practice the different Areas for Action identified through the New Manifesto process.

The remainder of this paper is divided in four sections. Section 2 provides a description of the diverse Latin American regional context. It briefly highlights the current picture of traditional science and technology indicators; narrates some of the regional historic background of science and technology institutions and policy, as well as some of the literature; and ends with a summary of some recent national policy changes in science, technology and innovation. Section 3 documents and briefly discusses some examples of existing initiatives in the region – public, private, and civil society – in terms of each Area for Action proposed by the New Manifesto, gathered from the roundtables and a limited review of the literature. Section 4 briefly revisits recent advances made in the region in terms

² See the New Manifesto background paper on the 3Ds by Stirling (2009) for further discussion and background.

³ Details of each roundtable including the photos and final reports can be found on the New Manifesto website at <http://anewmanifesto.org/section/round-table-events/>. The Venezuela roundtable was hosted at the campus of the Instituto Venezolano de Investigaciones Científicas (IVIC) by the Centre for Social Studies of Science and Fundacite Miranda (a regional science and technology ministry). The Argentina roundtable was held at the campus of the National University of Quilmes. The Colombia roundtable was hosted by Corporación Biotec at the campus of CIAT, the International Tropical Agriculture Research Centre.

of linking science, technology and innovation towards social goals, and presents some of the persistent challenges that limit their full realisation. Section 5 offers a few concluding thoughts and suggestions for developing further research in this area.

THE LATIN AMERICAN CONTEXT

HETEROGENEITY WITH COMMON CHARACTERISTICS

Despite the tendency to group its component countries under one broad label, Latin America⁴ is a heterogeneous region – culturally, economically, and politically diverse – so it is difficult to make universal observations or broad policy recommendations on science, technology and innovation. Several recent reports from international organisations emphasise this diversity of social and historical context and warn against prescriptive generalisations (Emiliozzi et al 2010; ECLAC 2010b; Albornoz et al 2010). Of course, despite differences, there are also common features. Latin America is a geographic area rich in natural resources – mineral, ecological, agricultural and biological – and many countries in the region share similar and interwoven histories. Following the burden of colonialism experienced from the 16th until the early 19th century under the Spanish, English, Dutch, French and Portuguese, many Latin American countries have had a history of political instability and change, marked by dictatorships as well as social movements, including both overt and covert interventions and influence by its northern neighbour, the USA; while over the last decades there has been relatively steady democratisation.⁵

Problems of income inequality, concentration of wealth, poverty and social exclusion are also shared across the region and have remained persistent, ranking it among the worst in the world. The Economic Commission on Latin America and the Caribbean (ECLAC) statistics for 2008 show 33.8 per cent of people in Latin America and the Caribbean living in poverty (27.6 per cent of those living in urban areas and 52.2 per cent in rural areas) (ECLAC 2010c: 29). Other measures of social wellbeing vary significantly from country to country, as well as quite significantly within countries. However, generally in the last decades the region has rapidly urbanised, and currently over three-quarters of the population of Latin America and the Caribbean reside in urban areas, where inequality

⁴ In many reports (e.g. UN) Latin America and the Caribbean (LAC) are treated as one region. Due to limitations in the scope of this paper, the Caribbean is not treated properly as an individual sub-region of LAC with its own unique characteristics. For example, the Caribbean includes small island states, and is notable in part for the development of service industries and heavy reliance on imported goods. And like Latin America, the Caribbean also exemplifies striking heterogeneity. Some Caribbean states have higher income than the Latin American average, while the Caribbean also includes Haiti, for example, with the worst socioeconomic conditions in the Western hemisphere. As in other parts of Latin America, in the Caribbean many states were also affected dramatically by market liberalization and structural adjustment in the '80s and '90s as well as political instability and change over a longer period, and many are still struggling to reshape their economies. The development of science, technology and innovation is likely relevant in that process and thus some lessons from this paper may nonetheless be pertinent.

⁵ Some might argue that structural adjustments and patterns of forced privatization of public services and enterprises under influence of institutions including the World Bank and International Monetary Fund during the 1980s and 90s served to limit the full exercise of sovereign national democracies.

is exacerbated by cyclical patterns of social exclusion, extremely high levels of informality in employment and an associated lack of social security (ECLAC 2010c). ECLAC 2008 statistics show that, on average, 48.5 per cent of total urban employment is in informal sectors (ECLAC 2010c: 29).

The recent UNESCO Science Report (UNESCO 2010a) blames the persistent problems of inequality and poverty partly on continued structural weaknesses of the region's economies, echoing some of the same points that the Argentinian economist and Executive Secretary of ECLAC, Raul Prebisch, and others pointed out half a century earlier (Prebisch 1964). It is argued that these weaknesses include heavy economic orientation toward basic raw commodities, low levels of industrialization, regressive income distribution, limited access to international funding, and insufficient links between innovation processes and academic knowledge. At the same time, more optimistically, some structural conditions are arguably more favourable than they have been for decades, including greater economic and political stability, growing domestic markets, energy demand 'under control' in most countries, and the possibility of benefiting from global demand for commodities and current high prices (ECLAC 2010b).

Traditional measures of science and technology investment in Latin America show that, on average, R&D intensity (gross expenditure on research and development as a percentage of GDP) continues to be very low (less than 0.7 per cent, compared with nearly 2.3 per cent in OECD countries), with some significant heterogeneity across the region (UNESCO 2010a; IADB 2010b; Navarro 2009).⁶ Total regional gross domestic expenditure on R&D (GERD) accounted for only about 3% of total world R&D expenditure in 2007. Much of the region's R&D expenditure is concentrated in just a handful of countries. Brazil, together with Argentina, Chile and Mexico, account for 90 per cent of the region's R&D expenditure. Even within countries, investments are concentrated heavily in urban centres (Albornoz et al 2010). Still, Brazil is the S&T heavyweight in the region, accounting for 60 per cent of Latin American R&D, even as it lags behind competitive nations in other parts of the world in terms of R&D intensity. Almost half of Latin America's S&T researchers are in Brazil, and around half the scientific publications produced in the region come from Brazil (though Argentina scores higher when compared in terms of publications per capita) (Albornoz et al 2010).⁷ Also, R&D in Latin America is overwhelmingly funded by the state. The relative contribution of the private sector (BERD-business expenditure on R&D) is relatively low (about one-third of all R&D expenditure) compared to the rest of the world, especially OECD countries where the majority of R&D is privately funded. Of the R&D funded by the governments of the region, much of this (some 40%) is concentrated in universities. Another continuing challenge is the emigration of skilled researchers – which is particularly severe from some Central American countries and to a lesser degree for others (OECD-DAC 2010). Brazil, for example, has been working creatively to diminish the loss of valuable educated human capital with special incentive programs (Albornoz et al 2010).

However, despite these challenges, overall greater economic stability has marked the beginning of the 21st century in Latin America (following the Argentinean economic crisis of 2001-2002). This period of general stability and growth from 2003 to 2008 helped buffer the region somewhat from the recent global economic crisis compared to other parts of the world. And though regional growth was affected in 2008 and 2009, it has already shown strong recovery in many countries (ECLAC

⁶ Brazil is the only country with an R&D intensity over 1%, while many countries in the region are estimated to invest less than 0.1% of their GDP in R&D (UIS 2009).

⁷ Lemarchand (2010) notes that only three of the 2000 companies with highest R&D investments are based in Latin America and the Caribbean, and that all three of these companies are Brazilian (Lemarchand 2010: 82).

2010a; Lemarchand 2010). It is hard to predict how pre-crisis growth and export trends may play out, and different countries have experienced varying degrees of impact, but the region as a whole was estimated to have positive growth rates of over five per cent for 2010 (ECLAC 2010b).

In South America more than elsewhere in the region, much recent growth has been export-led, based on a resurgent focus on natural resources due to expanding markets in Asia and related increased prices for these raw materials.⁸ This concentration in primary exports, raw materials with little value-added or use of endogenous technology (technology originating within a country), is acknowledged as risky, and questioned as a long-term strategy by many authors and reports (Dutrenit 2006; Perez 2008; Government of Bolivia 2007; ECLAC 2010b; Gallagher and Porzecanski 2010).⁹ Perez (2008) as well as Dutrenit (2006) and Gallagher and Porzecanski (2010) acknowledge that China represents a market for Latin American exports, but that China is also a competitor; in order for Latin America to compete, technological capabilities need upgrading and diversifying.

Furthermore, though the commodity boom of the last few years has meant a comparative advantage while prices have remained relatively high, it is yet unclear how long this trend will last. A recent ECLAC briefing paper (ECLAC 2010b) raises concerns that this 'excessive reliance on commodities incorporates little know-how or technological progress,' echoing some of the same concerns repeated through the decades (ECLAC 2010b: 3). The same report further points out,

The challenge, then, is to find a way of taking advantage of this upsurge by strengthening the linkages between natural resources, manufactures and services, encouraging innovation in each of these links and coordinating them into clusters in which there is room for small and medium-sized enterprises, so that a vigorous export performance has greater spillover effects on the rest of the economy and so that the results of this growth are distributed more equally. This means there is a need for an integrated approach to stimulating competitiveness and innovation [...] with a view to coordinating policies on export promotion and diversification, technological innovation and dissemination, inward foreign direct investment (FDI) and human resources development. (ECLAC 2010b: 3)

The UNESCO Science Report 2010 reiterates a call made many times before: that 'science and technology could be the way to greater equality in Latin America' (UNESCO 2010b). However, as argued above, questions remain around how sustainable this growth trajectory is and how it can contribute to diminish inequalities in the region, especially with continued low investments in science and technology capacity building or infrastructure. Even with some progress in the region on environmental policies and expanded protected areas, the environmental impact of this resurgent reliance on natural resource use is also a real concern (ECLAC 2010f). A different recent ECLAC report cites deforestation rates in Latin America and the Caribbean at twice the world average, highest in South America, again, resulting from high levels of demand for food and natural resources from the USA, Europe and increasingly, China (ECLAC 2010f).

⁸ There is yet 'a high degree of heterogeneity' between the export flows of different countries, with Mexico, Central America and the Caribbean demonstrating different patterns from South American countries (ECLAC 2010b:11)

⁹ ECLAC suggests that the rise in the share of raw materials exports from the region has corresponded to a reduction in medium-, high- and low-technology manufacturing exports. 'After falling from some 52% of total exports in the early 1980s to a low of 26.7% in the late 1990s, the share of raw materials has risen over the past decade to reach almost 40% of the total in the last two-year period (2008-2009)' (ECLAC 2010b: 12).

These contemporary problems have a common resonance across the countries of Latin America and have been studied for decades by scholars from the region. These historical trends and literature are worth noting before we turn to current perspectives, challenges and examples.

HISTORICAL AND CURRENT PERSPECTIVES ON ENDOGENOUS STI CAPABILITIES AND INCLUSIVE DEVELOPMENT¹⁰

Spurred on by internal motivation from the scientific community¹¹ and encouraged by UNESCO proposals at the time, many of the national science and technology research councils in existence in Latin America today were established in the 1950s and 60s, or were consolidated from institutions already in existence at that time in a few countries.¹² These new institutions reflected and were part of broader processes of post-WW II economic and political change and were largely developed based on a linear model of science and development (Albornoz 2001; Dagnino 2010; Dagnino and Thomas 1999). This approach followed a worldwide trend influenced by Vannevar Bush's 'social contract for science' (Bush 1945), characterised by a strong focus on supply of human capital but without attention to links with the productive sectors (Dagnino & Thomas 1999; Lemarchand 2010; Vessuri 2003; Herrera 1973).¹³ Research institutions were largely distant from the productive sectors, while

¹⁰ Of course, the story of endogenous S&T capabilities in Latin America began long before the 1950s. Achievements by the three dominant cultures of the Americas prior to the arrival of the Spanish – the Maya, Aztec and Inca (and their predecessors) – represent profound accomplishments in science, technology and planning, gained through systematic empirical experimentation. But colonisation by the Spanish, English, Dutch, French and Portuguese led to massive and systematic disruption of existing social structures, contributing to the large-scale loss of local technologies except for fragmented exceptions (Sagasti 1992; see full article for a detailed historical description of indigenous S&T capabilities in Latin America). See Dagnino (2010); Dagnino and Thomas (1999); Jiménez Becerra (2010); Thomas (2010) and Vaccarezza (2002) for further discussions and summaries of the history and current context of science and technology studies in Latin America.

¹¹ In many countries, the desire for a concerted scientific voice led to the formation of a number of scientists' organizations pre- and post-WWII, including a number of Associations or Societies for the Advancement of Science. For example, early associations were established in Peru (1922), Argentina (1936), in Brazil (1948), and in Venezuela (1950), among others. Cuba is a unique example, having established its Academy of Sciences in 1861. These associations helped consolidate the existing scientific community into a more effective lobby, prior to which most researchers had been dispersed in universities or specific research institutes, for example focused on medicine or agriculture (AsoVAC website).

¹² For example, Mexico established its National Council for Higher Education and Scientific Research in 1935, though many Latin American national governments created research councils post-WWII, beginning in the 1950s. Brazil created its National Scientific Research Council in 1951 and the Venezuelan Institute for Scientific Research (IVIC) was founded in 1951. In Argentina CONICET was founded in 1958, the National Institute of Agricultural Technology in 1956, and the National Commission for Atomic Energy in 1950. Dagnino and Thomas (1999) suggest that the process of establishing S&T policy was galvanised (at least in part) by a nationalistic answer to recommendations made by the established international institutions, the view of S&T as an engine of growth, and a high desire for modernisation and development.

¹³ This supply-focused orientation of science policy, later called 'science-push', was fostered by UNESCO's institution-building efforts. In 1948 UNESCO created the Latin American Science Cooperation Office (LASCO), bringing together scientific experts from Latin America and the Caribbean to discuss science policy for the region.

research funded by international aid focused mostly on technical fixes, not on building longer-term technological or innovative capabilities (Vessuri 2003; Herrera 1973).¹⁴

Also around this time, a number of Latin American development economists began to question the international economic model and the peripheral role of Latin America, as sustained through international social and economic structures and consequent relations of political-economic power. Several of these researchers, including the prior-mentioned Prebisch, were linked to ECLAC, the Economic Commission on Latin America and the Caribbean, from which they proposed a different and active role of the State in regulating the economy, through industrial policies of 'Import Substitution Industrialisation' (ISI).¹⁵ Highly influenced by these Latin American structural dependency theorists, researchers began to question the 'deficiency' model of science and technology (of an S&T gap to be filled with more resources, training and planning) and move towards a more structural analysis of development, consequently reconsidering how to build S&T. For example, Herrera (1973) attributed the failure of efforts to build S&T in the region to the 'erroneous assumptions about the nature of the obstacles, [...] determined by structures conditioned by these countries' place in the international system' (Herrera 1973: 118). Thus both the broader political economic framework, and other contextual factors and institutional influences post-World War II, were important factors in opening up discussions on science and technology policy at this time.

As a result, during the period from the 1950s to 1970s an important body of ideas about social and economic development and S&T, many of which are still relevant today, was developed among thinkers and practitioners in Latin America. This is referred to as the 'Latin American School of Thought on Science, Technology and Development'.¹⁶ The 'School' focused on themes of

¹⁴ Herrera points out that support by international institutions, government and private funds was based on the experience of the industrialised powers and focused largely on technical assistance, exchanges, scholarships and science planning, towards support to the R&D system and specific technical objectives (housing, health, etc), especially at university research centres more closely connected to foreign nations' science communities, instead of support to building S&T capabilities and links with the 'productive apparatus', to address national problems domestically (Herrera 1973: 113, 118).

¹⁵ The role of ECLAC and its first Secretary General, Raul Prebisch, was highly influential in Latin America during the mid-20th century. Prebisch published 'The economic development of Latin America and its principal problems' in 1950, which proposed what later came to be known as the 'Prebisch-Singer Hypothesis' (Prebisch 1950). Prebisch and other structural dependency theorists (e.g. Carlos Furtado, Osvaldo Sunkel and Pedro Paz) described a situation of 'centre-periphery' (eg North-South, advanced-underdeveloped, developed-developing) relations that led to 'structural dependency', a pattern established in colonial times. This terminology described the situation in which the economies of periphery countries specialized in the production of raw materials for export, in response to the demand from centre countries. In Latin America, a deterioration in the terms of trade for raw materials (contrary to their supposed 'comparative advantage') led to restrictions on foreign business and periodic economic crises. The focus on raw materials also led periphery countries to a dependency on capital goods, critical inputs and technology imported from abroad (from the centre countries). This structural problem meant periphery countries would remain in perpetual 'underdevelopment'. One of the suggested pathways out of this chronic underdevelopment path was to pursue industrialisation through import substitution: this led to the creation of the Import Substitution Industrialisation (ISI) model, pioneered in Argentina, Brazil and Mexico, later to be followed by Colombia, Chile, Peru, Venezuela, and some Central American countries (Martinez Vidal and Marí 2002; Albornoz 2001). See also Furtado, C. (1964) 'Development and Underdevelopment', Berkeley, CA: University of California Press.

¹⁶ Sometimes also referred to as the Latin American School of Thought on Science, Technology, Development and Dependency, this rich heritage of science and technology studies was not an 'academic school' in the strict sense of a shared methodology deriving from a single disciplinary theoretical or institutional foundation.

technological autonomy, local and endogenous technological development, necessary building of associated endogenous S&T capabilities, and the role of each in a more integrated and broader development process which required attention to sectoral and national policies (Martinez Vidal and Mari 2002). Some of the School's work includes some synergies with the 3Ds proposed by the STEPS Centre in the 'New Manifesto', especially regarding attention to linking science and societal needs.

Members of the School led a regional call for the creation of local capacity to absorb imported technology and to adapt it to local factors, as well as to generate technology locally and respond to technological needs demanded by the process of industrialisation (Martinez Vidal and Mari 2002). An important contribution from the School was in paying attention to the indirect effects of other types of policies and the broader context on S&T. Amílcar Herrera described the important concepts of explicit (direct, or official S&T policies) and implicit (indirect) policies affecting the development of science and technology (the latter due to the impact of broader economic, social and political contexts as determinants of the S&T policy environment) (Herrera 1972; 1973).¹⁷ Herrera was also one of the members of the School especially interested in connecting S&T with basic social needs. Herrera wrote that 'the quantitative deficiencies of the R&D systems of Latin America are less serious than their disconnection from the societies to which they belong' and criticised the fact that 'in Latin America [...] the majority of scientific research holds very little relation to the basic problems of the region' (Herrera 1973: 116). In the 1970s, Herrera called for technological development to include 'new technologies which are not socially disruptive', to be focused on addressing basic needs such as food, shelter, health and education: in other words, a 'development based on indigenous natural and human resources', relying on 'rational management of the environment as a guideline of economic and social development' (O'Keefe and Howes 1979: 54). Orlando Fals Borda, a Colombian sociologist, also pointed to the validity of local knowledge and participatory methods in this period, as an early proponent of Participatory Action Research.

In the late 1960s, the Argentinean mathematician Oscar Varsavsky, together with Herrera and others, called for a 'committed science' to address inequality perpetuated by social structures. These researchers argued that science needed to have social relevance and should address the serious problems affecting the majority of Latin America's population: poverty and social exclusion. They argued that all scientists needed to demonstrate a personal commitment to political change, which should be evidenced by the scientific priorities they chose to pursue (*direction*). Others who were also considered part of the 'Latin American School', including Jorge Alberto Sábato, an Argentinian physicist with the National Commission for Atomic Energy, saw a somewhat different link between

Rather, ideas were developed alongside and from practice. Some of the authors often included are Jorge Alberto Sábato (Argentina), Amílcar Herrera (Argentina), Maximo Halty-Carrere (Uruguay), Javier Urquidí, Francisco Sagasti (Peru), Oscar Varsavsky, among others. Martinez Vidal and Mari place Varsavsky in the 'New University' reform movement (Martinez Vidal and Mari 2002). Not unconnected to these discussions, it is interesting to note that the *Latin American World Model*, a critical alternative vision presented by Latin American researchers in response to the neo-Malthusian *The Limits to Growth* of the Club of Rome, involved some of the same names (Herrera 1976).

¹⁷ Herrera described the importance of attention to the implicit broader policies, especially in 'underdeveloped' countries. 'The implicit science policy, even though it is what really determines the role of science in society, is much more difficult to identify, because it lacks formal structure; in essence, it expresses the scientific and technological demand of the "national project" active in each country' (1973: 126). This concept formed the basis for a concept of the need for policy 'clusters' developed during the Science and Technology Policy Instruments project (STPI 1974-1982), led by Francisco Sagasti with the Organisation of American States (OAS) and International Development Research Centre (IDRC) of Canada.

science and social needs, stressing the importance of science as universal and international. Sábato argued for creating the enabling conditions for effective scientific work, building strong links between the State, the scientific community and productive sectors (what became known as Sábato's Triangle), but without necessarily forcing direct links with social problems, and arguably neglecting local knowledge systems (Sábato and Botana 1968; Sábato 1975).

Although the School had some influence on industrial and technology policies in Latin America,¹⁸ their efforts developed somewhat in parallel to much regional research policy and associated institutional developments in many Latin American countries (Martinez Vidal and Mari 2002). Significant exceptions were associated with the Latin American School and directly and indirectly related to the Import-Substitution-Industrialisation model (ISI), fostered by the public sector.¹⁹ The integrated thinking of the School and its close links with practical needs and demands led to some important autonomous technological developments in State-owned industries.²⁰ Jorge Alberto Sábato was key in promoting the idea of developing technologies within Argentina's National Commission for Atomic Energy, and at a national level.²¹ In Brazil, the Institute of Aeronautics and Space Technology (Aeronautica – ITA) initiated a program of local development of airplanes for advanced training (Bandeirante was the first). State firms in a number of countries (e.g. Mexico and Venezuela) incubated similar projects, especially in the petroleum, iron and steel industries (Martinez Vidal and Mari 2002).²² During the 1970s and 80s, research for strategic sectors was viewed as critical for

¹⁸ Sábato wrote: 'One of the most unique characteristics of the process experienced in Latin America around the issue of *Science-Technology-Development-Dependency* was the close relationship between thought and action, in other words, between the production of academic works referring to specific aspects of that issue, and the measures executed by national and regional institutions to enact on real problems, on the basis of those studies' (Sábato 1972; quoted in Martinez Vidal and Mari, 2002: 4; translated by the authors).

¹⁹ The shift to Import-Substitution-Industrialisation (ISI) and the entry of significant amounts of foreign capital enabled some important infrastructure and associated support industries to be established in the 1950s and 60s (into the 1970s and 80s in some countries), allowing the development of nascent scientific and technological capacities (Perez 2008). In addition, both non-profit organizations and for-profit private firms oriented toward agricultural crops for export were increasingly involved in research efforts in some countries (Stads and Beintema 2009).

²⁰ In contrast to the State-owned industries, at the same time there were limits to private sector demand for local technological development, a circumstance which was tied to the disintegration of the Import Substitution Industrialisation (ISI) model and lack of consistency in applying some of the forward-thinking S&T policies put forward by the School. Members of the School thought that the State's productive sector and the dynamic of local innovation that was generated around these industries would lead to broader dynamisation of technological needs of private industry, from a sort of 'endogenous nuclei of technological dynamisation', but this failed to occur to any great extent (Martinez Vidal and Mari 2002). Herrera also points out that during this period military governments in some countries destroyed research centres, especially in universities, through direct political persecution and economic marginalisation of scientists (1973: 117).

²¹ Sábato is quoted describing the train of thought in that organisation towards paying attention to building local technological capabilities, when in 1957, after some discussion, it was agreed at the CNEA to build an experimental reactor instead of buying one, with awareness of the knowledge and skills that would be gained in doing so: 'we would immerse ourselves in the full problematics of nuclear technology, not only in the use of the instrument' (Sábato 1972, quoted in Martinez Vidal and Mari, 2002: 4, translated by author).

²² Mexico nationalized its oil industry between 1935 and 1938, creating PEMEX, which developed its own petroleum and petrochemical technology based on imitation and adaptation (Martinez Vidal and Mari 2002).

industrial development. For example, State involvement in the national mining sector in Peru pushed national technological efforts, resulting in the Cerro Verde Project, which relied on technologies which were substantially national in origin (Kuramoto 2007). Kuramoto points out that some of the actors in the innovation system at this time had a very fluid relationship, allowing knowledge to be transferred effectively to the productive sector (2007: 126).²³

Government priorities for science and technology in some Latin American countries today are arguably not so different from many of those proposed in the 1960s.²⁴ In 1965, UNESCO and ECLAC organized the 'First Conference on the Application of Science and Technology to the Development of Latin America' (CASTALA), in Santiago, Chile.²⁵ At CASTALA a regional outline for the development of S&T in the region was adopted. This outline included developing a science policy oriented towards economic development problems; increasing expenditure on R&D to between 0.7 and 1 per cent of GNP;²⁶ establishing research councils in all Latin American countries (except Argentina, Brazil and Uruguay, which already had them); emphasising science in higher education, to promote technological research intended for transfer to the productive sector; and supporting international and regional cooperation in science and technology.²⁷ Herrera criticised this common picture of the obstacles to the development of S&T (relating to a perceived need to change cultural habits, 'backward' and lacking productive industrial structures, and institutional bureaucratic deficiencies), a picture which he suggested 'conditions the strategy of international organisations' towards an

²³ Overall industrial policy today is much less sector-specific than in the 60s and 70s, which has arguably still favoured the primary sectors (e.g. petroleum, mining) (ECLAC 2010c: 113).

²⁴ In 1960 Latin American governments organised the first 'Regional Seminar on Scientific Research in Latin America' in Venezuela, out of which resulted the 'Caracas Declaration'. Lemarchand points out that a great variety of actions proposed in this declaration are still priorities for countries in the region: to promote scientific education, systematise science and technology indicators, establish regional organisations to jointly coordinate science, technology and innovation activities, create regional research centres in basic sciences, establish fellowships enabling exchanges and interaction among researchers, and develop collaboration between regional bodies such as LACSO and the Organization of American States (Lemarchand 2010: 86).

²⁵ This followed world attention to the role of science in development with the 1963 'United Nations Conference on the Application of Science and Technology for the benefit of the less developed areas' (UNCSAT) in Geneva, which was followed by the Vienna conference in 1979. A 'Second Conference on the Application of Science and Technology to the Development of Latin America and the Caribbean' (CASTALAC II) was held in 1985 (Lemarchand 2010: 89).

²⁶ It is interesting to note that this target comes before the original Sussex Manifesto and the World Plan of Action, which promoted the figure of 1 per cent of R&D (Singer et al 1970). It is also notable that progress towards these goals has been more limited in LAC than in other regions; the average R&D intensity in LAC is still below 0.7 per cent and Brazil is the only country that currently achieves the 1 per cent target (UIS 2009).

²⁷ In 1974 ECLAC entered into a formal agreement with UNESCO as to each of their distinct roles. UNESCO was to focus 'upstream' on science policies, infrastructure, teaching and research while ECLAC focused 'downstream' on studies of socioeconomic needs for technological development. ECLAC's involvement was set out in the 'Regional Action Plan for the Application of Science and Technology to the Development of Latin America' (ECLAC 1973). Among the main positions set out in this plan were: (a) to undertake careful comprehensive planning of scientific research, technological investigation and the generation of innovation processes in the productive sector; (b) to provide each country of the region with the capacity to adapt and introduce original innovations in those sectors of industry and agriculture having potentials that State has decided to develop; (c) to promote regional cooperation for science and technology planning, although the instruments to achieve this objective were not explicitly proposed (Lemarchand 2010: 95).

emphasis on 'addressing gaps based on the tacit assumption that science is a sort of external input to the productive system, that, if stimulated in the right way, will contribute powerfully to breaking the inertia of backwardness and to dynamise an essentially static society'(1973: 121).

Thus in this post-WWII period, there was an impulse towards supply-oriented attention to S&T, focused on the growth and strengthening of research institutions, the development of new Research Councils, and emphasis on increasing investment in research, with each of these actions supported by UNESCO. While in some countries a parallel focus was also developing on industrialisation supported by local technological development, this largely originated with heavy state involvement toward military applications or other major industries mentioned above (e.g. aeronautics in Brazil, nuclear technology in Argentina, oil in Mexico and mining in Peru)²⁸.

Despite the efforts by members of the Latin American School to foster the links in Sábato's Triangle (State, productive sectors and research community), overall these relationships were often tenuous, and demand for relevant research and technological capabilities remained low because of a continued focus on raw materials exports requiring low technological intensity, and because of the availability of existing technologies from 'advanced countries' for manufacturing consumer goods for the growing higher-income population in Latin America. Research communities arguably remained distanced from social needs, while the criteria for 'quality' research did not value social relevance in most cases (Dagnino and Thomas 1999).

Herrera argued that a principal obstacle was the resistance to change by the elite classes who enjoyed certain privileges associated with maintaining the social economic structures that served to limit the building of S&T. These structures originated in the colonial and immediately post-colonial period ('polarised, rigid social structures characterised by a dominant class, predominantly urban, that exercises almost total control' over the marginalised rural poor), and relied on the alliance between centres of world power and these local beneficiaries (landowners, exporters, importers, etc.) with regional economic and political power. In other words, the existence of foreign dependency and local hegemonies combined to prevent the deeper changes necessary to actualise a truly endogenous national development, including the necessary stimulus for local S&T (Herrera 1973: 127-28).

Mid-1970s to Mid-1980s: Economic Crisis and the Decline of Import Substitution

ISI arguably only worked for some economies for a limited time, and after several stages of substitution, its benefits were exhausted as the regional macroeconomic context changed. In the late 1970s and early 80s, a period of macroeconomic crisis ensued related to rising prices of imported oil, foreign debt, inflation, rising interest rates, and deficits in the balance of payments. This crisis was followed by a radical shift in economic policy orientation in the 1980s and 90s. During this period, some research councils were reformed into 'science and technology councils' with the aim for greater attention to technological change in industry. In the 1980s there was increased interest in some Latin American countries in establishing productive links between research and industry, through research networks, technology transfer, the creation of technology parks and other similar

²⁸ Martinez Vidal and Mari (2002) also describe a third parallel development (in some countries) they call the 'New University and National Project' during this period from 1955-1967, with only limited links between these three movements of supply-oriented institution-building, industrial technological development and the New University.

means.²⁹ Some initiatives tried to support regional STI cooperation in new ways, such as the establishment of the Ibero-American Programme on Science and Technology for Development (CyTED), a regional network for science and technology research, in 1984. However, ISI did not prepare countries for a sudden shift to an export-oriented growth model.³⁰

Late 1980s to present – Liberalisation and the death of the ‘Washington Consensus’

The rapid liberalisation of Latin American economies and associated structural adjustments in the late 1980s and early 90s, as part of an attempt to address the macro-economic crisis (both in North and Southern countries), was a major shock to many countries’ economies. The sudden full-on globalised market orientation, pressed on many countries by international funding institutes, emphasised export-led growth combined with the deregulation of international trade and cross-border investment. It was accompanied in many cases by a degradation of attention to both industrial policy and science and technology institutions and capacities (ECLAC 2010c). The political focus was on reducing imbalances and public expenditure, and controlling inflation, with wide-ranging privatisation and restructuring of the productive sectors of many countries in the region, as demanded by structural adjustment agreements with international funding institutions.³¹ The formation of the WTO in 1995 out of prior agreements on intellectual property and trade (GATT) led to greater attention to intellectual property rights and payments of patent royalties. This period was marked in some countries by the loss of national firms, and the endogenous STI capacities embedded in these firms and in public institutions, as industrial policy was nearly abandoned (ECLAC 2010c: 113). At the same time, many of those educated in science and technology careers emigrated to find jobs elsewhere. Though some economic stabilisation was achieved in the early 1990s, growth problems in the region persisted, in contrast with the experience in some Asian countries. In the mid-1990s there were further economic crises (Argentina was devastated by its crisis in 2000-2001) due to a variety of reforms (ECLAC 2010c).

The structural change processes of the 1990s increased the importance of non-technology-intensive sectors and depressed demand for local technology (Perez 2008). As foreign investment was promoted as a source of knowledge and technology, these imports increased, further diminishing the State’s role in boosting local technology capabilities.³² Brazil and Chile were among

²⁹ In 1975, Venezuela held its first ‘Science and Technology Congress’, which aimed to establish dialogue between scientists, technologists, politicians and industrialists in order to establish supportive policies for science and technology. In the 1980s, efforts in Venezuela were oriented toward the creation of ‘technology parks’, incubation of technology-based firms, technology transfer, among other activities (Bifano 2010).

³⁰ Freeman (1995:13) compares the Latin American and Southeast Asian innovation systems of the 1980s in which Latin America is marked by a deterioration of the education system, a low proportion of graduates in engineering, high levels of technology transfer from the United States but low levels of industrial R&D, industrial R&D as less than 25 per cent of total R&D, deteriorating science and technology infrastructure and weak relationships with industry, decline in foreign direct investment and low participation in international technological networks, slow development of telecommunications infrastructure, weak growth in electronic industries and minimal learning of international marketing.

³¹ Cassiolato and Lastres point out that the ‘central target of neoliberal policies was the elimination of any important role for the State in fostering structural change’ and that ‘policies and institutions for development as designed by advanced countries and international organisations are totally in contradiction with their own historical experiences’ (Cassiolato and Lastres 2008).

³² For example, Kuramoto points out that foreign firms investing in Peruvian mines in the 1990s maintained their productive links with their providers in the exterior, thereby offering little stimulation to links with

the few countries where S&T remained significantly on the political agenda, though some countries received support from the Inter-American Development Bank and other entities during this period. The policy focus at this time was more demand-oriented than before, almost by default due to the budget crises, with a 'hands-off' approach to S&T policy in which markets took on the role of promoting development instead of the State, dependent on different sectors' ability to articulate their technological needs.³³ This situation reflected the broader political-economic shift and was partly tied to the general downsizing of the role of the State. 'On balance, the policies implemented in the 1990s were better at dismantling the technological supply system inherited from ISI than constructing a new system based on incentives to increase demand' (ECLAC 2010c: 115). In addition, some countries began to use the concept of the National Innovation System (NIS) to organise their policies, especially under influence of the Inter-American Development Bank. Cassiolato and Lastres argue that this has sometimes occurred without close attention being paid to the real structural arguments of the Innovation Systems approach, which, similarly to the Latin American structuralism approach, gives great importance to the role of the State, the importance of broader (systemic and historic) contexts and the localised and national nature of innovation, and acknowledges the relevance of power relations, among other factors (Cassiolato and Lastres 2008). These cases of 'policy transfer' were rarely based on thorough diagnoses of local contexts (Albornoz 2009: 17-18).³⁴ According to ECLAC, in nearly all countries, the policy as formulated was often far removed from policy as actually carried out (ECLAC 2010c).

Overall the 1990s was a period of liberalisation policies in Latin America. It was believed that trade liberalisation would promote technological innovation by increasing foreign competition and reducing the prices of imported capital goods. Policies during this period also relied on foreign direct investment as a mechanism for successful technology transfer from abroad. S&T policies (for example, in Argentina, especially since the creation of the National Agency for the Promotion of S&T (ANPCyT) in 1996), prioritised the private sector by providing subsidies to private R&D and also by supporting public-private linkages. Meanwhile, public institutes and universities developed a regulatory framework to promote interaction with the private sector.

Cassiolato and Lastres point out the negative impact of neo-liberalism on the previous structuralism consensus in the South.

By proposing a world where countries would converge if they followed the same liberalising economic recipes and using their economic and political power to influence government and intellectuals, international organisations forced a radical shift in the nature of the

Peruvian technological actors, and even helping to contribute to a 'disarticulation' between the agents of the Peruvian sectoral innovation system (Kuramoto 2007: 126).

³³ This was also the case in Argentina during the 1990s, where there was a stronger reliance on private initiative in innovation (both foreign and local) than on public, and the main scheme of S&T policy during the decade was the promotion of private R&D (Arza et al 2008).

³⁴ For example, Albornoz cites the case of Argentina, where in 1996, the government began to develop its 'National Multi-year Plan 1999-2001' (Plan Nacional Plurianual 1999-2001) which calls for the development and strengthening of the National System of Science, Technology and Innovation (Albornoz 2009: 18). Also in the latter half of the 1990s, support from the Inter-American Development Bank in Venezuela was oriented towards the development of the country's National Innovation System, with particular attention to higher education. Venezuelan S&T programmes at this time also emphasised specific sectors and issues (e.g. cacao, health, violence and metallurgy, among others) (Bifano 2010).

debate. One of the most significant by-products of these views was that previous theorising about development and underdevelopment coming from Latin America was almost totally discarded as a frame of reference for understanding and changing the world. Another consequence, perhaps more disturbing, is that 25 years of neo-liberal experimentation with economic policies led to a more divided world, with the gap between rich and poor countries (and people inside countries) widening and poverty and starvation increasing. (Cassiolato and Lastres 2008: 2)

In the late 1990s, there was a renewed call to address the links between innovation and social needs, with some differences from the 60s and 70s. In 1999, UNESCO called for 'a new social contract for science and technology' at the Conference on World Science for the 21st Century in Budapest (Budapest 1999, cited in Lemarchand 2010: 117). In preparation for this meeting, a Regional Consultation for Latin America and the Caribbean was held in the Dominican Republic (Santo Domingo 1999). Some of the issues raised at the regional meeting resonate with the Manifesto's 3Ds, and include the need for attention to transdisciplinarity and science communication, the role of women in S&T decision-making, specific attention to poverty, technology assessment and research quality assessment, and civil society lobbying for increased investment in science to meet social needs (*distribution* and *direction*). Concerns were also raised about the asymmetrical nature of science cooperation as international agencies generally set the priorities for research, a concern that remains relevant today (similarly touching on *direction*) (Lemarchand 2010: 96). From the 1990s attention to the 'popularisation' or 'social appropriation' of science also surged in Latin American multilateral and national institutions and public policy, terms which embody concerns for broader social participation in knowledge production. In particular, Lozano suggests that in the 1990s there existed some 'consensus in the region regarding the importance of the popularisation of science and technology as a fundamental element for social and economic development of the region', but that this consensus was not reflected in a widespread programmatic orientation of policies around the popularisation of science and technology in the region, and remains a point for debate (Lozano 2005: 217; translated by authors).

Yet the call among academics and practitioners for social inclusion in science and technology in the region has continued, and if anything has increased over the last decade. This is reflected, for instance, in the fact that the central theme in the 2010 VIII Latin American Social Studies of Science (ESOCITE) Conference, was precisely 'Science and Technology for Social Inclusion'. Discussions at the conference paid attention to democratisation, inequity, growth and social cohesion in current scientific and technological development.

Nevertheless, the challenges are huge, and include 'the simultaneous integration and exclusion of countries, regions – as well as of peoples within countries' where 'advances in science, technology and innovation are both a cause and a consequence of all the other changes in the forces that are shaping the emerging fractured global order' (Sagasti 2004: 74-5). There is no doubt that, today, many acknowledge the need for State intervention in achieving more just and equitable pathways for science and technology, and that the Washington Consensus has been declared 'dead'. The question remains: in what way can the State best foster the conditions that enable science, technology and innovation to prosper while contributing to improve social equality and wellbeing? As we will see below, the response to this question varies significantly among countries, with more commitment to linking these two sets of issues from some National States (e.g. Venezuela) than from others.

NEW DEVELOPMENTS IN S&T INSTITUTIONS AND RECENT POLICY CHANGES

Over the past decade, many Latin American countries have demonstrated renewed attention to science and technology (see Table 1), with significant variation in legislative reforms from country to

country, reflecting the diversity among the STI systems themselves.³⁵ A number of countries have been attempting to better align their science and technology policy with broader development strategies and to include attention to social equity. Some of these have explicitly added 'Innovation' on to what were previously laws on 'Science and Technology', with an attempt to embrace the National Innovation System concept.³⁶ Others have also created new institutions or shifted prior lines of command so that executive powers would be better informed about S&T and to try to reshape the place of S&T within the larger government and economy.³⁷ Many prioritise building endogenous technological capabilities in various strategic areas, and some bring special attention to a desire for 'technological sovereignty', echoing some of the same concerns of the 1960s and 70s (e.g. Venezuela, Bolivia). These reforms have been accompanied by a new generation of policy instruments intended to stimulate innovation.³⁸ A range of new funds have been established recently, aiming to bring public research and private enterprise closer together. Some reforms aim to improve the speed and transparency of resource allocation procedures, as well as monitoring, evaluation and accountability for public S&T policies, while others focus on 'assessing R&D results, promoting innovation, strengthening the relationship between research centres and business, designing long-term policies, employing strategic intelligence tools, monitoring public opinion on S&T issues, and disseminating knowledge', and improving links between universities and the productive sector (Albornoz et al 2010: 78).

Yet while some countries do seem to be adding stronger policy language regarding choice of *direction* in S&T priorities linked to poverty, social development and environmental sustainability (see far right column in Table 1), and while there are also varying programs and strategies devoted to 'popularization' and 'appropriation' of S&T, many of these efforts do not involve civil society representation in the institutional spaces created for setting such priorities. According to Lozano this has to do with the fact that terms like 'popularisation' and 'appropriation' remain conceptually weak and there is, as yet, lack of agreement on what they mean in practice (from a 'deficit' model to a 'democratic participation' model), what their objectives and strategies should be, and how they relate to other contexts, such as formal science education (Lozano 2005: 217-218). Most commonly, S&T Councils or similar bodies are composed of ministers of government and members of academia, sometimes including representation from the private sector, and even less frequently including representatives from civil society through rural associations or other groups. For example, in addition to the usual executive, ministerial and academic representation, Peru's National Council for Science, Technology and Technological Innovation (CONCYTEC) unusually includes representatives from private firms, communities and civil society, while Paraguay's National Council of Science and Technology (CONACYT), includes representation from state and private industries, universities, unions and rural associations (see Table 1).

³⁵ For example, Brazil, Argentina, Mexico and Chile have the largest and most complex STI systems, while others like Colombia and Venezuela have relatively embryonic systems by comparison. Others in the region have very weak or negligible S&T systems beyond the existence of institutions of higher education (Albornoz 2010: 79).

³⁶ A general trend of using the frame of the National Innovation System approach (NSI) as a focus for organising resources has become widespread (e.g. in Venezuela, Colombia, Peru, Argentina, Mexico and Bolivia), in part resulting from the influence of the Inter-American Development Bank.

³⁷ For example, a 2009 Colombian law elevates the status of Colciencias, the government body responsible for science and technology funds, programs and policies, to the level of ministry (see Table 1).

³⁸ The 2009 Inter-American Development Bank inventory of S&T policy instruments shows at least 30 types of S&T policy instruments being implemented across Latin America (Lopez et al 2009).

Although mechanisms of permanent deliberative, democratized spaces for setting STI priorities are scarce, some, such as Cuba, Mexico, and Venezuela, have used broader consultations that include parties beyond the various ministries and scientific or academic institutes. For example, Cuba's and Venezuela's recent consultation processes involved regional and national input to identify priority areas for S&T investment (Clark Arxer 2010: 128; MCT 2005) (Table 1)). Some countries have regional offices of their S&T ministerial body (e.g. Venezuela, Cuba, Colombia), or even State- or municipal-level committees or coordinators (as is the case in Venezuela and Cuba respectively), to enable more distributed input into national science and technology agendas.

Finally, although many countries are prioritising social development goals and environmental concerns in the general objectives of new S&T policy, areas of new technologies and an emphasis on economic growth and competitiveness of exports in international markets remain prominent goals under many national policies. The links between these two aims (social and economic) are not always explicitly outlined, and are likely to depend on some of the more detailed aspects of programming and the actual implementation of the policies. Thus, for the Latin American region as a whole, it remains unclear whether these recent policy changes truly mark a renaissance in science, technology and innovation for sustainable development in the region.

Table 1. Some examples of recent STI public policy reforms in Latin America

<i>Country</i>	<i>STI Reform</i>	<i>Year</i>	<i>Types of representation on agenda-setting S&T body</i>	<i>Some areas of current STI policy</i>
Argentina	National Agency for the Promotion of Science and Technology (ANPCYT) founded to fund R&D and infrastructure projects	1996	The National Council for Scientific and Technological Research (CONICET) is composed of 9 members, including a president (appointed by the Executive Power), 4 members elected by active researchers in each of the main research areas, and one member each chosen by the council of universities, industrial associations, agricultural associations, and by the S&T bodies of the provincial governments and capital city of Buenos Aires. The Council is also linked to various regional Scientific-Technological Centres, that function as part of the Council's decentralised institutional network	STI to contribute to the cultural, educational, social and economic patrimony of the nation, towards the common good, supporting national identity, the generation of employment opportunities and environmental sustainability (STI Law 2001) Programme in strategic areas includes health, agriculture, energy, food security and cultural industries Emphasis on biotechnology
	Science, Technology and Innovation Law passed by Congress	2001		
	Medium-Term Strategic Plan (2005-2015): Innovation & Social Development	2005		
	Law 26.270 Promotion of the Development and Production of Modern Biotechnology	2007		
Bolivia	Law to Strengthen Science, Technology & Innovation Establishes the National Council of S&T (CONACYT) and the Departmental S&T Councils (CONDECYT) as permanent organs with assessor responsibilities.	2001	The National Council includes representatives of public and private universities, research centres, associations of small and medium-sized industries, the women's science association, the agricultural and farm workers' union,	STI for national integration, sovereignty, social inclusion; recuperation, protection and utilization of local know-how, technical and ancestral knowledge National Development Plan calls for three lines of development for
	National Development Plan 2006-2011	2007		

			business associations, as well as the National Secretary of STI, and up to four additional representatives appointed by the Executive Power.	STI policy: 1) STI as part of national integration towards productive development with sovereignty and social inclusion; 2) Inclusive scientific culture for the construction of a knowledge society with its own characteristics; 3) Recuperation, protection and utilisation of local know-how, technical and ancestral knowledge (Government of Bolivia 2009)
Brazil	<p>Ministry of Science and Technology created</p> <p>Sector-specific funds created as part of Brazil's privatization strategy; introduced targets for government-selected R&D projects of benefit to industry and reduced taxation on industries to be privatised. Legislation specifies a minimum of 30% of each fund's value to be directed to development of more marginal regions of the country</p> <p>Parliamentary Innovation Bill</p> <p>Innovation, Technology and Trade Policy (PITCE)</p> <p>Plan of Action in Science, Technology and Innovation for Brazilian Development 2007-2010</p>	<p>1985</p> <p>1999</p> <p>Approved 2004</p> <p>2003</p> <p>Adopted 2007</p>	<p>National Council of Scientific and Technological Development (CNPq), linked to the Ministry of S&T: the president and directors of the council are appointed by the President of Brazil, as well as a 20 member Deliberative Council involving the heads of the major S&T funding institutions and members of the business community</p> <p>The Council is responsible for the investment of resources, definition of budget and actions related to the institution's policies</p>	<p>Sector-specific funds are part of privatisation strategy</p> <p>Increasing private sector R&D</p> <p>Connecting innovation policy to export objectives and established priority areas: semiconductors and microelectronics, software, capital goods, pharmaceuticals and medication, biotechnology, nanotechnology and biomass (de Brito Cruz and Chaimovitch 2010)</p>
Chile	National Advisory Council to the National Commission for Scientific and Technological Research (CONICYT)	2004	The National Commission for Scientific and Technological	CONICYT's mission is to promote the formation of advanced human

established				
National Council of Innovation for Competitiveness (CNIC) formed as permanent advisory board to presidency	2005	Research (CONICYT) is a public autonomous organization under the Ministry of Education, with an appointed president.		capital, and to promote, develop and disseminate S&T research, in coherence with the National Innovation Strategy, with the aim of contributing to the economic, social and cultural development of the country (CONICYT website)
Inter-Ministerial Committee for Innovation	2007	The National Advisory Council to CONICYT is composed of:		
National Innovation Strategy	2006-8	the President of CONICYT, two representatives of the country's President, the Ministers of Education, National Defence, Economy, Planning and Cooperation, Public Works, Health, Agriculture, Mining,		Priorities include areas with greatest growth potential (productive clusters), energy, hydrological resources, environment and ITCs, health, security and education
National Innovation and Competitiveness Agenda 2010-2020	2010	representatives from National Commissions on Energy, Productivity, Environment, the high council of the S&T Fund, rectors of the national university as well as three rectors from other universities, 12 members of the national S&T community appointed by the Minister of Education, and three representatives of private industry, appointed by the National Societies of Agriculture, Manufacturing and Mining		The National Innovation Strategy aims to strengthen capacities to create, adapt, and adopt new knowledge and technologies, seen as essential for economic progress, and for improving the living conditions of the country in the context of a global knowledge economy (CONICYT website)
		The Inter-ministerial Committee for Innovation is composed of the Ministers of Economy, Education, Foreign		

			Relations, Mining, Agriculture and Finance.	
Colombia	<p>National Observatory for Science, Technology and Innovation created</p> <p>National Science, Technology and Innovation Policy passed</p> <p>Colombian Institute for the Development of Science and Technology (Colciencias) elevated to Ministerial level (previously under the Planning Department), becoming the Administrative Department of Science, Technology, and Innovation</p> <p>National Advisory Council on Science, Technology and Innovation to Colciencias</p> <p>Strategy for Social Appropriation of STI 2011-2014</p> <p>Conpes 3697 - Policy on the Commercialization of Biotechnology for the Sustainable Use of Biodiversity</p> <p>Royalties Law (Ley de Regalías) devotes 10% of royalties from oil and mining to Science and Technology; within a broader reform effort to decentralise these resources toward regional and local development (averaging 40% of royalties) (El Espectador 2011)</p>	<p>1999</p> <p>2008</p> <p>2009</p> <p>2009</p> <p>2010</p> <p>July 2011</p> <p>2011</p>	<p>Colciencias is an administrative department of the government, led by a general Director.</p> <p>The National Advisory Council on STI is composed of ten academic, private sector, public sector Ministers, and other regional S&T representatives, and is led by the Director of Colciencias.</p>	<p>STI to contribute to the competitive and equitable development of the country's social and economic needs</p> <p>Strategy for Social Appropriation of STI includes 4 areas: citizen participation in public policies for STI; communications on science, technology and society; knowledge exchange and transfer and knowledge management for social appropriation of STI (Colciencias 2010)</p> <p>Biotechnology is considered one of Colombia's 'pillars of competitiveness' in the National Policy on Competitiveness and Productivity (Conpes 3527 2008). Within this framework Conpes 3697 aims 'to create the conditions' to attract 'public and private resources for the development of firms and commercial products based on the sustainable use of biodiversity, specifically biological, genetic and their derivative resources' (Conpes 3697 2011: 4)</p>
Costa Rica	Ministry of Science and Technology (MICIT) established	1986	The National Council for Scientific and Technological	National S&T Program, For Knowledge toward Development,

	<p>under the National Program of S&T 1986-1990</p> <p>National S&T Program: For Knowledge toward Development</p> <p>National Development Plan 2006-2010</p>	<p>1998-2002</p> <p>2006</p>	<p>Research (CONICIT) is composed of members named by the Government</p>	<p>most recently focused on ICTs and telecommunications as 'instruments of excellence in the transformation of society and economic development of the country'</p> <p>The mission of CONICIT is 'to promote development of S&T, toward pacific ends, by means of systematic research and creative activity' (CONICIT website)</p>
Cuba	<p>Ministry for Science, Technology and Environment (CITMA) established</p> <p>Centre of Genetic Engineering and Biotechnology founded, one of Cuba's top R&D institutes</p>	<p>1994</p> <p>1986</p>	<p>CITMA has subordinate executive offices in each province, and coordinators in each municipality</p> <p>Sectoral programmes are selected and supported by related ministries, while decentralised provincial delegate offices of CITMA help select and monitor local projects (Clark Arxer 2010: 124)</p> <p>In 2007-2008 CITMA conducted a consultation process involving the Cuban Academy of Sciences, more than 600 scientific experts, university professors and decision-makers, territorial authorities and business leaders, to identify short and medium-term strategic</p>	<p>To link scientific knowledge with sustainable forms of development</p> <p>National Research Programmes include: neurosciences, 'agricultural production for sustainable development; basic research in mathematics, physics and computer science; ICTs; new materials; the sugar industry; agricultural biotechnology; pharmaceutical and biotech products; human and veterinary vaccines; sustainable development of mountain region ecosystems; Cuban society: challenges and perspectives; trends in the world economy and international relations; global change and the evolution of the Cuban natural environment; plant breeding and genetic resources' (Clark Arxer</p>

			priority areas for S&T investment	2010: 127)
Guatemala	<p>Law on the Promotion of National S&T Development</p> <p>National S&T Council (CONCYT) established</p> <p>Programme to Support Technological Innovation (PROINTEC)</p> <p>National Science, Technology and Innovation Plan 2005-2014</p> <p>National Sectoral Programmes in Science, Technology and Innovation established</p>	<p>1991, passed</p> <p>1994</p> <p>Established 2000, operational 2004</p> <p>2005</p> <p>2007-8</p>	<p>CONCYT is comprised of 9 members: the Vice-President, the Minister of the Economy, President of the Congressional S&T Commission, the Presidents of the Chambers of Trade, Agriculture and Private Industry, the Rector of the University of San Carlos, a Rector representing private universities, the President of the Guatemalan Academy of Medical, Physical and Natural Sciences.</p> <p>There is also a Consultative Commission with 9 members, in turn appointed by members of the CONCYT</p>	<p>PROINTEC's aims: 1) stimulate SMEs' productivity and competitiveness; 2) implement an information and extension service; 3) consolidate a national policy framework to stimulate and regulate STI development</p> <p>National STI Plan 2005-2014: STI for sustainable economic and social development, for a society with better quality of life, more just and equitable. Specific legislation for 'contribution of S&T to meet basic needs', including lines of action in health, education, housing, and natural resource use.</p> <p>National Sectoral Programmes in STI include: quality control, ICTs, basic sciences, agro-fisheries, construction, industry, environment, biotechnology, science popularization, human resources, energy, health</p>

Mexico	New Science and Technology Law passed by Congress, creating a 'Special Programme on S&T' resulting from a national consultation process involving scientists, technologists, businessmen, academics and government	2002	Consultative S&T Forum presided over and integrated by 17 members of the science, technology, academic and business communities General Council on Scientific Research and Technological Development is directed by the person appointed by the Executive	Areas of strategic growth for resolving most urgent national problems: ICTs, biotech, advanced materials, design and manufacturing processes, infrastructure and urban and rural development, including social and economic aspects (CONACYT website, Mexico)
	Consultative Science & Technological Forum established with the aim of enabling dialogue among the 'multiple sectors involved in innovation for human development' (Stads and Beintema 2009)	2002		
	'Organic STI Law' passed, National Council for S&T (CONACYT) reformed; a non-sector entity under the Executive branch, with sectoral coordination functions and as administrator of budget branch for S&T Intersecretarial Committee for the Integration of consolidated federal S&T budget National S&T Conference as a coordinating opportunity between offices and councils of the states and CONACYT for promoting S&T decentralisation	2006		
Paraguay	National Council of Science and Technology (CONACYT) formed by law to support the National S&T System	1997	CONACYT is under the Presidency of the Republic, representatives of various Executive Ministries, industry, state and private industries, universities, unions and rural associations, and the scientific community	First National S&T Policy establishes priority sectors: energy, water resources, environment, agrofisheries and related industries, services and health. Initial projects aim to contribute to 'economically, socially and environmentally sustainable development' (CONACYT website, Paraguay)
	First National S&T Policy	2002		
	First S&T projects developed with help from the UNDP and IADB	2006		

Peru	Science, Technology and Innovation Fund established to direct funds to finance R&D in private enterprise (with loan from IADB)	2005	STI Fund's Board of Directors includes representatives from scientific institutes and academia, government, and the private sector	The National STI Plan for Competitiveness and Human Development 2006-2021 includes priorities of 'poverty reduction and the improvement of quality of life for the most marginalized sectors' while emphasizing economic growth and competitiveness in international markets. (CONCYTEC website)
	National Science, Technology and Innovation Plan for Competitiveness and Human Development 2006-2021	2006	CONCYTEC is the 'rector' institution of the National System of Science, Technology and Technological Innovation (SINACYT), and is composed of representatives from academia, the State research institutes, private firms, communities and civil society.	
Uruguay	National Agency for Research and Innovation (ANII) established to consolidate competitive funds	2005	The National Science, Technology and Innovation Council (CONICYT) is composed of representatives from the Executive Power (5), the academic-scientific sector (7), the productive sector (5), from the Congress of Intendants (1), workers (1), the National Administration of Public Education (1), and a President elected by CONICYT	Vision of ANII: 'to be a key actor in the permanent construction of an equitable, democratic and competitive society based on knowledge and innovation as the pillars of sustainable development by means of the implementation of public policies in research and innovation.' (ANII website)
	The Ministerial Cabinet for Innovation created	2005		
	National Program for the Attention of Social Emergencies (PANES)	2005		
			Ministerial Cabinet for Innovation includes the Ministers of Education and Culture; Economy and Finance; Industry, Energy and	

			Mining; Cattle, Agriculture and Fisheries; and the Director of the Planning and Budget Office	
Venezuela	<p>Ministry of Popular Power for Science & Technology (MCTI) created, to organize a National STI System in accordance with the new national political project</p> <p>'Science Mission' launched: 'a process of incorporation and mass articulation of social and institutional actors through economic, social, academic and political networks towards a more extensive use of knowledge in function of integration and endogenous development' (Venezuela Roundtable Report 2010)</p> <p>Science, Technology and Innovation Law passed (CONICYT becomes FONACIT, the National STI Fund)</p> <p>National Observatory on Science and Technology created</p> <p>Organic Science, Technology and Innovation Law modified</p> <p>National Plan for Science, Technology and Innovation 2006-2030</p> <p>Organic Science, Technology and Innovation Law modified</p>	<p>1999</p> <p>2001</p> <p>2001</p> <p>2005</p> <p>2005</p> <p>2006</p> <p>2010</p>	<p>FONACIT is an administrative entity under the MCTI, which manages funds for Science, Technology and Innovation.</p> <p>There are Committees of Knowledges and Production (Comite de Saberes y Produccion) for each state of the country, open to public participation</p> <p>Regional offices of the Ministry of Popular Power for S&T</p> <p>National consultation process to set ST&I research agenda</p>	<p>Objective of the Organic STI Law is 'to promote, stimulate and strengthen scientific research, social appropriation and transfer of knowledge, and technological innovation, with the aim of strengthening capacities for the generation, use and circulation of knowledge and stimulating national development'</p> <p>National Plan for STI 2006-2030 is oriented towards greater sovereignty, endogenous development with social inclusion and participatory democracy</p> <p>(MCTI website)</p> <p>Makes it mandatory for public and private enterprises to pay FONACIT between 0.5% and 2% of their annual profit (depending on the nature of the activity) in order to contribute toward the national science and technology</p>

				development plan
Regional	<p>Surveys on public perception of science (in six major cities in Argentina, Colombia, Venezuela, Panama, Brazil and Chile). NOTE: most respondents favour promoting citizen participation in decision-making, but most were unable to name a single scientific institution in their country</p> <p>MERCOSUR Science, Technology and Innovation Framework Program 2006-2010, to promote the advancement of knowledge in strategic areas, including natural resources</p>	<p>2007 (most recent)</p> <p>2005</p>		<p>MERCOSUR Program to address challenges facing the region and its particularities, including advanced and alternative energy, sustainable development, ICTs, biotechnology, nanotechnology and new materials. (Zurbriggen and Gonzalez Lago 2010)</p>

Table by authors based on multiple sources: Argentina (CONICET website; STI Law 2001; Argentina Law 26.270); Bolivia (Government of Bolivia 2009); Brazil (de Brito Cruz and Chaimovitch 2010); Chile (CONICYT website); Colombia (Colciencias 2010; Colciencias website; Conpes 3697; Conpes 3527; El Espectador 2011); Costa Rica (CONICIT website); Cuba (Clark Arxer 2010: 127); Guatemala (CONCYT 2005; CONCYT website); Mexico (CONACYT website); Paraguay (CONACYT website); Peru (CONCYTEC website); Uruguay (ANII website); Venezuela (Venezuela Roundtable Report 2010; MCTI website); Regional (Zurbriggen and Gonzalez Lago 2010)

Leaving these questions open, the next section will explore some of the experiments that have emerged over recent years in various Latin American countries. Some of these interesting and innovative efforts underway on the part of governments, the private sector, NGO and community-based initiatives focus on building science, technology and innovation capacities, paying attention to social needs, and sharing lessons across countries and with other regions. For example, ECLAC, with support from the Kellogg Foundation, recently identified and reviewed 4,800 social innovation³⁹ experiences across Latin America and the Caribbean (ECLAC 2010), affirming the existence of creative grassroots innovation efforts. Some of these are described further on in this paper. At the same time, more research and experimentation is still needed, as well as better ways of recognising and supporting relevant knowledge held by local communities that may address basic needs.⁴⁰ Examples highlighted in the next section provide a focus for questions around the democratisation of STI and allow us to examine the relevance and applicability of the New Manifesto's 3D agenda in the region.

AREAS FOR ACTION SUGGESTED IN 'A NEW MANIFESTO': CHALLENGES AND OPPORTUNITIES FOR THE DEVELOPMENT OF SCIENCE, TECHNOLOGY, AND INNOVATION IN LATIN AMERICA

As mentioned above, the STEPS New Manifesto calls for five specific 'Areas for Action' to better link science, technology and innovation to sustainability, development and social justice: *agenda setting, funding, capacity building, organising and monitoring, evaluation and accountability*. This call has great resonance with the work that various prominent Latin American researchers have been developing over the last decades on existent gaps between social needs and science, technology, and innovation. Many of these authors have also described, in different words, aspects of each of the Manifesto's 'areas for action' and the 3Ds, and have also pointed to the cross-theme of more inclusive democratic deliberation.

For example, Dagnino and Thomas (1999) suggest that different visions and priorities of social actors could be made more explicit through more democratised processes of decision-making, thereby helping to establish a more coherent and legitimate policy agenda

³⁹ ECLAC considered innovations that addressed 'persisting problems that affect vast sectors of the population', including both strictly new ideas as well as 'innovative experiences' that involved introducing 'significant changes to positions or processes' that demonstrated a strong impact (ECLAC 2010d: 9). Murray et al refer to 'social innovations' as 'innovations that are social both in their ends and in their means, [...] new ideas (products, services and models) that simultaneously meet social needs and create new social relationships or collaborations. In other words, they are innovations that are both good for society *and* enhance society's capacity to act' (Murray et al 2010: 3).

⁴⁰ Sagasti points out the importance of supporting traditional and local 'knowledge, techniques and production' as especially 'crucial' for the subsistence and health needs of much of the world (2004: 54).

that is more participatory, transparent and consistent with social demands (*agenda setting*). They also call for democratic participation as 'a condition for the increased density of the relationship web, currently lacking in developing innovation systems in Latin America' (*organising*) (1999: 49). Vessuri (2003) describes the democratic process as a channel for change, pointing out that inequity reflects the inability of many people to appropriate the benefits of public R&D. She argues that instrumental science requires democratic forms of participation and accountability to ensure integrity and responsibility (*monitoring, evaluation and accountability*)⁴¹.

Pointing out that 'it cannot be taken for granted that a strong effort in STI will be evenly distributed among the whole population, or even that it will contribute to a self-sustainable development process', Sutz and Arocena (2006: 6) call for the democratisation of three 'pillars' (economic, public policy and education) in order to achieve greater social equity from innovation. They suggest a framework for policies that includes five building blocks that might also to varying degrees be interpreted in terms of the areas for action of the New Manifesto. These are: 'strengthening learning possibilities' (*capacity building*), 'enhancing knowledge demands' (*funding and organising*), 'promoting articulations and linkages' (*organising*), 'fostering STI involvements and consensus' (*agenda setting & monitoring, evaluation and accountability*), and 'the prospective dimension' (*agenda setting*).⁴² They describe the need for greater emphasis on directly linking and integrating innovation policies and social policies, explicitly bringing attention to social needs and learning processes (thus calling for consideration of issues of *direction* and *distribution*), including protection and support for experimentation in niches, what they refer to as 'gardening policies' (Sutz and Arocena 2006: 39).⁴³ They also point out that these more direct links will both increase legitimacy of innovation policies but also promote accumulation of new knowledge and productive capabilities linked to social demands and what they term 'proactive equality', beyond assistance-type social policies towards empowerment through building capabilities to innovate and participate in setting priorities (highlighting areas of *organising, agenda setting* and *capacity building*), toward developing a 'distributed supply of diverse capacities' (Sutz and Arocena 2006: 24).

⁴¹ Some would argue that the research's pertinence and consequences are subjects of public interest as well.

⁴² For each of these five building blocks Sutz and Arocena suggest a number of relevant instruments and mechanisms (Sutz and Arocena 2006: 20) and in their recommendations to IDRC's Innovation, Policy and Science Program, they suggest four areas of focus, which are: demand-detection; supply-detection; providing linkages; and evaluation and follow-up (Sutz and Arocena 2006: 38). These also correspond to certain areas of recommendations of the New Manifesto.

⁴³ Sutz and Arocena (2006) provide an example of 'failed protection' from the biotechnology industry, where STI-related policies were short-sighted. In the 1980s a small Uruguayan firm developed a very efficient and successful vaccine for foot-and-mouth disease (a significant problem in cattle-raising zones across South America), which was affordable for small-scale and poor producers. Through vaccination, Uruguay was able to become free of the disease by the early 1990s, and exports were accepted by the European biosafety standards. However, when the government implemented a law banning the manipulation of the living virus of the disease, local production of the vaccine was stopped (Sutz and Arocena 2006: 26).

Direction is also discussed more broadly in the literature, in the context of what political economic path to pursue. Some describe two opposing potential directions: the neoliberal way of competitive world markets, or democratisation of the prioritisation of S&T and the State and the strengthening of its institutions as a vital player in that process (Vessuri 2003; Dagnino and Thomas 1999) - yet even the most left-leaning governments include market-based strategies in their national development plans. Perhaps it does not have to be a case of one path or the other. Many now agree that the reckless open markets phase is over, and the role of the State is again considered legitimate in orchestrating the strengthening of a dynamic National Innovation System. Perez says that the "State or Market" dichotomy is now obsolete and counterproductive' and calls for a 'dual integrated strategy' involving localized innovation and prioritisation of social needs (*diversity*), addressing inequality and poverty, while also pursuing the creation and injection of greater scientific and technological capacities into natural resource sectors towards the development of process industries (Perez 2008).⁴⁴

Dagnino and Thomas point out the need to build a strategic vision with a long-term perspective, based on the scenario of 'economic and political democratization', toward improved social integration. They suggest that within this process, the socially and politically marginalized sectors will have increased space to vocalise interests, and that their increased influence on public opinion and their political power in decision-making processes at the government level will generate stronger pressures towards income distribution by changing innovation demand profiles, will signal 'fields of relevance' (*direction*) and 'enlarge the now reduced span of opportunities for original research' (*diversity*) (1999: 44). Hence there are many terms that share the ideas of the Manifesto.

Each of these authors points out the need to experiment with methods and policies to enable STI to contribute toward social development and environmental sustainability goals matched to the heterogeneity of the region. Indeed, to different degrees of commitment and depth, this challenge is now being taken on board in most Latin American countries.

The purpose of this section is to discuss some of the developments but also the challenges that are apparent in this ongoing and flourishing process of 'experimentation', through a focus on each of the five critical 'Areas of Action' identified in the New Manifesto. In order to do so we draw some examples of existing initiatives in Latin America that fit each 'Area' together with comments from the Latin American Roundtable Reports and other literature as relevant to each 'Area for Action'.

⁴⁴ Perez (2008) proposes a 'Vision for Latin America' involving a 'resource-based strategy for technological dynamism and social inclusion' (see also Marín et al 2009). This proposal carries some suggestions that fit with those of the New Manifesto, but arguably holds a greater emphasis on competitiveness and markets. For example, Perez points out features of a present 'window of opportunity' including the phenomenon of 'hyper-segmentation' of value chains, global markets and technological capabilities that has resulted from the process of globalization, which she argues allows for 'adaptability to specialised demands', and subsequent development of specialized niches, from knowledge-intensive technological capabilities or units to artisanal methods, points which arguably link to the New Manifesto's call for attention to *diversity* (Perez 2008: 11). It would be interesting to explore more closely the synergies and differences between Perez's 'Vision' and the New Manifesto.

AGENDA-SETTING

As mentioned before, the New Manifesto calls for 'an explicitly political consideration of innovation direction, distribution and diversity' and suggests that institutional architectures must enable diverse interests, including those of marginalized people, to be taken into account in an inclusive debate on priority-setting. Whether existing institutions fulfil this role, or new fora are needed, may depend on the context. In particular, the New Manifesto suggests establishing 'Strategic Innovation Fora' at the national level 'to review funding allocations, debate major investment decisions, deliberate on controversial areas of S&T options and audit the distribution of risks and benefits' and that these fora should involve a wide range of stakeholders 'including citizen's groups and social movements' (STEPS Centre 2010: 19). A similar suggestion is made for a global deliberative body, 'widely networked [...] into civil society [...] [to] facilitate open, transparent political debate about major investments with global or trans-boundary implications, north-south technology transfers, and public and philanthropic international aid geared to science, technology and innovation' (STEPS Centre 2010: 20).

This 'Area for Action' arguably resonates with and responds to a need apparent in the Latin American context, as evidenced by previous research and the New Manifesto roundtables in the region. Some researchers argue that the locus of S&T decision-making in Latin America has historically been with political and scientific elites often out of touch with the realities of social demands, causing their particular interests to drive priorities for science and technology (Casas Guerrero 2004). Furthermore, scientists respond to a global and universal definition of science (Kreimer 1994), which inherently tends to limit the possibility of being open to local needs and to exclude other forms of knowledge in innovation processes.⁴⁵ Additionally, Dagnino and Thomas argue emphatically that the scientific community in Latin America has been highly insular and resistant to change, sometimes as a result of pressures from authoritarian political regimes. 'The Latin America S&T decision-making process takes place at the intersection of the interest fields of the scientific community and civil and military bureaucracy within an elitist environment marked by a brutal social exclusion' (Dagnino and Thomas 1999: 44). The Colombian Roundtable argued that, in Colombia, agenda setting usually occurs in 'closed fora managed by elite groups from the capital city' of Bogotá, and that regional research groups 'do not have direct relationships with the formulation of agendas in the region' (Colombian Roundtable Report 2010: 5). The Colombian Roundtable thus called for 'building trust' and 'wider participation' in the construction of agendas (Colombian Roundtable Report 2010: 5). This situation has led some to argue for democratisation (mentioned above) as an essential factor for better linking innovation to meet broader social needs and demands (Dagnino and Thomas 1999; Vessuri 2003; Casas Guerrero 2004; Sutz and Arocena 2006).

Recently, there have been some interesting experiments in broader participation or consultation in S&T agenda-setting, and in several countries efforts or proposals do exist that might match some of the aims of the Manifesto's proposed 'Strategic Innovation Fora', as

⁴⁵ Sagasti points out that indigenous or traditional knowledge 'is rarely codified and systematized – or codified in highly idiosyncratic manners – which makes it difficult to transmit, at least according to modern scientific and technological standards' (Sagasti 2004: 54).

described in this section and above (for example, Venezuela's National Science and Technology Plan, Mexico's Produce Foundations or Colombia's Social Appropriation Strategy - detailed below). Many countries have national or regional S&T Councils, including a spread of membership that goes beyond the scientific community and executive powers, sometimes including unions and rural associations, associations of small and medium-sized enterprises (see for example, Peru and Paraguay in Table 1), but still perhaps often lacking broad civil society representation, and primarily oriented towards the prioritization of public resources and public policy, as opposed to the further oversight of the private and philanthropic sectors as suggested in the Manifesto.

The Colombian Roundtable acknowledged positive steps represented by the new Colombian STI Law as a move away from centralised decision making toward more distributed agenda setting, which they suggested, on paper at least, 'empowers regions and obliges the national system to reinforce regional efforts by means of financial instruments and political mechanisms' (Colombian Roundtable Report 2010: 7). The Argentina Roundtable also recommended 'the discussion and construction of long-term national agendas on science, technology and innovation, articulated with regional agendas' (Argentina Roundtable Report 2010: 4). This also raises the important point to carefully articulate, coordinate and integrate agendas at local, regional, and national levels, as suggested in proposals for regional and national platforms for discussion as set forth in the new Colombian Strategy for Social Appropriation of Science, Technology and Innovation (see Box 3).⁴⁶ Thus agenda-setting in science and technology arguably must also be carefully integrated with the broader social development and industrial agendas – a role towards which a national or regional 'innovation fora' might contribute.

An example of broader consultation in agenda-setting is Venezuela's most recent National Plan for Science and Technology, which calls 'for a sustainable, endogenous and humane future' (Ministerio de Ciencia y Tecnología 2005: 4). A year-long national consultation process across the country resulted in the following five priority areas for the national research agenda: housing and habitat, urban development, climate change, energy efficiency and health. Another example is the Produce Foundations in Mexico. In addition to serving as a permanent sub-national space for agenda-setting, the Produce Foundations also contribute towards building the capacity of civil society to participate in agenda-setting exercises. Their success is also attributed to the unique organisational arrangements linking research institutes, financing organizations and agricultural extension. Along similar lines, Colombia's recent National Strategy for the Social Appropriation of Science, Technology and Innovation includes some proposals for programs that more closely align with the Manifesto's proposal for 'strategic innovation fora', but it remains to be seen how these

⁴⁶ The concept of 'territorial development' has been used to organise some Brazilian policy, and suggests that boundaries of municipalities, counties or states may not be the most appropriate for development policies, but rather suggests organising policy according to social, cultural and environmental factors that define a region or sub-region, to then coordinate with other levels of organization. An ECLAC report (ECLAC 2010c: 140) argues for the role of territorial planning in innovation for growth and social change, as the localized focus and symbolic meaning of territorial identity fosters interaction and learning between businesses in diversified productive clusters, or regional innovation systems, as highlighted in Brazilian policy. See also da Silva (2009) and OECD (2009).

proposals are implemented and sustained and how much influence these deliberative fora actually demonstrate on public policy (See Box 1 for details of these three agenda setting mechanisms).

Box 1. Venezuelan, Mexican and Colombian agenda-setting mechanisms

Venezuela's National Plan for Science, Technology and Innovation

Venezuela's National Plan for Science and Technology is described as being 'conceived as a process of effective citizen participation in the formulation of public policy, generating spaces for political learning and permanent exchange', involving nearly 4000 actors from across the country 'in the collective construction of a shared vision for science and technology in Venezuela' (Ministerio de Ciencia y Tecnología 2005: 4)⁴⁷. The different phases of the consultative process involved - in addition to leadership by the Minister of S&T - the Foresight and Planning department, as well as the regional offices of the S&T ministry, which enabled participation by regional actors (Ministerio de Ciencia y Tecnología 2005). This follows previous programmes, which aim to 'model a new scientific and technological culture based on a collective organisation of science, the dialogue of knowledges, integration, interdisciplinarity, and participation by diverse actors in the S&T development of the country, to achieve greater levels of sovereignty' (Cubero 2010, translated by author)⁴⁸.

The Venezuela Roundtable Report acknowledges the State's efforts to open the debate on the STI agenda to society in the last decade, pointing out that 'S&T stopped being a theme and responsibility exclusive to the traditional centres for the generation of knowledge (universities, research centres)', enabling some 'public debate', and 'leading to open up reflection and debate among researchers and technologists about their own scientific practice and innovation, their relation with society, culture and training processes' (Venezuela Roundtable Report 2010: 11). The Report points out that this generated some changes in the STI agenda at multiple levels but to different degrees,⁴⁹ yet has led to recognition of a more diverse set of actors, institutions,

⁴⁷ The Venezuelan Science, Technology and Innovation Plan for 2006-2030 describes the 25-year 'shared vision': *Venezuela can count on a transdisciplinary and inclusive scientific culture, in which the population is social, creative, acts in solidarity, and is culturally integrated, where well-being is shared by all its citizens, nature is respected, popular knowledges are preserved, along with the diversity of our culture, the ancestral knowledge of our indigenous peoples and Afro-descendants, within the framework of values of cooperation, inclusion and national sovereignty.* (Ministerio de Ciencia y Tecnología 2005: 13).

⁴⁸ This new 'institutional platform' includes the creation of the Ministry of S&T, today the Ministry of Popular Power for Science, Technology and Intermediate Industries, the creation of the Bolivarian University of Venezuela, the Science Mission (2006), the Organic STI Law (2001), the Program of Technological Literacy in ICTs, and the National STI Plan 2006-2030.

⁴⁹ The roundtable also argued that, although the State's policies have been strongly oriented towards achieving greater popular participation in the definition of the STI agenda, there are still insufficient channels of communication and dialogue between the scientific community, the State and civil society. In particular, the scientific community feels insufficiently included, generating a sense of conflict that serves as a barrier to effectiveness of State policies. The report recognizes that these processes take time, and that there are still important weaknesses in the developed initiatives towards supporting articulation between actors that conform to the National STI System (Venezuela Roundtable Report 2010: 10).

knowledges, and the need to create spaces for articulation. However, change is also limited by embedded structures and largely vertical institutional arrangements, a point that will be discussed again later in this paper. Despite some apparent synergies with the Manifesto's call for broader participation in agenda-setting, the consultative development of the Venezuelan S&T Plan is not a permanent space for inclusive deliberation as the Manifesto suggests by the proposal of a national innovation fora. Nevertheless, the Venezuelan Plan can certainly be seen as a broadly positive step.

Fundación Productores (Produce Foundations) – Mexico

The Mexican Produce Foundations (PFs) are civil society organizations managed by farmers, created in Mexico in 1982 (one in each of the 32 states) to manage public funds for agricultural research and extension, that have evolved to influence the design and implementation of agricultural and STI policies, contribute to changes in public research institutions and the setting of research priorities, and have been the source of new communication links between commercial farmers' associations and federal and state authorities, as well as researchers. The PFs were created without significant involvement from foreign or multilateral institutions, to improve the interaction between the Institute for Forestry, Agricultural and Livestock Research (INIFAP) and farmers. Eventually farmers gained control of the boards of the PFs, and a national coordinating office was set up (National Coordinator for the Produce Foundations – COFUPRO). The Produce Foundations were set up in the midst of the country's experience of economic and political liberalisation, when public research institutes were not well equipped to help farmers cope with the new challenges and opportunities presented by the changing economic situation and access to technologies. Ekboir et al (2009) point out the importance of the Produce Foundations' experience in developing 'learning abilities, including identifying knowledge gaps and defining strategies to fill them', leading the PFs to have 'major and diverse impacts on the agricultural innovation and research systems' (Ekboir et al 2009: xiii). This success is attributed primarily to the activities the farmers themselves introduced as they learned to manage funds for research and extension. Ekboir et al contrast this experience with the limited impacts resulting from the typical agricultural policies of many developing countries that separate the financing and implementation of research, and have reduced their public extension programs (Ekboir et al 2009: xiii). This example highlights the kind of institutional mechanisms suggested by the Manifesto for more deliberative priority-setting in a sectoral and sub-regional (feeding into a national level) space. However, the example also raises the question as to how or to what degree the Producer Foundations enable a balance of power between larger commercial and small-scale farmers.

Colombia's National Strategy for the Social Appropriation of Science, Technology and Innovation

The Colombian Strategy for Social Appropriation of STI 2011-2014 falls under the National STI Policy (2009) and aims to better integrate STI into Colombian society. With a budget of US\$4.1 million funded by the World Bank and the Inter-American Development Bank, the Strategy includes four priority areas: citizen participation in public policies for STI; communication of science, technology and society; knowledge exchange and transfer; and knowledge management for social appropriation of STI (Fog 2010). It defines social appropriation of knowledge as 'a process of comprehension and intervention in the relationship between techno-science and society, constructed on a base of active participation by the diverse social groups that generate knowledge' (Colciencias 2010: 22). The Strategy aims to broaden attention 'beyond synergies between academic, productive and State sectors, to include communities and interest groups from civil society' (Colciencias 2010: 22) and suggests a move toward more democratic models of citizen participation in setting public policy in STI (Colciencias 2010: 16). The Strategy acknowledges a need for 'a fundamental shift in the view of the role of citizens, from passive receivers or final users of S&T production to active, reflexive, critical and capable participants' (Colciencias 2010: 27). The Strategy

recognizes citizen participation in STI as a way of promoting, evaluating and exerting social control of S&T development, and privileges deliberative processes over consultative forms of participation, seeing the creation of spaces for participation as medium and long-term social processes (Colciencias 2010: 27). It calls for 'promoting projects with an effective dialogue and exchange of knowledge, those that demonstrate a complex vision of S&T, and where techno-scientific problems are presented in the context of their political and social dimensions, and taking into account the diverse groups that have interest in their construction' (Colciencias 2010: 18).

One of the proposed programs within this Strategy sounds much like the Manifesto's 'strategic innovation fora' and is an annual national forum involving 32 departmental (sub-national) meetings, a district-level meeting and 2 national panels to discuss public policies in three defined strategic areas (water and biodiversity, health and energy). These meetings will bring together members of the government, productive sector, academic sector, and civil society with the aim of facilitating processes of dialogue between different social groups (including minorities and other vulnerable populations), stimulating these actors to influence the public STI agenda – from design to implementation and evaluation (Colciencias 2010: 38-39). The Strategy also proposes a program called 'Ideas for Change', which aims to identify citizen interest groups in the three defined strategic areas for STI development, to document perceptions, key problems and existing solutions, and to consolidate social networks of citizen participation around these areas. The Departmental S&T Councils (Codecyt) are important institutional actors in the above activities (Colciencias 2010). Some have raised concerns regarding the continuity of these strategies beyond the initial period so that efforts and alliances are not lost, as well as reservations regarding the strategy's articulation with cultural and education policies (Fog 2010).

FUNDING

In Latin America, as in other regions, two antagonising factors arguably limit the development of science, technology and innovation, and their contribution to social needs. One of these factors is funding. Although there has been some increase in spending on science, technology and training (in some countries much more than others), this investment is still insufficient in most circumstances to achieve a 'critical mass' of human capital, infrastructure and resources toward R&D or training (Albornoz et al 2010; Lemarchand 2010; Sagasti 2011). This general dearth of invested resources continues and has implications for research and technology output (e.g. numbers of researchers, publications, and patents), as already described in Section 2.1.⁵⁰

The other factor frustrating STI in the region is a marked concentration of these same limited human and capital resources in certain locations, relevant when examined at multiple levels. Investment resources are also largely concentrated in (and are often provided by) the public

⁵⁰ See also Massarani and Lewis (2009) and SciDev.net's recent Latin American focus article 'Latin American research small but growing, survey finds' <http://www.scidev.net/en/news/latin-america-s-research-small-but-growing-survey-finds.html>.

sector, while private expenditure on R&D remains very low.⁵¹ Most research funds are directed to universities, and most major scientific research institutions are based in major capital cities (Albornoz et al 2010), so many countries' R&D research capacity is concentrated in just a few urban centres. Pointing to the concentration of resources, participants at the Colombian Roundtable suggested that 'the countryside has been "discriminated against" in favour of the cities' and that 'there has been a degradation' in 'entities that had provided leadership in research and innovation' in rural areas (Colombian Roundtable Report 2010: 3). As one remedy for the concentration of S&T resources in just a few states and major cities, in Brazil sector-specific funds now include a requirement that at least 30% of each fund's value should be directed to more marginal regions of the country (North, Northeast and Central West) (de Brito Cruz and Chaimovich 2010)⁵². This particular aspect of the legislation is conceived by the Brazilian government as an 'instrument of national integration policy' that helps 'prevent the concentration of activities in science and technology and distribute its benefits' (Government of Brazil website).

In Latin America generally, resource allocation has often been fragmentary; progress can be seen in cases where policies (and resources) have been placed in a direction consistently over a long period of time beyond an electoral period (e.g. in the training of PhDs in Brazil) (Lemarchand 2010: 47).⁵³ Even if funding itself has increased, all the above points still neglect the vital link between science and technology investment and social or environmental goals.

The traditional strategy of focusing largely on maximizing the R&D budget also only addresses a narrow aspect of the S&T system.⁵⁴ Other issues, like the importance of linkages and networks, strengthening of S&T infrastructure, long-term vision and prioritization processes cannot be separated from the allocation of resources in order to enable greater effectiveness of R&D efforts. Furthermore, in some countries, the added complication of the migration of the S&T base, or 'brain drain', has remained a problem since it was discussed in the original Sussex Manifesto (Singer et al 1970). Specific funding for returnees has been

⁵¹ Beintema and Pardey (2001) estimate that only 4.4% of all Latin American agricultural R&D in 1996 was private sector research, more than half of which was conducted in Brazil (Stads and Beintema 2010: 9).

⁵² In the late 1990s Brazil pioneered the Latin American region's return to sector-specific funds after a focus on sectoral support had lost popularity during several decades. Such funds are directed toward a range of purposes, including fostering technological capabilities of small and medium-sized enterprises, the development of Centres of Excellence (e.g. in Chile) and especially public-private partnerships and networks to better link research and productive sectors. In Brazil, sectoral funds were introduced as part of Brazil's privatisation strategy (recognising that state-owned companies had cultivated S&T capabilities, especially in R&D), with the aim to buffer the state companies' transition to privatisation by protecting and encouraging their R&D activities (de Brito Cruz and Chaimovich 2010).

⁵³ Brazil produces around 70% of Latin American and Caribbean PhDs, while Mexico produces 20%, leaving the rest of the region to make up the 10% (Lemarchand 2010: 47).

⁵⁴ See Arond and Bell (2010) for a discussion of some limitations of focusing on R&D indicators.

used as an instrument in many countries to attract the diaspora (and the skills they have developed elsewhere) back to their home country.⁵⁵

In the area of Funding, the New Manifesto calls for funding of science, technology and innovation to 'be geared much more strongly to the challenges of poverty alleviation, social justice and environmental sustainability, [...] increasing support for the social, cultural and economic dimensions of innovation systems.' The recommendations include funding allocated specifically toward supporting 'experimentation in niches, networking and learning', including in the private sector, among community groups and by individual entrepreneurs. Establishing incentives for the private sector to invest in innovation oriented to social and environmental goals ('such as advance purchase agreements, technology prizes or tax breaks'), and involving end users of S&T (including marginalized) in the allocation of funding are also key recommendations (STEPS Centre 2010: 20).

In Latin America, the emphasis between new high-tech 'strategic priorities' on the one hand and support for traditional sectors and the satisfaction of social needs on the other varies from country to country (Albornoz et al 2010). Many countries are keen to establish science and technology policy oriented to developing 'cutting-edge' science, and though many also propose goals of social development and inclusion within their S&T policy aims, one challenge is how to link and balance these aims, and how to fund and support distributed mechanisms for building local innovative capacities in traditional sectors.⁵⁶

As mentioned before, recent attention to S&T in Latin America has been accompanied by a wide range of public policy instruments, many of which are funding-related. Some of these policy instruments are intended to promote private R&D and innovation, either through direct public funding, through tax mechanisms, grants, competitive funds, awards and prizes, seed funds, or through technology business incubators, among others (Albornoz 2010: 83). Other types of supports include such practices as waiving import taxes for scientific equipment and materials (in Brazil this is oriented mostly to academia), fellowships, government procurement or 'advance market commitments', or the leveraging of venture capital funds to support entrepreneurship (de Brito Cruz and Chaimovich 2010: 109). Though the connection between these funding mechanisms and social equity goals is not always direct or explicit, there are examples of leveraging each type to support innovation to meet social goals (see Table 2).

⁵⁵ Some examples can be found in Brazil, which has focused strongly on training and retaining a critical mass of S&T researchers in priority areas for strategic national development (Albornoz et al 2010: 84; de Brito Cruz and Chaimovich: 119), or in Argentina's *Programa Raíces* (Roots Programme) (Emiliozzi et al 2010: 40, 87-88). One historical problem has been the scientific orientation toward the research centres of the United States and Europe, drawing educated scientists from the South to seek education and employment in these countries, which are often considered more prestigious than education or jobs in their own home countries.

⁵⁶ Agriculture is an example of a neglected traditional sector in some countries. The 2009 Bolivian Innovation Plan described the need to increase agricultural productivity and quality and to address the obsolescence of technology in the productive sector. The Plan laments 'insufficient agro-fisheries research, without significant growth in rents from principal crops in more than 20 years' (Government of Bolivia 2009: 9).

In Venezuela, for example, since 2003, proposals for research projects to be funded by FONACIT, Venezuela's National Science, Technology and Research Fund, must make evident the project's 'component of social impact, multi-disciplinary focus and transfer of results to communities', responding to the focus on social inclusion of the 1999 Constitution (Venezuela Roundtable Report 2010). Furthermore, amendments made to this law in 2010 make it mandatory for public and private enterprises to pay FONACIT between 0,5% and 2% of their annual profit (depending on the nature of the activity) in order to contribute to the national science and technology development plan. Likewise, in order to diminish *the asymmetrical nature of international science cooperation* (2010: 96), Venezuelan and Cuban governments launched a South-South cooperation program to finance and promote scientific research between institutions of both countries searching for common needs, and address social problems. This program has a broad scope of research including health, communications, education, food production, environment, among other themes.

Colombia's new 'Strategy for the Social Appropriation of Science, Technology and Innovation' calls for a program on Communication of STI for Social Change, offering project-based financing intended to promote the development of participatory projects on STI communication through calls for tenders. The aim is to generate regional capacities for developing this type of social processes. Each department of the country, by means of the Departmental S&T Council, supports local groups to apply for these program funds (Colciencias 2010: 41). The Uruguayan *National Programme for the Attention of Social Emergency (PANES)* provides project-based financing for S&T to meet specific social needs in areas such as nutrition and health.⁵⁷

The government can also leverage its purchasing power to foster innovation through direct technology procurement or 'Advance Market Commitments' (this is done in defence and health in many countries), as suggested in the STEPS New Manifesto (see Table 2). For example, a 1993 Brazilian law allowing the omission of bidding for government contracts in the case of public procurement for public use, motivated public research institutions to research and produce serums and vaccines against many illnesses, including tetanus, diphtheria, pertussis and Hepatitis B, with the Ministry of Health as the guaranteed buyer. Parallel research in related basic sciences has also contributed to new capabilities for technological development (de Brito Cruz and Chaimovich 2010: 111).⁵⁸

⁵⁷ For example, to address malnutrition among children, the Programme has supported the development by a team of biochemists of a simple, cheap, and nutritious biscuit that can be provided to children in school (Sutz and Arocena 2006: 34). Another project funded by the programme aimed to address frequency of parasitic worm exposure from poor sanitary conditions leading to illness among poor children. Medical doctors and soil specialists worked together to identify the environmental conditions leading to the proliferation of worms, and to develop an early alert system for parents and teachers to monitor and identify when risks of infection were high. (Sutz and Arocena 2006: 34)

⁵⁸ Vaccine development has also been a government priority in Cuba leading to the development, among other achievements, of the first synthetic vaccine for *Haemophilus influenzae* type b (Hib), an affordable option to address an illness exhibiting high mortality among young children (Clark Arxer 2010).

In a slightly different arrangement from direct government procurement, one Uruguayan public health policy enabled some stimulating protective conditions for developing low cost medical devices nationally by guaranteeing an electronic pacemaker to anyone who needed it (without subscribing to a particular brand or maker), regardless of their ability to pay, and by developing a public fund to achieve this (Sutz and Arocena 2006: 32). In Argentina, a recent law declared 'the research and public production of medications, raw materials for the production of medications, vaccines and medical products' as an issue of 'national interest', with the aim of improving the Argentinian population's access to medicines and to foster national scientific and technological capabilities for public production. The law also calls for mechanisms that enable the State and municipal bodies to establish preferential purchasing of medications, vaccines and medical products from these public production laboratories (Argentina Public Health Law 26.688).

Additionally, there are examples of non-governmental funding initiatives such as the Inter-American Development Bank's 'Knowledge Economy Fund' which also provides project-based financing for innovation in areas of social interest such as education, or improving interaction between sectors (university-business interactions, public policy and institutional strengthening) (see Table 2). There are also some excellent examples of private-sector initiatives directing funds to support innovations in creative niches, addressing specific social needs and developed through networking and in collaboration with local communities, as the Manifesto recommends. For example, the *Banco do Brasil Foundation Social Technology Prize* is aimed at 'identifying, certifying, supporting and disseminating' non-commercial 'social' technologies, 'products, techniques or methodologies developed in interaction with a community, and which represent effective solutions for social transformation', in areas of water, food security, education, energy, housing, environment, income-generation and health. The Ashoka Foundation Fellowship for social entrepreneurship helps support networking and learning among various groups and entrepreneurs to achieve social goals. These awards help to broaden the concept of innovation beyond a focus on R&D.⁵⁹

Venture capital is one way to help creative entrepreneurs to develop, innovate and grow, and may also be focused more directly to social needs. Though venture capital itself is conventionally funded by private investment, some countries are creating public policy to support, attract and develop venture capital and seed funds to foster an entrepreneurial or innovative culture; however, not all these funds include commitments to specific social or environmental goals beyond general wealth-creation (see Table 2). Endeavor, a non-profit organization and international model for supporting 'high-impact' entrepreneurs in emerging economies, including Latin America, suggests a focus on 'social responsibility' and many of the firms led by Endeavor's selected entrepreneurs demonstrate direct interest in social impact or environmental sustainability.⁶⁰ Endeavor supports its entrepreneurs through

⁵⁹ Since Ashoka first launched in Brazil in 1986, it has selected over 500 fellows from South America, and has offices in Mexico City, Lima, Buenos Aires, and Sao Paulo. Ashoka's South America program focuses on 'developing relationships between the social and business sectors', addressing inequality, democratic participation, and environmental degradation (Ashoka website).

⁶⁰ For example, in Brazil, Bento Massahiko Koike started a small wind blade company outside of Sao Paulo in 1995, and with the support of Endeavor's network, his company, Tecsis, <http://www.tecsis.com.br/> has become the world's second largest producer of blades for wind turbines (Endeavor website).

networks, training, linking with capital investment opportunities, and mentoring advice. The Endeavor model also requires entrepreneurs to 'multiply' their impact by functioning as national role models, stimulating local venture capital and influencing education and policy reform, thus addressing the New Manifesto's recommendation on networking and learning to support innovation and influence policy.⁶¹

It is also worth mentioning collective financing mechanisms that are not conceived specifically to fund innovation, but which are themselves innovative in their approach to funding social programmes and can open up opportunities for innovation.⁶² For example, some interesting experiments are underway at formalising international remittance flows to enable credit opportunities, or as a source of investment funds for innovation and development of markets.⁶³ An interesting example comes from Mexico, where links with a diasporic community in the USA have served as a source of investment funds and as business partners for a group of Mexican women to develop new processing methods and international niche export markets for a local traditional crop, the nopal (an edible cactus). In this case, the women also received support from the local city government and other governmental organizations to develop their own association of nopal processors, adapting traditional processing methods to achieve export quality and export quantities, and eventually forming a partnership company, *Productos Nostálgicos Alimenticios Oaxaqueños*, S.A. de C.V., while the group of Mexican migrants in the USA developed their own separate USA-based company called Chapulín, Inc (ECLAC 2010d).⁶⁴ This example clearly shows the

⁶¹ Globally, Endeavor entrepreneurs have contributed towards raising capital, creating jobs, investing in R&D and advising, mentoring and investing in other companies. In contrast with the general trend among private firms in emerging economies, 76% of Endeavor Entrepreneurs (internationally) invested in R&D in 2009. Endeavor sees its role as 'transforming emerging countries by establishing high-impact entrepreneurship as the leading force for sustainable economic development' (Endeavor website). Endeavor also has affiliate outreach programs that target young start-up companies in South Africa (Excellerator) and Latin America (Promesas).

⁶² Urban Poor Funds are an innovative collective financing mechanism now being implemented in at least ten countries, that work with federations of savings groups formed by homeless people, slum or shack dwellers, to support members to gain shelter (or better quality shelter) along with access to basic services. These Funds are not directly oriented to financing innovation but aim to meet basic infrastructure needs for severely vulnerable populations, where there is an ideal space for socio-technical innovation (Mitlin 2008).

⁶³ According to the recent OECD-DAC Latin American Outlook (2010) more than 20 million Latin American and Caribbean people live outside their country of origin. Most are in the United States, while others have migrated to Spain and Canada, or within the region, for example to Mexico, Argentina or Venezuela (OECD-DAC 2010). Remittances represent more than 10% of GDP in some countries, especially in Central America and the Caribbean (OECD-DAC 2010). Families rely on remittances for basic needs, often enabling families to spend more on healthcare or keep their children in school longer. This translates into investment in human capital; however as highlighted here, there are also opportunities for remittances to be leveraged to support wider development objectives at regional or national levels.

⁶⁴ The project raised women's incomes by 50%, and the women say the project has reduced the incentive to migrate. See the ECLAC report (2010d: 71) for a more detailed description of the project 'Binational investments of remittances for the establishment of a processing plant for "nostalgic" foods from Oaxaca'.

type of funding the Manifesto recommends – toward building the capacities of disadvantaged women and supporting innovative arrangements that enable financing, marketing and innovation that address social needs.

In Table 2, we highlight some examples of different funding instruments and '3D' (the Manifesto's 'direction', 'distribution' and 'diversity') aspects of each.

Table 2. Examples of Financial Instruments for supporting Science, Technology and Innovation

Instrument	Example	3D aspect
Tax incentives	Jamaica's Tax Incentive Scheme offers tax exemption to stimulate private investment in STI, focusing on experimental projects that use new scientific methods in the study of materials or processes	Diversity: specific attention to experimental projects in early stages
Taxes	Venezuela's LOCTI (Organic Law for Science and Technology) Law, makes it mandatory for the public and private enterprises to pay FONACIT between 0,5% and 2% of their annual profit (depending on the nature of the activity) in order to contribute with a national science and technology development plan	Direction, Distribution, and Diversity: funds raised through the LOCTI law are to be directed at scientific and technological innovation through FONACIT to 'strategic areas' (see below on sector specific funds), with special attention given to projects that have a clear social impact, multi-disciplinary focus and transfer of results to communities
Subsidies	<p>Argentina's Scientific and Technological Research Fund (FONCYT) includes a Programme in Strategic Areas that offers subsidies for public or private non-profit R&D institutions conducting research in health, agriculture, energy, food security and cultural industries</p> <p>Venezuela's 2011 PEI Programme (Programme for the Stimulation of Research), under the National Observatory of Science, Technology and Innovation (Oncti) offers a monthly subsidy for those individual researchers who carry out research in priority areas and contribute to the achievement of the country's national sovereignty and social well-being</p>	<p>Direction: A focus on 'Strategic Areas' suggests broad attention to direction, but without clear consideration of direction within the target sector, nor explicit consideration of distribution or diversity</p> <p>Direction and Distribution: Individual researches are provided with a monthly subsidy if their research areas fall within 'strategy areas' and have a clear social impact</p>
Competitive Funds or Prizes	Banco do Brazil Foundation Social Technologies Prize, created in 2001, supported by Petrobras, UNESCO and KPGM	<p>Diversity: These prizes provide support for diverse innovations to get started that might otherwise not get off the ground ('experimentation in niches')</p> <p>Distribution: A focus on social impact and user participation</p>

	<p>Venezuela: the Europa Prize, a European Union-funded project for innovation in sustainable development</p> <p>L'Oreal-UNESCO 'For Women in Science' Award is an academic-focused fellowship to encourage the participation and recognition of women in science⁶⁵</p>	<p>Direction: the prize seeks to stimulate innovative research in sustainable development⁶⁶ by giving public recognition and a nominal monetary subsidy for the best research in this area each year</p> <p>Distribution and Diversity: The grants aim to encourage scientific cooperation and inter-cultural networks</p>
Sector-specific funds	<p>Brazil's R&D Infrastructure Fund</p> <p>Venezuela- LOCTI's 2011 Strategic Projects</p>	<p>Direction: Though the funds appear to have a direction component (toward a specific sector), this does not signify which in a portfolio of options might be supported.</p> <p>Distribution: Brazil's sector-specific funds require that 30% be directed to more marginal areas away from the big cities that attract most investment.</p> <p>Direction, Distribution and Diversity: this programme has a specific focus on stimulating research for sustainable development and national sovereignty in the following areas: housing and habitat, urban development, climate change, energy efficiency and health.⁶⁷ Special attention is given to projects that have a</p>

⁶⁵ The annual L'Oreal-UNESCO Award is given for major achievements in science, and for 2008, 2009, and 2010 it has been awarded to Latin American scientists (Alejandra Bravo, Mexico; Beatriz Barbuy, Brazil; and Ana Belen Elgoyhen, Argentina). The Programme also annually awards 15 young women scientists 40,000 USD grants to carry out doctoral or post-doctoral studies over two years (3 from each geo-cultural region of Africa, Arab States, Asia and the Pacific, Europe and North America, and Latin America and the Caribbean) (Lemarchand 2010: 61).

⁶⁶ In 2011 the Prize was won by the *Risk Project* (Risk Factors in the reduction of habitats in Canaima National Park, Venezuela: vulnerability and tools for sustainable development) a multidisciplinary and inter-institutional initiative carried out between the Simon Bolivar University, the Venezuela Institute for Scientific Research (IVIC), Universidad Experimental de Guayana and Pemón indigenous communities (Bilbao and Vessuri 2006) (see Box 3 for more details of the project).

⁶⁷ As a result of the first public bidding process, FONACIT approved a total of 92 strategic research projects: 42 of them were in Climate Change, 27 in Urban Development, 12 in Energy Efficiency, and 11 in Housing and Habitat.

	<p>Argentina- FONARSEC, the Argentinean Sectoral Fund), led by the National Agency for Promotion of S&T (ANPCyT), includes special schemes directed to software (FONSOFT, Fondo Fiduciario para la Promoción de la Industria del Software) and to Health, Energy, Agribusiness, Social Development, ICTs, Nanotechnology, Biotechnology, and Climate Change (ANPCyT website)</p>	<p>clear social impact, multi-disciplinary focus and transfer of results to communities</p> <p>Direction: toward a specific sector (note: 'social development' is one of the funds; as is 'climate change')</p>
Grants and Project financing	<p>Uruguay's National Programme for the Attention of Social Emergency (PANES) supported R&D projects to address malnutrition and infectious disease</p> <p>Venezuela's 2011 OCTI-PEI Priority Areas Programme</p>	<p>Distribution: These projects are explicitly aimed to address concerns affecting marginalized groups</p> <p>Direction and Distribution: Researchers registered under the PEI Programme may opt for funds to carry out research in critical areas for sustainable development and national sovereignty: health, food security and sovereignty, economy, telecommunications, energy, environment, housing, habitat and urban development</p>
Government procurement	<p>Brazilian and Cuban commitments for government procurement have helped research institutes to develop key vaccines for Hepatitis B and <i>Haemophilus influenzae</i> type b (Hib), among others</p> <p>Argentina: INVAP is a public firm entrusted by the government for the design and construction of radars and satellites. INVAP became a leader in the region, as it is currently the only Latin American firm with the capacity to implement full satellite projects and to develop secondary radars for air traffic control</p>	<p>Distribution: These investments focus on neglected diseases that are especially prevalent among vulnerable populations</p> <p>Direction: towards high value-added high-tech activities in strategic industries</p>
Technological incubators	<p>Brazil - Technological Incubators of Popular Cooperatives (ITCP) bring together multidisciplinary groups from Brazilian universities and community groups interested in generating employment opportunities through the development of cooperatives or collectively-managed firms</p> <p>Argentina: various experiences with incubators and scientific parks supported by ANPCyT. Many are promoted by universities or city councils. A key sector for incubators is in biotechnology</p>	<p>Diversity: These provide support for diverse innovations to get started that might otherwise not get off the ground ('experimentation in niches')</p> <p>Distribution: A strong focus on social impact and user participation</p> <p>Direction: sector-focus</p> <p>Diversity: Aim to support the development of new firms</p>

Venture capital	<p>Endeavor - an international non-profit organization that supports connecting entrepreneurs in emerging economies, including Latin America, with local and regional venture capital investment, networking, training and mentorship opportunities</p> <p>Innovar, a programme involving Brazilian government agencies and funding from IMF, IDB and others, to establish venture capital and seed funds as an instrument to support innovation in technology-based firms, firm incubation, networking opportunities and relevant training (Emiliozzi et al 2010: 100)</p>	<p>Diversity: helps support emerging firms that need financial or other types of support to grow, though these firms have often already demonstrated some level of success</p> <p>Clear commitment to wealth creation, not specific social or environmental goals</p>
Seed funds	<p>Brazil's National Bank for Economic and Social Development (BNDES) established the seed fund CRIATEC to support innovation in start-up technology-based firms</p> <p>Argentina-the Sub-Secretary for Small and Medium Enterprises manages seed capital schemes (loans without collateral and with no interest rate) directed to young people (18 to 35) with innovative ideas to create new firms. Around 2400 young firms will be created in 2012 under this scheme (SePyME website)</p>	<p>Diversity: supports start-up firms (experimentation in niches)</p> <p>Distribution and Direction: The BNDES generally has a social function to contribute to national development, but besides contributing to economic growth and technological capacities, it is unclear if this fund carries a specific social or environmental commitment</p> <p>Diversity: supports start-up initiatives (experimentation in niches)</p> <p>Distribution: particular focus on young people who often do not have access to capital</p>
Fellowships and Awards	<p>Ashoka Fellowships - awards fellowships to social entrepreneurs</p>	<p>Direction and Distribution: Social entrepreneurship aims to meet social needs Diversity: the fellowships support 'creative experimentation'</p>
Remittances	<p><i>Nostalgic Foods</i> in Mexico channels remittance income to support innovation in local agricultural production and marketing, utilizing diaspora communities in the US as a source of investment funds and to develop international niche export markets</p>	<p>Diversity & Distribution: Remittances used to support local innovation that might not have occurred without the financial and other types of support</p> <p>Distribution: A focus on social impact and user participation from the start, led by users</p>

CAPACITY BUILDING

With regard to capacity building, the New Manifesto calls for moving 'beyond a focus on elite science and so-called "centres of excellence" to support science that works more directly for diverse social and environmental needs' – 'more inclusive, networked and distributed forms of innovation'. Thus capacity building must include local entrepreneurs, citizen groups, small

businesses and others, with attention to linking between groups (e.g. supporting civil society networks, sharing practices and learning) and enhancing the ability of users to be active participants ('users, creators and inventors') in innovation processes. Some examples have already been mentioned in 'Funding' that bring together these aims, such as the *Social Technology Prize* and *Nostalgic Foods* (Table 2). Networks of entrepreneurs that include a focus on mentoring, such as *Endeavor*, also already mentioned, also meet some of the aims of the Manifesto's suggestions for capacity building. The Manifesto also calls for 'bridging professionals' who can link between technical and social, ecological and environmental contexts. Finally, this capacity building arguably should help enable citizens' groups to participate in broader political debates and priority-setting, as in the example of the Communicating for Social Change Programme of Colombia's Strategy for Social Appropriation, mentioned in the section on agenda setting. The New Manifesto also calls for new or reformed institutions to 'actively link science and technology to located needs and demands' through 'new learning platforms', community engagement in higher education and wiki spaces (STEPS Centre 2010: 21-22).⁶⁸

There are a number of excellent Latin American examples of the sort of capacity building to which the New Manifesto refers (detailed in Box 2), with particular focus on users as active participants in innovation processes, such as Ecuador's System of Participatory Agrofishery Technological Innovation (S.I.T.P.A.), the Soil Fairs and the Socialist Networks of Productive Innovation in Venezuela, the Technological Incubators of Popular Cooperatives (ITCP) in Brazil (also in Table 2) and the Haitian NGO VETERIMED. The S.I.T.P.A. example emphasizes capacity building and organising with farmers and fisher to address issues of agricultural productivity and environmental concerns while the ITCP model demonstrates a bridging function extending between university research groups and citizens' groups with specific social demands. The Haitian NGO VETERIMED is an impressive example of a 'bridging organization' that enables inclusive innovation to meet social needs through careful institutional linking and coordination, as well as careful consideration of contextual social and technical realities.

⁶⁸ For a further discussion on innovation capabilities, see Bell (2009), a New Manifesto background paper, which points out the need for greater attention to 'the importance of dispersed innovative capabilities that are deeply and pervasively embedded in production activities.'

Box 2. Examples of Capacity Building

Ecuador: System of Participatory Agro-fishery Technological Innovation (S.I.T.P.A.)

The System of Participatory Technological Innovation for Agro-Fisheries ('Sistema de Innovación Tecnológica Participativa Agropecuaria, S.I.T.P.A.) was launched as an official government policy in July 2010, with the support and presence of President Rafael Correa and many rural producers. S.I.T.P.A. results from the practical and methodological experience of the Andean Consortium for Participatory Innovation (Consortio Andino de Innovación Participativa) and Corporación PBA in Colombia, as well as the experiences of Ecuadorian field schools in agricultural research methods, facilitation practice, organizational development and rural capacities, among others. Mauricio Proaño, executive director of the National Institute for Farmer Training (Instituto Nacional de Capacitación Campesina – Incca), coordinator of the Andean Consortium in Ecuador, and assessor of the Ecuadorian Ministry of Livestock Agriculture, Aquaculture, and Fisheries, led the development of the new 'S.I.T.P.A.' policy. The S.I.T.P.A. law proposes that farmer organisations appropriate the processes of productive transformation and institutional development, themselves solving problems of rural employment and low productivity among small and medium-sized producers, gaps in marketing and also loss of biodiversity.

According to Proaño, 'To improve the local capacity of people is the mark of this plan, that the same producers are responsible for their development. The idea is to develop people's capacities, not just apply technologies' (Corporación PBA 2010, translation by author). Through S.I.T.P.A., 580 young professionals, along the lines of the Manifesto's call for bridging professionals, have been trained in the methods of rural participatory innovation (innovación rural participativa - IRP) and, through a technical process of selection, 340 of these will be contracted to continue the work. Each of these will be responsible for accompanying three 'Schools of the Agrarian Revolution' (Escuelas de la Revolución Agraria -ERAs), which will cover all the country's provinces. These young professionals will also lead the effort in promoting participatory technological innovation and training producers in their rights and responsibilities for forming good citizens (adapted and translated from Corporación PBA 2010).

Venezuela: the Soil Fairs

The Venezuelan Soil Fairs originated as part of a transdisciplinary project carried out by the Institute of Scientific and Technological Research of the Simon Rodriguez National Experimental University, with the aim of developing agro-ecological management systems adapted for poor and drained soils of the Central Flood Plains whilst at the same time attending to the pressing need for food production and security in the area. The project took part in farming communities adjacent to the Iguana Experimental Research Station in Guárico State, and was preceded by participatory evaluations which had determined: a) the farmers' need to improve the production and productivity of corn crops, b) their perception that low production and productivity was linked to poor soil quality conditions.

The Soil Fairs were created as a methodological strategy that would allow the integration of local and technical knowledge in the search for agricultural alternatives for this region. Their objective is to strengthen in a simple and practical way the capacity, skills and attitudes of farmers to know the physical, chemical and biological properties of their soil and link them with local knowledge acquired through their daily practices. Farmers are first asked to collect soil samples on their farms following a series of criteria provided by the researchers. The samples are then taken to the Fair where they are

analysed in working groups according to different soil quality indicators identified by the farmers. After the Fair, the samples are analysed in a laboratory to determine their exact composition. The process shows a very strong correlation between local and technical knowledge in relation to soil quality and characteristics. However, it also helps to identify areas in which there are knowledge gaps from the part of the farmers with respect to practices that could help increase soil fertility, such as fractioning the sources of nitrogen (N). The identification of these knowledge gaps helps to assess both future farmland use choices and agricultural extension practices in the area (Hernandez 2011).

Replicates of this experience are now being carried out in other parts of the country with the assessment of the Institute of Scientific and Technological Research of the Simon Rodriguez National Experimental University, one example being the 'Integral and Participatory Water Basin Project: River Pao and Unare Case Studies' carried out by Universidad de Carabobo (UC), Universidad Pedagógica Experimental Libertador (Upel), Universidad Simón Bolívar (USB), La Salle Foundation y Tierra Viva Foundation with funding from the Ministry of Science and Technology (Hernandez 2011).

Venezuela: Socialist Networks of Productive Innovation

Socialist Networks of Productive Innovation (RSIP), launched in 2006, are small and medium-sized production units of goods and services that support each other in order to solve financial, commercialisation, capacity-building and technology development problems, among others, through an innovation system that helps them create favourable socio-productive conditions in a region or the country as a whole.

Their objective is to take advantage of or develop the capacities and resources of local communities in order to aid human development, production and social inclusion in sustainable development through the generation, dissemination, transfer and social appropriation of knowledge and a dialogue between local knowledge and the Science, Technology and Innovation System. There are currently more than 600 RSIPs in the country.

Brazil: Technological Incubators of Popular Cooperatives (ITCP)

Technological Incubators of Popular Cooperatives (ITCP) first appeared in Brazil in 1995 at the Federal University of Rio de Janeiro. The ITCP was 'conceived as an instrument for transferring the accumulated knowledge of the university to the socially and economically excluded segments of society' (Portal on Popular Cooperativism website). The ITCP seeks to assist the founding of workers' cooperatives by providing specialised advice, with the intention of inserting members of economically marginalised social segments into the formal labour market. Their target population, differentiating them from other more traditional experiences in incubation of technology companies, is the large contingent of workers that are unemployed or are working in the informal economy. The model has since expanded and been supported at a national level, and ITCPs are now part of the extension programmes of many federal universities. In 1998 the National Program of Incubators of Popular Cooperatives (PRONINC) was founded in a partnership between several institutions, including FINEP, a government financing entity, the Banco do Brasil Foundation, the Banco do Brasil itself, and the technological incubator at the Rio de Janeiro Federal University. In 1999, these incubators set up the University ITCP Network, and continue bringing new universities into the fold, based on the ITCP model, in collaboration with another entity, the Unitrabalho Foundation (Portal on Popular Cooperativism website). This initiative illustrates how the funding of science, technology and innovation can be more closely linked to the challenges of poverty alleviation and social justice, and also pay attention to experimentation in niches, networking and learning involving marginalized communities as active participants. The support ('incubation') of

cooperative enterprises provides a good example of the recommendations in this area for action, with shared learning being the aim across and between ITCPs.

Haiti: Milk in Abundance (Lèt Agogo) innovative micro-dairy

VETERIMED (<http://www.veterimed.org/ht>) is a Haitian NGO founded in 1991 that developed a program to increase and improve local milk production in Haiti. VETERIMED functions as a sort of 'bridging institution' addressing social contextual realities, technological obstacles and institutional coordination toward the development of socially relevant technological adaptations and innovations. Dairy farming is a primary economic activity in the Limonade region of Haiti, where smallholder farmers had no land titles. Prices were low, as milk was sold through intermediaries and low quality meant consumers preferred imported powdered milk. A participatory assessment of the problems with dairy production identified the negative view of local milk by consumers, infrastructure obstacles, and low knowledge of production methods among farmers. Among the numerous infrastructure obstacles were bad roads, no electricity, poor water access and few veterinarians in the region. The micro-dairy was developed by finding alternatives to conventional milk processing machinery that did not rely on electricity for pasteurization or running water for cooling. Alternatives were found using steam methods based on gas-powered heat sources for pasteurization, and ice for cooling. Local farmers and others were involved through training workshops on micro-dairy operations, and they were able to produce competitively priced, quality long-life milk and yogurt.

The ensuing increased demand by consumers also motivated farmers to increase production and consequently their interest in improving their livestock farming methods. VETERIMED coordinated with the National Institute for Agrarian Reform (INARA) and the Milk Producers' Association of Limonade (APWOLIM) to legalize tenure rights to land, which was approved by the Ministry of Agriculture. This process contributed to the strengthening of the milk producers' association, helping enable citizen's groups to participate in broader political debates, and farmers began to invest in farm improvements. VETERIMED also helped train farmers to grow locally appropriate fodder for their livestock, as well as to monitor animal health and give vaccinations. Many women have since become certified veterinary technicians, and animal vaccinations in the area have risen to almost 80% from near zero. VETERIMED also created a registered trademark recognized by consumers. Other dairies using the trademark must meet quality norms and rules, which require using only fresh local milk, and that local farmers participate in ownership of the dairy. By 2010 there were 30 micro-dairies in Haiti, involving 2,500 rural residents as dairy workers, farmers and veterinary technicians, generating new jobs, decreasing local prices of milk for consumers while raising incomes of dairy farmers (ECLAC 2010d: 65). This remarkable example highlights many facets of the Manifesto's recommendations on capacity-building to foster innovation that works directly for social needs, is highly networked and sensitive to technological, social, cultural and ecological contexts relevant to the innovation process.

However, despite these interesting examples, there are still great capacity-building needs in order to more effectively advance towards more socially inclusive forms of science and technology for sustainable development. One of the key areas continues to be through developing inter- and transdisciplinary ways of thinking and doing research among academia. For instance, the Venezuelan Roundtable mentioned the urgent need to create spaces for integrated thought and training, such as a 'School for Global Change that would permit development of an integrated and transdisciplinary way of doing science towards environmental sustainability and social equity' (Venezuela Roundtable Report 2010: 5). The Colombian Roundtable also pointed to the need to train human resources in areas relevant to the region as a whole, to encourage more interdisciplinary training (for scientists and for entrepreneurs), and to move from sector-based and vertical thinking towards more network-based and integrated horizontal interactions.⁶⁹

Other capacity-building needs mentioned in the roundtables touched on developing human capabilities for change, such as facilitation and negotiation skills. For instance, the Venezuela Roundtable argued for the need to pay special attention to the 'technical and organisational training of facilitators of processes of change' and to avoid 'scaling up' too quickly, so programmes can be improved before they are replicated at national level (2010: 13). The Colombian Roundtable addressed issues of institutional capacity-building, including leadership toward building, supporting and promoting a vision of STI meeting social demands, and with the abilities to participate in international negotiations (Colombia Roundtable Report 2010).

ORGANISING

The New Manifesto uses 'Organising' to refer to the social and institutional arrangements that allow technologies to be useful in meeting the needs of a society, including the more marginalized members, and calls for a more 'open, distributed and networked approach, with active investment in linkages between public, private and civil society groups' (STEPS Centre 2010: 22). It suggests that 'bridging functions' or coordinating bodies be identified and supported, to better link upstream and downstream R&D, as well as networks and movements that support 'informal, lateral sharing of innovation' (STEPS Centre 2010: 22). One method is through support for open source innovation platforms and limits on overly-constraining intellectual property-based systems.

⁶⁹ Sutz and Arocena (2006) point out an example of interdisciplinary training to more directly link science and technology to located needs and demands in Uruguay. In this example, collaboration between medicine and engineering research groups led to the development of a device for monitoring and managing uterine contractions, which has helped lower the rate of child mortality. As a result, this link has been institutionalised through the establishment of a common Chair in Biomedical Engineering between the Medical School and Engineering School, with the aim to train 'hybrid engineers', as well as the development of an R&D group on Biomedical Engineering, dedicated in part to the design of intensive therapy devices destined for public hospitals, whether in the form of new designs or cheaper versions of existing instruments with different features adapted to local needs (Sutz and Arocena 2006: 36).

In the latest UNESCO Science Report, Albornoz et al state that 'S&T Systems in Latin America are characterised, with some exceptions or nuances, by a lack of strong links and poor coordination between public R&D – encompassing universities mainly – and the business sector' (Albornoz et al 2010: 90). This statement agrees with prior views on the general weakness of the relationship between public research and industry in Latin America (Cassiolato et al 2003; Cimoli 2000; López 2007). Yet recent research indicates that important links have been created between the innovation process and academic production centres in some of Latin America's most innovative sectors, largely due to traditional investment in the S&T sector. For example, Argentinean agricultural development has benefited significantly from research carried out in INTA, the Argentinean National Institute for Agri-fishery Technology (Instituto Nacional de Tecnología Agropecuaria), and the same is true for the aerospace industry in Brazil, the coffee industry in Costa Rica, and the chemical industry in Mexico (Arza 2010). Nonetheless, though research at universities and public research institutions has been key to the development of certain industries and sectors, with intentional policy efforts to support such links since the 1990s, in many cases formal linkages are still not widespread or have been limited to certain types of relationships.⁷⁰ What is more, the further link with civil society and more directly with social needs, as suggested by the Manifesto and others, is even less visible.⁷¹

All three roundtables in Venezuela, Argentina and Colombia called for greater attention to linkages and better articulation between academia, government, private sector and civil society. The Venezuela Roundtable pointed out that insufficient links have resulted in a 'disarticulation of constructed capacities' (Venezuela Roundtable Report 2010: 12). The Colombian Roundtable also acknowledged the 'separation between researchers and private industry', pointing out that 'the verticality' of the supply chain and the linear view of innovation do 'not help promote other visions – of who manages knowledge, has knowledge, and can or does contribute to innovation' (Colombia Roundtable Report 2010: 3). The same roundtable, however, suggested that the new STI law is doing better to integrate the relationships between 'University-State-Private Industry in order to achieve results' (Colombia Roundtable Report 2010: 3).⁷² The Argentina Roundtable also agreed this point on disarticulation:

⁷⁰ See Arza (2010) for a description of various types of relationships between public research institutions and industry (traditional, services, commercial and bi-directional), and the relative benefit of each to the different actors involved.

⁷¹ Albornoz (2009) points out that 'innovation policies should be redefined and enriched, not only in order to maximize opportunities offered by technological change, but also to foster a form of innovative behaviour that enables avoidance of social exclusion and helps to attenuate the wealth gap between countries and social groups' (Albornoz 2009: 20, translated by authors).

⁷² The process of construction of a 'Regional System of Innovation of Biotechnology for Agriculture, Agro-industry and Bio-industry' in the Valle del Cauca, Colombia, is an attempt to build on a process of agenda setting among 80 regional actors from the private, academic, research, government and civil society sectors, towards applying the new national Colombian STI policy in articulating resources and building regional STI capacities linking research and productive sectors, as well as linking with community groups (Sánchez-Mejía and Gutiérrez-Terán 2011).

It was generally agreed that marginalised groups hardly ever turn to S&T institutes spontaneously. Politicians, who may have better knowledge about their needs than S&T researchers, rarely make explicit demands on the S&T sector. Finally, S&T institutes have their own priorities, which very rarely match to those of the marginalised groups. Therefore, interactions between S&T institutes and marginalised groups are usually sporadic, isolated and rely on the personal commitment of researchers or individuals within social movements or other groups in the civil society. (Argentina Roundtable Report 2010: 2)

Low coordination and articulation between research centres and universities has resulted in limited sectoral or regional impacts of research (Vessuri 2003; Government of Bolivia 2009). The Colombian roundtable also called for 'changing the linear scheme of research', creating better links between academia and the private sector, and integrating farmers and other minority groups into value chains and relevant research, citing models like Fedecafé, the Colombian Coffee Federation (Colombian Roundtable Report 2010: 5; 7). The Argentina Roundtable further suggested that 'students and scholars could act as "bridges", mediating between actors involved in innovation policy making and the society at large' and suggested that 'professionalisation of these mediators is desirable' (Argentina Roundtable Report 2010: 4). Support for science, technology and innovation in small and medium-sized enterprises (SMEs) is arguably especially important due to their economic and social significance across Latin America. Along the lines of the Manifesto's call for coordinating bodies and professionals with 'bridging functions' to better link public, private and civil society groups, Sutz and Arocena recommend 'technological extensionism' and 'technological missions', including year-long placements by young professionals among firms, to assist 'very small firms, cooperatives, trade unions, local movements and other collective actors who usually lack the knowledge needed to be active partners in innovative circuits and linkages' (Sutz and Arocena 2006: 21-22).⁷³

Sagasti also suggests bridging or 'blending' approaches for better supporting and 'upgrading' indigenous or traditional techniques in order to contribute to poverty reduction aims. He points out the need 'to devise strategies, create institutions, and adopt policies to foster a sustained interaction between the depositaries of indigenous knowledge and techniques on the one hand, and scientific researchers and engineers on the other [...] focusing on the complex interactions that take place within indigenous innovation systems...' (Sagasti 2004: 54-55).

Social innovation experiences reviewed by ECLAC highlight an important characteristic of successful projects as the existence of successful 'linking' including the development of alliances across sectors and actors – among the community and with other communities, with civil society organizations, the private sector, interest groups, and the State at various levels – local, regional or national (ECLAC 2010d: 5-6). Additional 'organising' factors

⁷³ Sutz and Arocena recommend 'innovative circuits' – defined as the linking between an actor with a need and another actor with knowledge to address that need. For example, they describe the 'Commission on New Technologies', an initiative in the 1980s by the metal workers' trade union with the motto 'New Technologies, New Alliances'. The Commission brought together workers and university researchers to 'establish more systematic "knowledge contacts"' in order to understand how to best introduce new technologies to the industry (Sutz and Arocena 2006: 22).

attributed to success included projects that encouraged or developed links between traditional knowledge and technical 'modern' knowledge, as well as leadership by individuals and institutions in contributing toward technical capacity and political articulation) (ECLAC 2010d: 23). Interestingly, very few projects showed the presence or participation of the central government as vital to success, but many involved local or municipal governments (ECLAC 2010d: 24).

Examples of institutional re-arrangements to enable innovation to meet social goals, and involving the role of bridging agents are highlighted in Box 3. One of them is a case from Brazil in which the government's demand that private power companies invest in efficiency and R&D helped contribute to the conditions for useful institutional arrangements, while the institution of a new role of community-level 'bridging agents' enabled relevant information-sharing that led to innovation that genuinely meets social demands while also serving the companies' needs. Another case from Venezuela is a multidisciplinary and inter-institutional socio-ecological research project in Canaima National Parks that uses a methodology for integrating different knowledge systems and researchers, and acts as a 'bridging agent' between academia, indigenous peoples and government sectors with the aim of harnessing science, technology and innovation for sustainable development in the area.

Another illustration of the 'Organising' Area for Action, in principle at least, are the Venezuelan government's *Misión Ciencia* or 'Science Mission' (a policy passed in 2001), as well as its more recent Programme on Socialist Networks of Productive Innovation (mentioned above). Both carry the aim to more effectively bring together relevant social groups and institutions through a variety of networks in order to link science and academic knowledge with 'endogenous development'. The Science Mission is described as a 'process of massive incorporation and articulation with social and institutional actors by means of economic and social, academic and political networks, for the extensive use of knowledge in the function of endogenous development and integration' (Venezuela Roundtable Report 2010). The Programme on Socialist Networks of Productive Innovation tries to help link local productive activities and needs to technical and scientific actors of the National STI system. The programme aims to survey local communities' productive focus, evaluating in particular links with environment, education and health, and to connect these with relevant technical and scientific expertise to improve the capacities and skills of the local productive actors (not only small-scale producers), to develop integrated projects and support productive development (Cubero 2010). However, the Venezuela Roundtable Report also acknowledges that contributions by these new institutions and policies to their stated goals have sometimes been limited due to a number of obstacles, including insufficient deeper institutional changes (Venezuela Roundtable Report 2010).

A community-level example of 'organising' towards science and innovation to meet social and environmental aims is that of Gaviotas⁷⁴, an eco-village or intentional community located in the eastern plains of Colombia, founded by architect and visionary Paolo Lugari (see Box 3). Named by the United Nations as a model of sustainable development, the village includes about 200 people, and has become a success in many dimensions – from promoting a peaceful and productive community in the midst of a politically and socially

⁷⁴ <http://www.centrolasgaviotas.org/>

conflicted region, to regenerating an indigenous rainforest using native pine, developing a biodiesel industry based on the collection of tree sap, and the creation of an associated North-South research exchange programme, as well as inventing and commercialising a wide range of agricultural, housing, and renewable energy innovations (Gaviotas website).

The Social Technologies Network (*Red de Tecnologías Sociales – RTS*⁷⁵) in Brazil (also Box 3) exemplifies the Manifesto's recommendations on 'Organising' through its efforts in networking and supporting the capacity building of initiatives for developing technologies that meet social needs and involve users as participants in the innovation process, known as 'social technologies', while the case of cassava production in Colombia highlights a very different model of organizing for innovation in one specific sector (see also Box 3).

Box 3. Examples of 'Organising'

Institutional Arrangements for Inclusive and Efficient Electric Power Provision in Brazil

Feldman Borger et al (2009) point out the close relationship between poverty and energy access in Brazil, where the electric power distribution sector is obliged to meet the needs of diverse regions – from wealthy condominiums on the coast to impoverished homes deep inland. Still, millions of Brazilians, many in the lowest income bracket, do not have access to electricity and other basic services. When the electricity sector regulating agency in Brazil, ANEEL, mandated that companies in the sector 'must invest 0.5% of the net operational revenue in programmes to enhance effectiveness (better energy performance in use) and 1% in Research and Development', the company COELBA (Companhia de Electricidade do Estado da Bahia, originally a state enterprise that was privatised in the late 1990s and the third largest electric power distributor in Brazil), chose to invest these resources in building community relationships and new technologies. Through the development of 'commercial demand agents' who served as a link between the company and the community, COELBA managed to integrate their operational management with community social actions serving low-income populations, directing resources from increasing power effectiveness to invest in new and more energy-efficient technologies.

These 'bridging agents' (which also meant the creation of new jobs for young people) helped 'reduce the distance between the company and the community', and 'led the relationship to evolve beyond the request of services, as the agents began to act as facilitators in the negotiation of debts for defaulted payments and the regularization of clandestine connections' (Feldman Borger et al 2009: 5). The project also subsidised communities' upgrading to more energy-efficient devices, bringing power savings estimated at over 10,000MWh/year. For consumers, the advantages were lower bills and less defaulted payments. For the company COELBA, a closer relationship with the community also proved fruitful: their subsidies led to the stabilising of power demand (delaying the need to make expensive investments in the system) and fewer customers defaulting. The project is also being considered for inclusion in the Clean Development Mechanism (CDM) which would free more capital to acquire more energy-efficient refrigerators for underprivileged people (Feldman Borger et al 2009). This example shows effective institutional arrangements linking between efforts by the State, the power sector, and local communities to make public policies for socially inclusive and

⁷⁵ <http://www.rts.org.br/>

more sustainable electricity provision, meeting the needs of low-income populations through innovative service arrangements.

Integrating Knowledge Systems for Sustainable Development in Canaima National Park, Venezuela

Canaima National Park is the second largest in Venezuela (30,000 km²), and has a singular landscape and geology. In 1994 UNESCO declared it a Natural World Heritage Site. Additionally, the park is an important hydrological source for the Guri Dam, the biggest hydroelectric complex of the country, and is the park with the largest number of inhabitants in Venezuela. Three-quarters of the total population of the Pemon indigenous people live within the park's boundaries. These complex geopolitical, socio-cultural and ecological factors make the management of this area extremely difficult.

The project 'Risk factors in the habitats reduction within the Canaima National Park: vulnerability and tools for sustainable development' seeks to assess the vulnerability of the socio-ecological system of the Park in view of climate change, changes in land use patterns, and the incidence of fires; and social, cultural, economic, and political factors at different spatial-temporal scales. The project uses a methodological approach developed by ICSU-ISTS-TWAS in 'harnessing science, technology and innovation for sustainable development', which aims to articulate knowledge and action for the solution of priority problems of sustainable development, contributing to the building up of capabilities throughout the different activities and spatial scales.

This research is a pioneering initiative in Venezuela in the integration of the social and ecological systems, as well as in the integration of different knowledge systems from academic (ecology, sociology, anthropology, mathematics, geography, forestry and agronomy), technical and indigenous backgrounds. The research team is drawn from a variety of research institutions (Universidad Simón Bolívar (USB), Instituto Venezolano de Investigaciones Científicas (IVIC), Universidad Nacional Experimental de Guayana (UNEG) and the Parupa Scientific Research Station (CVG)). Many of the research activities have involved close collaboration with the Indigenous Federation of Bolívar, Pemon indigenous communities and government institutions in charge of the management of the area. These have included a variety of sector-specific, multi-actor and inter-community dialogue and deliberation processes about environmental change factors and views of sustainable development which will be used to inform future management decision of the area (Bilbao et al 2008, Sanchez & Vessuri 2009). Special attention has been drawn to developing a research approach at the community level that would be culturally meaningful to the Pemon, as well as helpful to them in developing a dialogue with other actors in conditions of equity. Special attention has thus been paid to helping the Pemon reflect about a variety of issues which they consider essential for the articulation of their own community Life Plans (Planes de Vida). These include reconstructing local history, land use and change, the use of fire, food security and views of a desired future (Rodríguez et al, in press).

Brazil - Social Technologies Network (RTS)

The Social Technologies Network is part of a broader movement to support the development of 'social technologies' in other countries in Latin America, including Argentina. Social technologies are understood as 'replicable products or methodologies developed in interaction with a community, which represent effective solutions for social transformation' (RTS website). The RTS 'gathers, organizes, coordinates, supports and integrates actors and institutions that work to develop or promote social technologies, and also works to promote the use of social technologies as public policies, as well as their appropriation by communities' (RTS website). The website offers an

online forum for members of the network to share learning experiences.

Innovation in the Colombian Cassava Industry

The cassava industry in Colombia has benefited from improved linking and coordination between government, industry, research and small-scale farmers' associations, towards innovation to meet farmers' production and marketing needs (World Bank 2006). Cassava production in Colombia has received renewed government support since the mid-1990s for research, policy and coordination with industry to expand, improve and commercialise production. The government's activities included support for organising agricultural value chains and enabling greater interaction between its actors, sponsoring competitive funding calls in R&D for cassava (cassava is also considered part of animal feed value chains for pig and poultry). Two organisations appear to have been key players in the success of sectoral coordination and innovation: the Association of Small-Scale Cassava Farmers from the Cordoba and Sucre Plains (APROYSA), and the Latin American Consortium for Cassava Research and Development (CLAYUCA), a regional consortium of producer countries linked to national and international research organizations (e.g. CIAT, the International Centre for Tropical Agriculture). Coordinated efforts have resulted in organising to link small-scale farmers to international and regional research and innovation, as well as international markets and finance, with the outcome of:

a partnership between CIAT, cooperative processing plants, and the Colombian national agricultural research organization; the creation of an apex association to link cooperatives in processing and marketing innovations; and the creation of a research-focused network comprising a regional consortium, the industry (with its small-scale farmer base), national and international research organizations, the government, and financial organizations—all linked to domestic, regional, and international markets. (World Bank 2006: 40)

The World Bank report highlights a number of factors leading to the success of the initiative, including 'interaction mechanisms' and an 'enabling environment'. Among the positive factors in interaction were flexibility in attitudes and practices enabling new forms of partnership and more 'socially-inclusive' innovation, a tradition of cooperatives and industry associations, an interesting 'emphasis on the social and economic feasibility of a dualistic sector of small and large-scale producers', and value placed on S&T as useful for crop and industry improvements. These factors resonate with the Manifesto's call for more active investment in linkages, in a more networked and distributed approach to innovation.

MONITORING, EVALUATION & ACCOUNTABILITY

Transparency is considered essential for more democratised innovation systems, to enable the monitoring, evaluation and accountability of public and private innovation activities, and demands active involvement by citizens. The New Manifesto calls for the setting of 'benchmark criteria' on the priorities of poverty alleviation, social justice and environmental sustainability to become the basis for monitoring innovation systems. It also suggests shifting the emphasis of current S&T indicators on aggregate R&D expenditure, publications and patents, towards improving data collection systems and methodologies on the wider development outcomes of innovation efforts, with such data being reported publicly (STEPS Centre 2010: 23).

The Colombia Roundtable called for attention to be paid to monitoring, evaluation and accountability, including new metrics for evaluation and related training to build relevant 'competencies among project evaluators' (Colombia Roundtable Report 2010: 11). It was pointed out that researchers produce academic products instead of what may be more socially-relevant and innovative products, in part because those are the terms on which they are measured and evaluated. The new Colombian STI Law calls for a shifting of this focus, but the question was raised about how evaluators also need to change. Finally, the roundtable called for 'information systems' which currently do not exist 'on research and innovation projects', in order to 'enable monitoring and evaluation of results and progress' (Colombia Roundtable Report: 11). The Roundtable also explicitly called for the monitoring of politics in order to counteract corruption and favouritism. The new Colombian Strategy on Social Appropriation of STI suggests some elements of monitoring and evaluation, as well as the need to search for new measures and indicators of social impact (Colciencias 2010). The Argentina Roundtable called for 'academic evaluation schemes to be widened to include interaction activities' (Argentina Roundtable Report 2010: 3).

Sutz and Arocena (2006) also point out the importance of 'evaluation and follow-up' for institutions aiming to help link innovation capacities and social demands. They suggest some indicators, along the lines of the Manifesto's call for benchmark criteria, including on the amount and kinds of resources dedicated to social needs, as well as the 'levels of participation of usually neglected actors in knowledge linkages', such as trade unions, NGOs, and other civil society associations. They call for building up data on, for example: the 'absolute and relative numbers of scientists and engineers working in social programs'; data about 'scientific and technological diaspora' involved with social programmes; connections between 'public and private organisations dedicated to the solution of social problems with knowledge-based and high-tech firms'; as well as whether neglected actors have scientific and technical personnel on their staffs, if they are consulted regularly by governments regarding S&T decisions and priority setting, among others (Sutz and Arocena 2006: 40-41).

Albornoz points out the need to widen the conception of innovative activities to better address Latin American realities and meet social needs (Albornoz 2009). For example, traditional innovation indicators largely focus on manufacturing, while in the majority of Latin American countries this sector represents less than a fifth of GDP. Other important sectors in the region sometimes neglected by survey measures include agri-fisheries, services, and raw materials. He and others such as Dagnino also point out that the persistent importance of the informal economy, as well as the high levels of poverty and social exclusion, suggest a need to broaden the concept and indicators of innovation even further (Albornoz 2009: 22; Dagnino, quoted in Viano 2011).

Some regional initiatives for evaluation and follow up of innovation capacities in S&T are in place in the region. One of them is the Ibero-American Science and Technology Indicators Network (RICYT),⁷⁶ an organization that collates and produces periodic statistics on science and technology indicators as well as analysis and research on topics related to measurement of S&T and innovation. Although the organisation is dedicated to producing the standard science and technology data, such as figures on R&D expenditure, publications, researchers

⁷⁶ <http://www.ricyt.org/>

and patents (using internationally comparable surveys, with some adaptation to Latin American contexts), it is also working towards the question of how indicators can reflect social needs. RICYT recently hosted a conference with the Organization of Ibero-American States on 'social demands and new trends in scientific and technological information' (RICYT website).⁷⁷

Another regional initiative is the Inter-American Development Bank's recently established Science, Technology and Innovation Network⁷⁸, in collaboration with RICYT, as part of its Regional Policy Dialogue. The STI Network was created with the aim to be a forum for high-level policy makers of S&T in Latin America and the Caribbean 'to discuss common policy issues impinging upon the performance of their STI systems and explore regional cooperation initiatives' (IDB website). The Network aims to enable the exchange of experiences and perspectives on STI policy and institutional reform, S&T capacity strengthening, and innovation performance among IADB borrowing member countries; to identify best practice in policy, and to discuss regional cooperation initiatives to 'build upon and leverage the region's human, technological, financial and natural resources to develop regional and/or global innovation platforms or centers of excellence' (IDB website). In collaboration with RICYT, the STI Network has developed a website that enables public access to a database on institutional arrangements and S&T policies among Latin American countries, including descriptions of national STI system structures, legal frameworks, organisations and policies from member countries, and national summaries and maps of existing National Innovation Systems. The site is linked to RICYT's regional STI indicator database, and a significant aspect of the Policy Dialogue appears to focus on training towards improved capacities for the collection of quality STI indicators (IDB website).

This example, similar to other regional initiatives led by international organisations, does not match the Manifesto's call for broader participation in monitoring and evaluation directly, nor does it address benchmarking of social or environmental criteria. However, the aspect of offering public information on S&T might be considered a step in that direction, while this type of initiative, if broadened to civil society and other actors beyond high-level policymakers, might serve as a platform at a Latin American regional level toward something like the Innovation Commission suggested in the STEPS Manifesto.

Some examples of the broader types of monitoring, evaluation and accountability suggested by the Manifesto can be found outside the realm of science, technology and innovation policy. For example, some fifty 'Social Observatories' across Brazil serve to monitor use of public funds and address concerns about corruption among public officials and in public bidding processes. These observatories were set up by and continue to involve a range of participants including representatives from community organisations, universities, businesses and unions (ECLAC 2010d: 42). Though this is not necessarily about science and technology only, it is a mechanism that might be applied in the application of funds oriented to science and innovation goals, with the criteria of social relevance. Two similar projects for monitoring of public and private spending are supported by the organization, Transparency

⁷⁷ See also the RICYT Congress website: <http://congreso.ricyt.org/>

⁷⁸ <http://www.politicasciti.net/>

for Colombia. The first, called 'Citizens Watching Over Public Funds', involves 47 social and community organizations, and has successfully achieved accountability and monitoring in public management of funds at regional levels. The second, in the water provision domain, is a self-regulation exercise among private sector firms meant to develop trust among competitor companies by following carefully set rules, agreements and mechanisms to prevent corruption. The programs have developed joint agendas with public agencies to combat corruption (ECLAC 2010e).

In important ways, the action areas of 'agenda setting' and 'monitoring, evaluation and accountability' are closely linked. Broadening participation in agenda setting and reorienting policy priorities to meet broader social needs also requires compatible monitoring, evaluation and accountability mechanisms, and awareness of links to other types of policies as well. Brazil's 'Territories of Citizenship Programme' (Box 4) is an interesting example of more participatory agenda setting *and* monitoring, evaluation and accountability that also comes from outside the innovation realm, but which may hold lessons for STI policy making.

Box 4. Monitoring, Evaluation and Accountability: Brazil – Territories of Citizenship Programme⁷⁹

In 2008, the Brazilian government created a programme called 'Territories of Citizenship'⁸⁰ to help reduce poverty and social inequality in rural areas by supporting income generation activities, and improving infrastructure and citizen participation in the planning of 'sustainable territorial development and access to essential public services' through explicit attention to social, cultural, economic and political rights. This includes addressing land reform, one of the most challenging but important areas for reducing social inequality (ECLAC 2010c: 141; da Silva 2009). The program aims to integrate public policies on the basis of territorial planning and action at multiple levels, involving federal, state and municipal actors, following a model of decentralisation and high citizen participation that are considered vital aspects of the programme's effectiveness (da Silva 2009; Territories of Citizenship website). The Ministry of Agricultural Development (MDA) is the principal federal institution involved in managing the programme, which primarily targets territories with the lowest human development indices, a high concentration of beneficiaries of the cash-transfer programme Bolsa Familiar, and high concentrations of small-scale farmers, fishing communities, indigenous populations and descendants of African slaves (Quilombola) (ECLAC 2010c: 141). The focus of the program is on rural areas, but it recognizes that rural territories often include smaller urban areas or the outlying (peri-urban) areas of large cities, which are connected to the social and economic context of the rural territory. The program currently covers 164 territories, representing some 52 million people (ECLAC 2010c: 141).

Social participation is a primary aspect of this programme: participating communities help define the priorities and the regional development plans, as well as monitor the programme's implementation. Municipal and state governments can further augment the budget in areas they

⁷⁹ <http://www.territoriosdacidadania.gov.br/>

⁸⁰ 'Territories' are formed by groups of municipalities with similar economic and environmental characteristics and social, cultural and geographical identities (da Silva 2009: 372).

consider need more support. In the spirit of transparency, monitoring can be carried out online through the Territories of Citizenship website, and accountability is also held through local 'Social Councils' (da Silva 2009). The program works on a principle of acknowledging the heterogeneity of Brazilian territory (true across Latin American countries), which requires context-sensitive and selective strategies. Local development that involves local participants in its design and monitoring is seen as a bottom-up process, 'mobilizing endogenous potential to build territories that are better able to create and drive their own capacities' (ECLAC 2010c: 140)

However, *Monitoring, Evaluation and Accountability* is one of the more challenging Areas for Action to break down to an operational level. How does one really reorient data collection systems and methodologies from publications and personnel to wider development outcomes of innovation efforts? How can researchers who are oriented toward the current incentive and research production models rethink their work to fit into new evaluation schemes? And how do we begin to develop and train new kinds of evaluators? Sutz and Arocena (2006: 37) describe a programme in Uruguay that called for R&D projects to address urgent social needs, which were to be financed by the public University Research Council budget. This program had an innovative format that required proposals to explicitly state how the topic to be researched would help close a specific knowledge gap to address a social problem. The programme also demanded involvement in the design and discussion of the proposal by the same actors who would be responsible for implementation. While researchers were enthusiastic to respond to the opportunity to shift their research agendas to social problems, they were not as adept at matching the types of knowledge they were accustomed to producing to the relevant social problems. The authors also point out that the initiation of this programme illuminated the problem of a lack of trained evaluators for this new type of project (Sutz and Arocena 2006: 37-38), reinforcing the point made in the roundtables. They argue that the structures of reward systems and employment opportunities are evidence of the absence of opportunities for scientists to use their research to address social problems; and that, if given the opportunity, as in the case of Uruguay's Social Emergency Fund, scientists will respond to the chance and will themselves have many ideas for the social benefits of their research.

DISCUSSION: THE 3DS, THE 'AREAS FOR ACTION' AND LATIN AMERICAN REALITIES

In the previous section we highlighted an array of examples from Latin America of both public and private initiatives that link science and technology to social and environmental goals, which we aimed to place in relation to the STEPS New Manifesto's Areas for Action. This is without a doubt only a small sample of the progressive efforts currently underway in the region. In this penultimate section we briefly review achievements advanced in the region and describe some persistent challenges for the development of science, technology and innovation for sustainability and socially inclusive development in Latin America.

Academic researchers have been calling for over four decades for science to better meet social goals, including more recent calls for more 'distributed' and democratised development of science, technology and innovation.⁸¹ Many have suggested that the region's (and its nations') unique historical, cultural, political, economic and ecological characteristics require unique, localised and endogenous approaches to linking science, technology and social needs, though perhaps with insufficient attention to the plurality of forms of knowledge necessary to respond to the diverse demands created by a mosaic of territories with unique characteristics. Nonetheless, the emphasis on acknowledging diversity (and the related context-dependency of theory and policy recommendations, as well as of knowledge and technology themselves) is evident in the historical contribution of the Latin American School and the structuralist approach, as well as in that of Innovation Systems (Cassiolato and Lastres 2008).

United Nations institutions have lobbied for the role of S&T in achieving development goals for decades, and the most recent 2010 UNESCO Science Report (2010a) also argues that STI has a role in achieving equality in the region. The authors point out that Latin American countries need to pursue new development paths using diverse strategies to generate wealth and achieve better wealth distribution, and in consequence, must also adopt and implement diverse STI policies to enable STI to fulfil a role in achieving growth and equality (Albornoz et al 2010: 176).

What distinguishes the last ten years is the fact that previously (apart from some experiences with the Latin American School and its examples of links with regional and national policies) those calling for 3D-type policies and initiatives were largely academics or those in non-governmental realms; whereas now, recent national policies regarding science and technology have assumed much of this '3D' language (see Table 1 in Section 2) and there are clearly examples on the ground that show that the 3D agenda is being put into practice. Some of the existing policies and programmes, as well as more grassroots experiences, have been highlighted in Section 3, including national policy examples from Venezuela, Brazil, Colombia, Cuba, Argentina, Mexico and elsewhere.

Nonetheless, though many countries are prioritising social development goals in the general objectives of their new S&T policy, it remains the case that areas of new technologies and an emphasis on growth and competitiveness in international markets remain prominent goals, while it is not always clear how the latter line of interest effectively contributes to the first. For example, while Peru's most recent National Science, Technology and Innovation Plan for Competitiveness and Human Development 2006-2021 includes the priorities of 'poverty reduction and the improvement of quality of life for the most marginalized sectors' and calls for 'the ethical and spiritual dimension of the human person [to] be prioritised', it ultimately emphasises 'economic growth and competitiveness in international markets through the development of STI' (CONCYTEC website). The question remains whether Peru's programmatic emphasis on promoting 'basic scientific research, supporting publications in prestigious indexed journals, the formation of a critical mass of scientists [...], applied research [...] towards the generation of knowledge that is value-added, appropriable and transformable in products and services, as possible patentable and utilizable by private firms

⁸¹ Certainly the relevant literature also includes other authors not represented in this paper.

that wish to compete in international markets' really is prioritising 'quality of life for the most marginalised' (ibid.). Beyond the scope of this paper, it would be useful to explore in detail how these goals are actualised at the executable level - in other words, whether the links between these national institutions and social priorities are as strong in practice as they sometimes appear in policy.

GAPS BETWEEN POLICY AND IMPLEMENTATION

In general in the region, while there are many inspiring and novel policies and laws on better supporting STI, and even linking STI to social development, this does not mean that the actual operational outcomes reflect those noble aims. Often there is a gap between the rhetoric and the action (in other words, between expressed policy and actual implementation), sometimes resulting from a general difficulty in enabling change in public institutions. The Venezuela Roundtable Report pointed out this obstacle as twofold:

The manner in which the 'established agenda' of scientific-technological innovation is installed within our educational system and in general in our institutions at all levels, by which despite multiple efforts, we find that the reality of organisations impedes the development of emerging initiatives.

The difficulties of our institutions' lack of knowledge for adapting to new circumstances, in particular to new forms of production and use of knowledge. The public sector is very vertically-organised, and maintains a traditional view of these processes. The traditional academic and professional training which is strongly compartmentalised [discipline, sector] has contributed in an important way to the resistance that some sectors have manifested regarding the new agenda that has been put forward for the construction of multidisciplinary, interdisciplinary and transdisciplinary knowledge. (Venezuela Roundtable Report 2010: 2-3)

The Colombian Roundtable Report also states that the recent Colombian STI Law makes positive changes towards better supporting innovation through a systems approach and through the decentralisation of STI agenda setting towards the regions, but that it remains to be seen how this is actually implemented. 'The STI Law is placed to open new opportunities, but the group considers it necessary to move from paper to actuality (from policy to action)' (Colombian Roundtable Report 2010: 4).

INSTITUTIONAL LOCK-IN AND RESISTANCE

The work carried out by some Latin American scholars mirrors these concerns for institutional resistances to change in S&T development in the region. For instance, Emiliozzi et al (2010) argue that difficulties in integrating and implementing existing policies may be due to the fact that the policies are not easily operationalised, or that there is inadequate coordination within and across institutions.⁸² This can also be due to the fact that

⁸² An example is Brazil's 2007-2010 Plan of Action in Science, Technology and Innovation for Brazilian Development, which is described for the federal S&T system, and presents an opportunity for evaluation of the Plan's implementation. Although most its proposals have been implemented, it

bureaucratic structures, embodied in processes and people, are not easily amenable to change, and often hold on to existing ways of doing things (for example the linear model). Vessuri (2003) points out that the ability of institutions to do something new can also depend on the existence of new funds because it is often difficult to redistribute historical allocations.

The Venezuela Roundtable Report suggested that 'the model of public sectoral management is insufficient for the management of [actual] complexity' (2010: 7) and also cited the challenges of 'institutional variability and lack of continuity which makes operationalisation of policies difficult' (2010: 8). Albornoz et al (2010) describe heavy inefficient bureaucracies with complex institutional structures and without the political, technical or operational capabilities to exercise their duties (and implement policy) effectively. Dagnino and Thomas (1999) suggest that bureaucratic structures are only likely to change under extreme external pressures or signals, when decision-makers are obliged to accept and enact change, and that in science and technology policy, institutions have been resistant and slow to change. Herrera and others attributed this resistance to the systemic nature of social and economic structures – both national and international – and to their interaction at multiple levels, determined through local, national and international historical processes, which in turn contributes to asymmetries in development and learning processes and hence to the difficulty of enabling deeper structural change (Herrera 1973; Cassiolato and Lastres 2008). Sutz and Arocena (2006) and others also point out the need for a social transformation of public institutions in order to enable the effective integration of social and innovation policies, acknowledging that this is highly challenging and requires new metrics, similar to the Manifesto's suggestions for 'monitoring, evaluation and accountability'.

LIMITED RESOURCES AND PRESSING SOCIAL NEEDS

Several authors describe another challenge to implementation, namely the competition for limited resources, which produces a constant tension between immediate short-term goals of basic social needs (demanded of politicians) and the requirement for a long-term commitment in order to build S&T capabilities, and especially to link those to development goals. Under such political pressure, the long-term perspective is difficult to maintain (Dagnino and Thomas 1999; Vessuri 2003; Sutz and Arocena 2006). Vessuri characterizes the 'syndrome of short-term demands' in much of Latin America where there is high social inequality and the State is unable to respond to multiple social needs with limited resources and administrative inconsistency or disorganisation (Vessuri 2003: 266). Some of the most noted successes in Latin America in developing major technologies resulted from 'strategic decisions sustained by successive governments over time in the form of state policies' (Albornoz et al 2010: 95). These were arguably sustained partly because of stakeholder

appears that some sectors assigned as strategic in the Plan (including traditionally important sectors such as agriculture, energy and defense) actually received less funding in 2008 compared to 2000. Other critiques of the Plan cite the fact that other federal ministries that should be or are involved in developing STI are not integrated into the Plan, nor are state-level STI efforts well articulated (de Brito Cruz and Chaimovich 2010: 119). One of the four major focal points of the Plan and Brazilian state policy in general, is social development and inclusion, though these received fairly low priority for direct R&D funding in 2008 (de Brito Cruz and Chaimovich 2010: 105; 119).

interest (especially from the military). Examples include both the Brazilian aeronautics industry (EMBRAER) and Argentina's nuclear technology industry, which represent technological capacities acquired to serve the military but later adapted for commercial applications.

SOCIAL, ECONOMIC AND CULTURAL LOCK-IN

Like the arguments against dependency in the 60s and 70s, recent strategies by various Latin American countries indicate that endogenous development and social inclusion are clearly important elements of the new S&T. For example, Venezuela's S&T Plan calls for a 'sustainable, humane, endogenous development' within a vision of 'national sovereignty' (Ministerio de Ciencia y Tecnología 2005: 12-13). The Bolivian S&T Plan also calls for 'endogenous development' and lists technology dependency as one of the weaknesses of the innovation system, as well as highlighting a five-time increase in the imports of basic and processed foods in the last 20 years (Government of Bolivia 2009: 9). It also highlights the challenge of 'limited export capacity, with insufficient quality standards or volume for external markets', with the expressed goal of addressing this concern (Government of Bolivia 2009: 9). Though there are different interpretations between nations of how to accomplish endogenous development, common themes include building STI capabilities for greater export capacity, with a focus on international markets.⁸³

The Venezuela Roundtable Report points out the existence of 'important tensions and distances between the notion of development that we say at the discursive level that we want as a country (endogenous sustainable development based on a socialist system) and that which we are effectively bringing about', pointing to the oil industry as 'emblematic' of these contradictions and to 'incoherence between discourse and political action' which 'contributes to the lack of concretisation of a new effective agenda for sustainable development' (2010: 12). And despite positive steps toward greater participation and social relevance of STI policy in Venezuela, they point out that achievements in these processes have been 'limited and very partial' in terms of environmental sustainability and greater social equity (Venezuela Roundtable Report 2010: 25). These positive policy changes 'have not resulted in the most effective outcomes due to the persistence of certain technological trajectories' (*directionality/lock-in*) that reaffirm traditional agendas, making it difficult for the 3D agenda to fully emerge (Venezuela Roundtable Report 2010: 13). 'Even though a process of S&T institutionalization has included 3D elements, socio-political factors have prevented current technological trajectories from being sustainable' (Venezuela Roundtable Report 2010: 8). The Venezuela Roundtable Report also points out the limitations of initiatives toward change exemplified by the continued 'reproduction of the cultural scheme of the technology-consuming country', with a limited achievement in necessary capacity building towards developing new technologies (Venezuela Roundtable Report 2010: 11-12).

⁸³ The Bolivian National Innovation Plan states its aim for 'STI to contribute to the development of an integrated, systemic, multi-sectoral endogenous focus, with the consequential innovative solutions that address the national reality' (Government of Bolivia 2009: 9).

CONCLUSION

As indicated, some of the challenges described in the 1950s, 60s and 70s by Latin American researchers are still relevant today, even if there have been some significant changes. Poverty, social exclusion and inequality remain persistent problems, thwarting efforts toward investing in public policies for science, technology and innovation because these represent immediate and pressing needs. The recent financial crisis has contributed to unemployment, only exacerbating poverty. At the same time, more optimistically, some structural conditions are more favourable than they have been for decades, including greater economic and political stability, a growing domestic market, and the possibility of benefiting from global demand for commodities and current high prices. Also, some countries have taken the opportunity to implement new innovation and development policies. However, these efforts are yet considered inadequate by some, especially in their ability to link science and technology to social inclusion and environmental sustainability.

Reflecting on the 3Ds of the Manifesto, calls for direction, distribution, and diversity, as well as democracy, have been made by researchers across the region for decades, using these words and others. In the recent rise of concerted government attention to science and technology policy, there is much talk and also policy that fits into distribution and direction; that innovation must address poverty alleviation and sustainability, and lessen the severe inequality in the region. However, despite some noble policies and also some successful efforts linking innovation to social goals, there is still sometimes a significant gap between policy and implementation. One major obstacle is that due to urgent social needs, politicians are driven to meet short-term demands instead of following through on longer-term visions and goals, as the creation of significant S&T capacity requires (Vessuri 2003). Limited resources contribute to this 'syndrome'. It is also the case that the inertia of existing modes of behaviour, as well as the resistance to change of unwieldy bureaucratic institutions, limit progress in this direction.

Another important point that is perhaps situated in the 'organising' area of the New Manifesto, but which might merit greater attention, is the need to integrate sectoral, local, regional and national policies for concerted and coordinated efforts toward development goals. Effective implementation and integration of science and technology policies with other types of government policies, both short-term and long-term thinking, and local, regional and national perspectives are also vital. Cassiolato points out that the 'essence of innovation' is the commitment of 'a country in development toward coordinated and complementary national and local policies' (Cassiolato 2008). This view is grounded in both the Latin American School and Innovation Systems approaches.

Some more specific issues which will require further attention in the future, in order to strengthen even further the flourishing agenda for social inclusion in scientific and technologic development in Latin America, are listed below.

PERSISTENT SOCIAL INEQUALITY DEMANDS COORDINATED EFFORTS TOWARD A COLLECTIVE VISION

A number of authors call for building a collective vision for socially inclusive development, institution building, and training, with coordination and commitment at multiple levels (local to regional), on the basis that social inequality presents the major challenge for the success

and legitimacy of any public policy toward social and economic development in the region, including STI policy (Sutz and Arocena 2006; Cassiolato 2008; Sutz 2008; Emiliozzi et al 2010; Perez 2008). Sutz and Arocena (2006) also argue that a strong vision must be accompanied by implementation of clever, consistent and creative social policies (Sutz and Arocena 2006: 39). Despite increased efforts in recent years, some Latin American countries more than others arguably still need to expand their policies for social development, inclusion and citizenship, and within this context STI policies need to be better integrated into broader social policies and development visions.

A SOCIALLY INCLUSIVE AGENDA FOR S&T REQUIRES DEALING WITH RESISTANCE TO CHANGE AND POWER RELATIONS

Although in some countries important moves have been made in terms of creating a shared vision for socially inclusive S&T development, the challenge of how to put the 3D agenda into practice still remains. Its implementation implies radical change and transformation in society, which inevitably meets with resistance at many levels. Most importantly the 3D agenda requires the development of capacities to deal with the level of complexities involved in its implementation including, among others, a plurality of visions, interests and needs that arise in this process. In this respect, one issue that has not been explored here, but which requires greater attention in order to understand the complexities of putting a 3D agenda into practice, is to achieve a much greater understanding of power relations – at local, national and global levels – in the attempt to develop more just and equitable knowledge and technology production systems.

HETEROGENEITY REQUIRES A DIVERSITY OF APPROACHES

Given the heterogeneity of the Latin American region as a whole, as well as within each country in the region, one reason STI policies may have failed in some places and done better in others is arguably due to the common tendency to universalise solutions for the region, arbitrarily applying policy solutions (in some cases, policy transfer from OECD country experience to Latin America) while failing to consider the region's heterogeneity by differentiating between contexts, histories, institutions etc. (Emiliozzi et al 2010). As Sutz and Arocena suggest, a 'one-size-fits-all methodology' is unlikely to be appropriate for countries in the region, and rather 'different approaches will probably be required for different situations' (Sutz and Arocena 2006: 39). This echoes points made by Herrera, Cassiolato and Lastres, Sagasti, among others.

Diversity – of culture, environment, economy, etc. – signifies the existence of multiple communities of actors with different visions. In this context of diversity, how can we build effective processes of participation in the creation of knowledge and in decision-making around the creation and use of knowledge, in ways that are conscious of equity, social inclusion, power, justice, and the environment? There is yet further understanding needed regarding how to achieve greater equity in our societies, and the particular role of science, technology and knowledge in those processes. How do we build those spaces and collaborate towards those visions?

BEYOND CONVENTIONAL POLITICS - DIVERSE PATHWAYS TO SUSTAINABILITY

It is generally agreed by many of the authors cited in this paper (Vessuri, Dagnino and Thomas, Perez; Sutz and Arocena) that the only way to achieve any semblance of joint vision (or legitimate vision) is through more open, democratic and deliberative processes of prioritisation. Despite calls for democratic participation in decision-making and even acknowledgment in government policy for the need of greater transparency and accountability and civil society participation, few examples can be drawn in practice, and these are limited when it comes to S&T specifically. Attention to a diversity of innovation pathways and portfolios as a guiding goal for resilience is less visible. Diversity is mentioned in fragmented ways in the policy documents and the academic literature, but perhaps the contribution of the New Manifesto in making this 'D' more explicit could receive greater attention.

Finally, like the Venezuela Roundtable, which asked 'how can we enable 3D S&T development when we haven't achieved developing a productive apparatus that is innovative?', many countries in the region, for example some smaller countries in Central America, are only beginning to establish a basic institutional infrastructure for science policy, to increase resources – human, financial, and institutional – and to try to ensure that educated professionals stay in their country. This contrasts with others that have already developed more complex institutional and policy environments, like Brazil, Mexico, or Argentina. Yet across Latin America, as attention to innovation as a guiding concept for science and technology policy increases, this is an opportunity to explore novel approaches and experiments that bring into discussion social justice, poverty alleviation and environmental sustainability in one way or another.

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