Review Report: Policy Issues and Options in ResIST and the CARE Model

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Introduction

ResIST is an EU FP6 project, pursued through four interrelated streams of analysis, examining the role of science and technology in the construction of inequality, and the scope for new science and technology policies that might remedy such inequality and promote more inclusive growth.

The first part of this review report summarises the early work of the project under each of the streams, acting as a guide to the project's first papers which can then be read in summary or in full on the project website[1].

The task of a fifth stream of work in ResIST is to integrate these streams and try to add value for policy. The second part of this report examines three types of inequality, and their relations in a basic model, CARE (capacities, accountability and representation, and effects), before offering a development of this model to take account of contextual variables, grouped as politics and governance, cultural values, and resources.

In the third part we reflect again on some of the ResIST work from the first two years of the project in the light of this more nuanced understanding and show how the contextual influences can disrupt the CARE model and produce unexpected effects. In the concluding part of this paper we exemplify these effects for each one of the three types of inequality.

In the third year of the study we will try to further sophisticate the CARE model, and look to build the means to work with stakeholders in a variety of national and regional contexts to re-examine the implications of ResIST's work for their own policy choices.

[1] http://www. resist-research.net. Summaries of all papers cited in this review can be found at http://www.resist-research.net/paperslibrary/research-summaries.aspx Otherwise web links found elsewhere in this review are to the full version of the paper cited.

Part 1 – How research policies, innovation policies, human resource policies and accountability processes frame and respond to inequalities in development – the early work of ResIST

Innovation policies, research policies and human resource policies will all have a part to play in a new, more socially inclusive, approach to S&T policy, or in widening inequalities. *Innovation policies* that encourage the introduction of new products and processes claim to contribute to economic growth for particular regions or countries through the monopoly rents the innovations command, a process that some see as favouring countries that are already affluent, and products and processes developed for, or accessible chiefly to, the world's rich. *Research policies*, which encourage the production of new knowledge, increasingly emphasize adjusting research agendas to the needs of innovating industries, and are thus more and more implicated over time in the inequalities that innovation produces. Yet because research policies are set in the public sphere, they are also often the object of attempts by disadvantaged groups to increase knowledge about solutions to their own problems. Research policies are seen as a subset of innovation policies. *Human resource policies*, which attempt to assure an adequate supply of scientists and engineers for an innovating economy, are caught in the tension between egalitarian domestic objectives and the need to compete for top talent on a global market. Human resource policies cover a much broader terrain than innovation policies and research policies, but overlap and interact with the latter.

In addition to these three primary strands of policy, *Regulatory or Accountability policies* and processes, framed directly to respond to the distribution of benefits and harms in developing new S&T priorities, or in trying to shape the production and use of what already exists, may cut across any of them, as may broad international and world regional *regimes shaping trade and intellectual property*. Like human resource policies accountability and regulatory policies are also much broader, but to have good innovation policies that work we have to take the regulatory and accountability issues and policies into account. By their very nature innovation policies may be in tension with existing traditions in regulation and accountability.

It is this last - politically constructed configuration of institutional structures and power relations that are the focus of ResIST's first stream of work –

POLICY DIMENSIONS OF THE GLOBAL KNOWLEDGE ECONOMY –

This is important because it always sets the frame of national action, and sometimes tightly constrains it, and also because although from the perspective of individual developing country it may seem coercive and fixed to the, it is relatively young and quite dynamic system whose rules are still in flux. Two papers developed our early analysis of these issues: Cozzens, Kallerud, Ackers, Gill and Pereira (2006)[2] and Cozzens, Kallerud, Ackers, Gill, Harper, Pereira and Zarb-Adami (2007)[3].

[2] Susan Cozzens, Egil Kallerud, Louise Ackers, Bryony Gill, Tiago Pereira (2006): *Science, Technology, and Inequalities in the Global Knowledge Economy: Policy Dimensions. Preliminary position paper.* Available at:

One source of this dynamic at national level is the relationship between two challenges which policymakers face: a competitiveness challenge of closing gaps (or maintaining leads) in national performance, and a social cohesion challenge of sharing the benefits of economic growth broadly.

Narrow high-tech focused versions of the knowledge economy, focused on competitiveness, load the dice in favour of those particular advanced knowledge economies which are best placed to succeed in these particular industries, and restrict the range of policy options and strategies for the knowledge economy. The creation of "level" playing fields in single areas like intellectual property policy, for example, may cement the competitive advantage of the already strong players of the game.

However, we now understand that innovation needs to be thought of in broader and more systemic terms: the effective commercial and social exploitation of new knowledge depends on a combination of complementary assets, competencies and conditions, and require policies going way beyond R&D and innovation to the educational, industrial and social. R&D contributes to innovation not only as immediate source of innovations, but also by expanding and enhancing the capacity of people, firms and institutions to assimilate knowledge and put it to productive use. This is why it is important that knowledge production is strongly connected to the needs and capacities of local communities through more open innovation systems and knowledge exchange strategies linking researchers and end-users.

The social cohesion approach is one such strategy. It focuses on reducing inequalities in order to spread the benefits and costs of technological advance more evenly, creating win-win situations. We see reducing inequality to be a step towards "social inclusion" and "social cohesion," a general policy goal in many countries.

The papers explore different understandings of, and policy approaches to, inequality at national, European and global levels. The national cases are Portugal, Britain, Brazil, Mozambique, and South Africa. At this national level, *human resource policies* are often aimed at reducing inequalities in capacity, through programmes that recruit women or members of under-represented ethnic minorities into science and engineering careers or by building institutional capacity in disadvantaged communities. *Innovation policies* generally respond primarily to the competitiveness agenda, but can also be directed in pro-poor ways by putting jobs front and center and focusing on pro-poor technologies. *Research and regulatory policies* often become re-distributional through the active participation of civil society groups.

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http://www.resist-research.net/cms/site/docs/WP1-Preliminary%20position%20paper_Del_1_Final_09-11-06.pdf

[3] Susan E. Cozzens, Egil Kallerud, Louise Ackers, Bryony Gill, Jennifer Harper, Tiago Santos Pereira, Noel Zarb-Adami (2007): *Problems of Inequality in Science, Technology and Innovation Policy*. Available at:

http://www.resist-research.net/cms/site/docs/WP1-2_final.pdf

At European level, there is an unresolved tension between concentrating STI resources for competitiveness and spreading them around the region to achieve cohesion.

At international level, while intellectual property laws are creating advantages for countries with strong STI capabilities already, there are many organizations, including the development banks, the United Nations and its agencies, foundations, and non-governmental organizations, that put significant effort into directing innovation toward human needs, empowering women, and activating communities to solve their own problems actively and demand accountability from the public sector.

The team conclude that there is an emerging social cohesion agenda in science, technology, and innovation policy, but that there is ample room to expand its scope and sharpen its policy and programme tools. This is likely to be achieved through strengthening interdependencies between three dimensions of science, technology and innovation systems:

structural - the organization and distribution of STI resources and capacities;

representational - concerning political power and voice, and accountability processes;

distributional – who gets the benefits and who bears the costs of S&T.

The second stream of ResIST work takes up the key element of the structural element of S&T systems – the development, organization, distribution and use of highly qualified scientific and technological personnel, and the consequential

Policy Tensions between promoting Scientific Mobility, and achieving Balanced Growth

Three of ResIST's first set of papers pursue these issues: Elci, Sezal, Buehrer & colleagues, Mouton, Boshoff & colleagues, Ackers and Gill (2007)[4] look in detail at four countries that are the core cases in ResIST's mobility studies later in the project: Turkey and Germany (looking primarily at the movement of engineers), and South Africa and the United Kingdom (with a focus on health sciences); Gill & Ackers (2007)[5] examine migration and career policies affecting researchers in the European Research Area; whilst Mouton, Boshoff, Kulati and Teng-Zeng (2007)[6]

[4] Sirin Elci & Ihsan Sezal, Susanne Buehrer & colleagues, Johann Mouton & Nelius Boshoff and colleagues, Louise Ackers and Bryony Gill (2007) *Supporting Sustainable Scientific Mobility: Country Reports from Turkey, Germany, South Africa and the United Kingdom.* Available at:

http://www.resist-research.net/cms/site/docs/WP2%20Integrated%20Country%20Reports%205-8%20Final.pdf

[5] Bryony Gill and Louise Ackers (2007) *Researchers in the European Research Area.* Available at:

http://www.resist-research.net/cms/site/docs/WP2%20Integrated%20Country%20Reports%205-8%20Final.pdf

[6] Johann Mouton, Nelius Boshoff, Tembile Kulati and Frank Teng-Zeng (2007) *Scientific Mobility and the African Diaspora.* Available at:

http://www.resist-research.net/cms/site/docs/Mouton%20et%20al%20African%20diaspora,%20del%204%20(cont)%20final%20WP2.pdf

look at how net out-migration of the highly–qualified affects a range of African countries – chiefly to the benefit of Europe or the United States - and examine attempts to devise policies to encourage highly qualified scientists and technologists to remain or return.

Country studies of building and maintaining scientific capacity

Turkey illustrates that EU candidate states face significant challenges in trying to build and maintain scientific capacity. "Increasing the number and quality of scientists" is one of the three main objectives set in 2004 by Turkey's Supreme Council of Science and Technology (BTYK), the highest level policy making and co-ordination body headed by the Prime Minister. International mobility has been encouraged by various institutions in Turkey since the 1920s. The main organisations providing scholarships for this purpose include the Ministries, The Higher Education Council, The Science and Technology Agency TUBITAK, NGOs and international organisations. On the other hand 59 percent of scientists studying abroad do not return to the country. Reasons given for this include political instability, lack of facilities and equipment, and limited and poorly paid jobs in Turkey. While the programmes implemented by TUBITAK aim to help prevent or reverse the brain drain, there are as yet no direct measures to encourage the return of skilled researchers. The BTYK discussed, for the first time, at its meeting on 7 March 2007 the need to develop measures to reverse the brain drain.

Germany constitutes one of the pulls on the highly qualified from Turkey. Overall, the largest share of foreign students in 2005 in Germany was in natural sciences/ mathematics, followed by medicine and in last place engineering technologies. With regard to Turkish first degree students, business sciences, informatics, engineering/ technology and electrical engineering are the most important fields, but looking at the rank Turkish students have compared to other foreign students, the most important disciplines are informatics and electrical engineering, engineering/ technology as well as industrial engineering.

The Russian Federation, India and China had the largest number of postgraduate students at German higher education institutions in 2004, whereas Turkey ranks in 9th position (with 236 postgraduates). Turkish scientists/professors in funded German posts are mainly from the field of mathematics and natural sciences (134), but also including the fields of languages/cultural sciences and sports (72), law/ economics & business administration/ social sciences (42), and engineering (36).

Migration of researchers in the Physical Sciences and Engineering between Turkey and Germany, and returnees, will be explored further in the course of ResIST, as will migration of researchers in the health sciences between South Africa and the UK, again in the hope of being able to understand mobility choices, and thus make more robust policy recommendations.

In South Africa health research attracted 15% of total R&D expenditure in 2004 - second only to engineering.

Between 1999 and 2004 the numbers of newly graduating health researchers increased by 19% at bachelor's level, by 56% at masters level, and 53% at doctoral level. If we compare the health sciences to other fields, the health sciences have larger numbers of students enrolling and graduating in both the first professional

degree and the masters degree than any other field. Life and physical sciences, however, are greater in number for enrolments and graduates for the doctoral degree.

The share of foreign students enrolled for a masters and doctoral degree in health sciences remained more or less constant at 13%-14% per year during the period 2001 to 2004. With regard to graduation figures (masters and doctoral) larger fluctuations can be observed. For instance, in 2004, foreigners comprised about 21% of masters degree awardees in health, compared to 13% in 2003. Respectively about 77% and 59% of students who graduated with a masters or doctoral degree between 2000 and 2004 were from African countries.

Offsetting this growth in the newly trained, a 2006 OECD study reveals that a total of 37% South African doctors are working in the following eight countries: Australia, Canada, Finland, France, Germany, Portugal, UK and the USA. This makes South Africa the largest Sub-Saharan African "supplier" of medical doctors to the developed world (World Health Report, 2006).

For the period 1990 to 2003 the proportion of professionals leaving the country and moving to the United Kingdom declined from about one third to about one quarter. 18% of such emigrants are health professionals. In a 2004 study by the WHO more than half (58.3%) of the health professionals interviewed for the study in 2002, indicated that they considered leaving the country. Of these, 52% indicated that they considered the UK as a destination. The next biggest intended destination for these respondents was Australia, with 10%. A big inflow from other African countries in the early 1990s was effectively blocked by a moratorium on recruitment by the Health Professional Council; since then international recruitment has been from Cuba, Tunisia, Iran and Russia.

Current policies to control international flows include a memorandum of understanding about health professional recruitment with the UK, ministerial meetings to reinforce it, codes of practice and policy governing the Commonwealth, and with the Southern African Development Community.

The United Kingdom's pull on highly-skilled health researchers from South Africa has in recent history been at least as strong as Germany's on Turkish researchers in the physical sciences and engineering. One study shows the UK and Germany host over half of all reported tertiary level foreign students in the EU. European Commission statistics on undergraduate mobility present a similar picture, once again identifying the UK and Germany as key receiving countries. The combined figures for undergraduate mobility within the UK, Germany and France exceed the proportion of foreign students in the US. Subjects allied to medicine had the largest number of students registered in 2005/06 (as a total of undergraduate and postgraduate, full and part time). There were 55,960 full time and part-time undergraduate and postgraduate students studying Medicine & Dentistry in 2004-05, of these eighty six per cent were domiciled in the UK prior to starting their studies, four per cent were domiciled in the EU and the remaining ten per cent had come from outside the EU.

Of the 149,520 undergraduate and postgraduate students in the biological sciences in 2004-05 91% were ordinarily domiciled in the UK prior to starting their studies, four per cent had been previously living in the EU and five per cent had lived elsewhere internationally. In the UK in the academic year 2003/2004 15,255 PhDs

were awarded, the majority of which (11,680) were for full-time study. Biological and physical sciences together accounted for just under a third of all registrations (HESA, 2005). 59% of total doctorates awarded to full-time students in 2003/4 were to students who were domiciled in the UK prior to their PhD and 41% came from abroad. Thus a larger proportion of higher degrees in the health sciences are being undertaken by migrants.

In 2005 there were 232,380 doctors registered in the UK. Of these, 69 per cent had received their primary medical qualification in the UK, a further nine per cent in India, 3 per cent in South Africa and Ireland respectively and two per cent in Pakistan. By 2007 the number of doctors had increased to 239,845 but the proportion of doctors who were awarded their primary qualification in the UK had decreased to 62.5%, with 12 per cent trained in India and the second largest group having trained in South Africa. In order to attract health workers to the NHS a global advertising campaign was launched in 2001. Of the additional physicians, trained overseas, that were recruited in 2002 and 2003 twenty-four per cent were from sub-Saharan Africa. However, the UK government is keen not to extensively recruit from developing regions and have produced some guidelines to this effect, and the introduction of an Australian style points system for migrants, combined with the UK's failure to introduce the "scientific visa" package, suggests the advent of a much more restricted approach.

Researchers in the European Research Area

The second paper in this stream of ResIST work charts the policies towards scientists and technologists in Europe and the distribution of such 'knowledge workers' across countries and sectors. The Lisbon European Council of March 2000 established a strategic goal for the EU to become 'the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth'. The European Research Area (ERA) is central to the achievement of the Lisbon strategy through increasing the volume, quality and interconnectedness of researchers, in the interests both of higher research standards and of enlisting these in the service of competitiveness. The ERA has reshaped scientific governance within the EU, with the adoption of European-wide targets and the assessment of individual countries in relation to them.

Analysis of Europe's competitive position suggests that the US continues to 'race ahead through…its ability to retain the highest calibre researchers…and its active policy of immigration for the best and the brightest', and the effective use of human capital underpins the success of the ERA.

The Commission calculates that 700,000 new scientists (in addition to those required to respond to demographic concerns) will be needed in Europe by 2010 to meet the Lisbon objectives. In addition there is a concern to encourage labour mobility to respond to imbalances in supply and demand across sectors and regions. Mobility is thus central to the ERA strategy in two respects – firstly, increasing the *volume* of human capital through policies to retain researchers in the ERA and attract new researchers to the ERA from third countries; and secondly, shaping the distribution of this human capital within the boundaries of the ERA. These two goals are often linked in that European Centres of Excellence are important in keeping scientists in the ERA and in attracting them to it.

Thus the concepts of the ERA and knowledge economy are inextricably linked to the utilization of human capital and research capacity.

The report maps out key factors in relation to R&D personnel in the EU: investment in R&D, the distribution of R&D personnel, and internationalisation and mobility in the ERA. It provides evidence of the great diversification between member states in expenditure on science, sizes of research communities and the sectors in which research is conducted. Levels of internationalisation, clustering policy and mobility drives towards scientific hotspots may exacerbate these differences. Inherent in the European Research Area strategy lies a fundamental tension between the pursuit of two different dimensions of equality, namely individual equity (and the individual human right not to be discriminated against on grounds of nationality) and sustainable development within the European Union (sometimes referred to as 'balanced growth'). Although they are often not expressed as such, concerns around 'brain drain' within the ERA – and policy responses to it - need to be understood as facets of this wider debate.

Is there a fundamental tension between the commitment to individual equity and agency on the one hand and sustainable economic growth on the other or is the situation more complex and nuanced? Can the concept of capabilities, as Barnard et al propose, help us to understand these processes and gain a more accurate and nuanced understanding of what has become known as 'brain drain'. Viewed in this light, European social policy plays a critical role in supporting economic progress and ensuring optimal productivity or as the authors put it, 'European social law and policy can now be firmly regarded as a 'productive factor' which aids competition rather than hindering it. In this context, the promotion of equality and quality (through competition) go hand-in-hand.'

The Lisbon objectives refer explicitly to the idea of 'sustainable economic growth'. What is unclear, however, is the unit of analysis. If one takes the whole of the ERA as the appropriate level of analysis then one might argue, as many scientists indeed concur, that intra-EU mobility is effectively no different to internal mobility within an individual Member State. On the other hand, if the aggregate effect of individual career and migration decisions, fuelled by policy and resource allocation decisions within the ERA, leads to serious imbalances in flows then one might question the compatibility of free market economics with sustainability at Member State level. At another level, there are no guarantees about the benign effects of such free-market systems on developing countries.

The third in this set of papers on human capital confronts this issue of the conditions and available choices of the developing world, specifically in relation to –

Scientific Mobility and the African Diaspora

Such evidence that is available about such flows suggests that the skilled migration pattern is highly complex. For, example, there may be an 'internal brain drain' from other sub-Saharan African countries to South Africa, and there may also be an intra-country brain drain from academia to government and industry fuelled by stagnant salaries in many African higher education systems. These may present a

more serious if not permanent loss to the academic workforce than the outflow to overseas higher education.

There is lack of data and of common standards for collecting it, but the scale the outflow of HSP from Africa is indicated from many sources, among them:

- The Commission for Africa estimates that around 70% of Ghanaian medical officers trained in the 1990s have left the country;
- The Zimbabwe National Association of Social Workers estimates that 1500 of the country's 3000 trained social workers emigrated to the UK over 10 years;
- It has been estimated that there are more African scientists and engineers working in the USA than in the whole of Africa; furthermore, US data shows that, on average, only 50% of overseas graduates return to their country of origin at the completion of their studies and that the rate of return has been declining despite the increasing volume of immigration to the US. The offsetting opportunities for 'brain gain' are limited in countries where the rate of return is low.

The paper briefly examines skills and migration in industrialised economies (Canada, the U.K., Australia, and the United States),in newly industrialising economies (India, Republic of Korea, Malaysia and Brazil) before the migration situation in Africa and initiatives to address the brain drain (including a review of Lowell's classification of interventions to address the brain drain – reparation, restrictions, recruitment, return, and retention, and one Lowell doesn't mention, the role of remittances.

The paper concludes with a discussion of some conceptual issues and future research.

It notes that the prevailing advice to developing countries – that they ought to manage it by creating a favourable domestic (political and economic) climate that will make it possible not only for their skilled émigrés to return, but for these countries to attract other (developed) countries' HSP as well – hence the notion of a brain 'exchange'. The problem, however, is that not only does this advice sound very much like that which used to be dispensed by the IMF to struggling economies in the South *via* its Structural Adjustment Programmes: if only the developing countries could embrace the free market principle of liberalising their economies by lowering or breaking down their tariff barriers and introducing flexible labour markets, all will be fine. And, as we know, this remedy didn't work for the developing countries. As Meyer *et al* (2001) have noted, the international mobility of HSP is not simply a consequence of a neutral and/or market co-ordinated operation of the global supply and demand of labour. These knowledge flows are also, and perhaps pre-eminently, influenced by the highly selective nature of the immigration policies of most OECD countries; and it is only these OECD countries (plus Taiwan, India and China) that have to some extent reversed the unidirectional outflow of skilled workers and thus showed evidence of 'brain circulation'.

Since one of the key issues or concerns regarding these diasporal networks is their sustainability, it is surprising that there is not much discussion within the literature with regard to how these diaspora knowledge networks can – or should – be institutionalised, and what the benefits or disadvantages of such institutionalisation would be. One is thinking of the absence in the literature of the

role that (international) bilateral partnerships between universities could be used as a vehicle for fostering linkages between diasporal networks and their home countries, rather than leaving this to individual volition and effort. Other issues that have b require further research and investigation are the following:

• Are 'Southern' countries whose universities have established linkages through knowledge-producing networks with their counterparts in the North less likely to experience brain drain (and instead more brain circulation) than those countries without such networks, other things – such as political and economic stability – being equal?

• To what extent are the new modes of knowledge production fuelling the brain drain or the outflow of highly-skilled knowledge workers from developing countries?

• To what extent do bilateral agreements and partnerships between countries provide an opportunity for diasporal networks to get involved in long-term initiatives, especially if these are driven by institutionalised and well-funded projects in which universities from the participating countries participate?

• If South Africa can be regarded as a semi-peripheral country – in that, in terms of the world systems approach, it is a regional power that is attracting skilled personnel from other African countries on the one hand, whilst also experiencing its own skills-flight to other Northern countries – what strategies should it be looking at in promoting brain circulation?

The third stream of ResIST's work is –

ARTICULATING NEW ACCOUNTABILITY SYSTEMS

Systems of accountability are the means by which the potential distributional consequences of science and policy and practices can be recognised and assessed — and potentially incorporated — by formal elements of the political system. For this reason alternative accountability systems attuned to the needs of the disadvantaged are important to ResIST as possible first steps for reorienting scientific governance towards greater social inclusion in building S&T priorities and in distributing its products. The paper produced under this stream of work[7] provides a preliminary framework for the analysis of alternative accountability systems in two contexts:

- the design, development, availability and use of mundane, everyday technologies and what is the scope of accountability processes to address the distribution of benefits and costs associated with them;
- experimental initiatives in bottom-up capacity building and priority setting, often specifically designed with the aim of remediating inequality.

The first section of the paper is a discussion of social science approaches to accountability. It focuses on the differences between the notions of accountability in public, accountability of public and accountability for public, although these three areas often overlap in instances of accountability. Accountability *in* public relates to the sense in which forms of interaction are occasions of accountability.

[7] Daniel Neyland and Steve Woolgar, João Nunes, Marisa Matias, Ana Matos and Daniel Neves, and Rob Hagendijk (2007) *Articulating New Accountability Systems: Preliminary Integrated Framework.* Available at: http://www.resist-research.net/cms/site/docs/WP3%20Preliminary%20Integrated%20Framework%20Final.pdf

Accountability *of* public focuses more narrowly on those occasions where groups of people are rendered available to be held to account through, for example, surveillance systems (airport security, CCTV cameras, speed cameras and so on) or some other notable mechanism for accounting. Accountability *for* public refers to those actions understood as carried out, usually by an organisation, on behalf of an often unspecified mass audience. The section on accountability for public includes an extended discussion of the relationship between *transparency* and *accountability.*

The links between the discussion of the above notions of accountability and case studies on redistributional issues associated with the design, development, access to and use of mundane, everyday technologies are analysed. The research team is exploring three case studies to throw light on these issues:

Textiles. Clothing forms a ubiquitous aspect of consumer lifestyles in the developed world. However, often t-shirts are produced in developing countries, where questions are asked of labour conditions, safety and hours of work. Subsequent to use in the west, t-shirts are often donated to charities and shipped back to the developing world where they form the focus of emerging industries for accessing, distributing and owning such garments. How could these contexts of production, shipping, usage, shipping (again), re-distribution and usage (again) be connected through policy developments? Could a system of accountability be developed for encouraging the connectivity of these locales to be constituted in such a way as to be advantageous to the developing world?

Vaccines. Vaccines can form a pervasive, mundane and routine expectation within societies of the developed world (aside from questions of the reliability of MMR and questions of the availability of flu vaccines). However, the absence of, and political controversies pertaining to, vaccines in the developing world require that many aspects of day to day routine are organised around attempts (and failures) to gain access to vaccines in appropriate settings, within appropriate time frames, for appropriate sections of a population. Much of this access and routine expectation derive from vaccine development and ownership by developed societies. How might these contexts of vaccination be drawn into a connected system of accountability? How might such a system be developed in order to enhance the health and well being of those in the developing world?

E-waste. With the growing use and disposal of IT equipment, questions are being asked of where waste should go, how IT should be dismantled and what impacts such e-waste is having on particular locales. Currently it appears that the far-east provides the context for the development of IT, the western world provides the context for much IT use and the developing world (particularly India, China and Africa) provides the context for IT disposal. This case-study will ask: how can these contexts be drawn together through policy so that developers and users are also aware of, and perhaps more responsible for, disposal issues? What are the most appropriate ways for disposing of e-waste? Can we develop reliable mechanisms for holding to account developers, users and the contexts of disposal in order to enhance benefits of this connectivity of locales for those in the developing world?

The paper's second section designs a framework for the study of initiatives aimed at addressing issues of inequality as they are related to the active engagement of concerned actors, namely deprived population, and public bodies and institutions. This task is pursued through the identification and characterization of the

procedures which allow public policies to be made publicly accountable for their effects on inequalities. In that sense, the very basic concepts of the ResIST project — equality and inequalities; science, technology and knowledge(s) and accountability — are addressed, as well as the way these concepts are linked to current debates on democracy, citizen action, accountability and the co-production of knowledge and social order. The way these discussions are connected to the identification and development of case studies on experimental initiatives in capacity building and priority setting which aim at the remediation of inequality is considered in the final part of this section. A first set of case studies are on the ways in which accountability procedures are organized and enacted in relation to public policies with constitutive attachments to specific configurations of knowledge:

Participatory budgeting (PB). With Brazilian origins, PB initiatives are related to democratization processes that begun in the late 1980's. These kinds of experiences are, at the present moment, spread all over the world, and imply the participation of citizens in the processes of defining budget applications, as well as in the conception of public policies. These processes allow the re-examination, and possible inversion of priorities in the application of public funds, as well as the public control of the administration. Different PB processes were studied: in Belo Horizonte, Brazil; in S. Brás de Alportel, Portugal; and in Seville, Spain.

Health Management Councils (HMC). Also with Brazilian roots, the HMC relate to participatory practices in the field of health. Social actors organize themselves collectively, claiming access to health as a basic right. HMCs are institutionalized fora composed of, at least, 50% representatives of citizens or citizen organisations, the other 50% including professionals and agents of administration. Their objective is to deliberate and make binding decisions on the definition of health policies and the allocation of public resources for health care, and, in some cases, research on health. HMCs exists at the federal state and municipal levels. The case explored in this study is that of the municipal HMC of Belo Horizonte, Brazil.

A second set of case studies, on *public health*, in Brazil, is in progress. The initiatives dealt with in these case studies engage with the effects of different forms of inequality on the generation of vulnerabilities in specific populations and on the attempts to deal with these through collective action and collaborative production of knowledge and interventions in public health.

Environmental health and environmental justice. The Brazilian national environmental justice network has as its main field of action the articulation of environmental struggles and social justice. A specific action will be examined in detail: the campaign against the plans to allow the import of used tyres from the European Union to Brazil.

Programmes for fighting and controlling endemic diseases. The focus of this case study is on initiatives in health promotion inspired by the project of collective health, a brand of public health developed in the Latin America and associated with a conception of health as the outcome of the intersection of, and articulation of ecological, social, and political processes. The case study will engage specifically with the initiatives for the control of vector diseases in the urban areas of Rio de Janeiro and Recife, and, in particular, with those based on ecosystemic and ecosocial approaches.

As the project develops, the conceptual issues addressed in the first section regarding accountability will be revised in the second section in relation to these case studies of innovative procedures of public accountability. The role of S&T in these experiences will be explored as part of the broader process of generating new configurations of knowledge associated with situated responses to inequality.

The fourth stream of ResIST's work focuses on

THE DISTRIBUTIONAL CONSEQUENCES OF EMERGING TECHNOLOGIES,

an area where research and innovation policy meet. Emerging technologies are important because many countries in the developing world try to develop capacity in these areas in order not to be left out of global technological change; because there are reasons to think that such technologies increase inequalities; because there are fears that, as technological sophistication proceeds, the entry price to new technologies may raise, and because it may be that early intervention may change these distributive effects. ResIST's first working paper (Cozzens, Gatchair and Thakur, 2006)[8] combines hypotheses on the consequences of emerging technologies for inequalities into a qualitative model for use in analysing specific situations.

This initial paper's goal is to think carefully enough about the connections between emerging technologies, public and private policies, and a variety of inequalities, en route to constructing the model. The paper starts to hypothesise the relationships between an independent variable, technological projects; mediating or intervening variables, in the form of national characteristics and public interventions which may have four broad distributive approaches – utilitarian, pro-poor, equalizing or egalitarian; and the dependent variable in the model, distributional consequences - the effects of the technologies on inequalities in the distribution of things people value - income, health, education, social capital, cultural expression or political power. ResIST's ultimate goal for this stream of work is to develop options for decision makers in the private and public sectors to help emerging technologies reduce rather than increase inequalities.

Part 2 – Developing the CARE Model

The fifth and final stream of ResIST work -

PROMOTING BALANCED GROWTH WITHIN THE ERA AND BETWEEN THE ERA AND OTHER WORLD REGIONS

attempts to integrate the other four streams, intellectually, and by engaging with policymakers and practitioners, in focusing on potential uses of the research. This work is known within ResIST as stream 0 (zero).

Three types of inequality and the CARE model

[8] Susan E. Cozzens, Sonia Gatchair, and Danaraj Thakur, (2006): *Distributional Assessment of Emerging Technologies: A Framework for Analysis.* Available at:

http://www.resist-research.net/cms/site/docs/Cozzens%20et%20al%20Frameworks%20WP4%20del%2021-27%20Final.pdf

Conceptually, all ResIST's work in the four streams above can be seen as being organized around three types of inequality: structural, representational and distributional, which were introduced to us in the stream 1 paper summarized on page 3. The three types of inequality can be briefly characterized as inequalities in individual and institutional capacities (the primary concern of stream 2), in representation and accountability (stream 3), and in sharing benefits and costs (stream 4). Stream 1, which is concerned with policies, institutions and processes at national, European and global levels, is interested in all three types of inequality.

The preliminary paper from this stream[9] describes the concepts and how they work together, illustrating them with examples drawn from ResIST's first year of work. In 2006-07, the ResIST team consulted with policy audiences in three world regions, heard from them about their local issues and examples, and started work on case studies under three work packages. This framework paper uses the concepts of structural, representational, and distributional inequalities to link the continuing research in the work packages to what we heard from policy audiences about the distributional issues of relevance to them.

The three types of inequality (section I of the paper) form conditions for each other. High levels of inequality in one contribute to high levels in another; and conversely, decreasing inequality in one can help to decrease inequality in the others.

We see the three types of inequalities as three moments in a cycle of change. Structural inequalities, that is, the unequal distribution of capacities, are a starting condition for processes of distribution. Representational inequalities in politics and socio-economic and cultural activities contribute to inequalities in levels and forms of accountability – that is, to making visible whose interests are embodied in proposed solutions. Structural and representational factors combine to produce inequalities in effects, that is, in the distribution of benefits and costs for various individuals and households. Together, they form a cycle of CARE, a wheel that can spin for better or worse (see figure 1). Inequalities in capacity contribute to inequalities in representation, which in turn perpetuate inequalities in the distribution of benefits and costs. Conversely, greater equality in capacity across groups and communities can contribute to more accountability in decision processes that lead to real improvements in basic needs for a broader range of communities.

[9] Susan E. Cozzens, Rob Hagendijk, Peter Healey and Tiago Santos Pereira (2007): *A Framework for Analyzing Science, Technology and Inequalities: Preliminary Observations.* Available at:

http://www.resist-research.net/cms/site/docs/WPO%20Del%2032%20Final.pdf

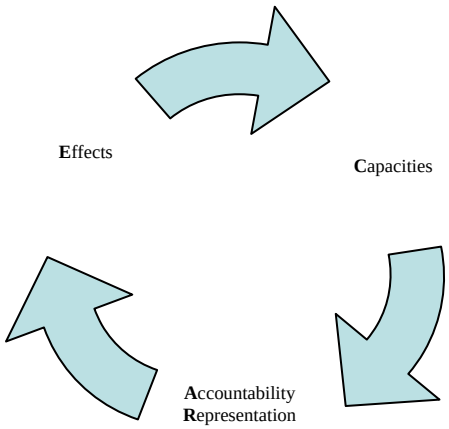

Figure 1 – the CARE cycle

Policy contexts (section II). The central challenge for ResIST is to use these concepts to develop tools that would allow policymakers to assess the distributional effects of their knowledge-intensive programmes, either prospectively or retrospectively. Their decision environments are complex. They need to take into account external factors, relevant actors, rationales for action, and the instruments available.

This section of the paper draws on a review of national policy documents from several ResIST participant countries and on presentations at the three world regional meetings. These countries serve as examples of the various strata of the world economic system and different levels of S&T capability. Mozambique is a low income country; Turkey and South Africa are upper middle income countries and Brazil falls just below the cut-off for this group. The UK and Portugal are both high income countries. While the profile varies across countries, each country has room for significant steps forward in all three areas, and thus for benefits in social cohesion.

Case study contrasts (section III) and *Policy options* (section IV). Applications of the concepts in illustrative stakeholder case studies reveal complex tradeoffs and no easy solutions. Yet the analysis of our cases should result in valuable suggestions and proposals for improved policies that reflect greater sensitivity to trade-offs and potential pitfalls.

Contextual influences on the CARE cycle

It is clear from our dialogues in national contexts that any solutions developed using the three concepts will need to be tailored to particular national histories and circumstances. Mozambique's current crying need for capacity creates a different set of tradeoffs on accountability than those that would be made in Portugal, for example. Turkey's relationship to Europe puts the options being explored there upfront and central in the policy agenda, even when the circumstances are quite different. Brazil's popular government requires explicit labeling of social inclusion efforts, but its large population, modest capacity, and

internal inequalities may make real progress on the agenda more difficult than in poorer countries.

Thus ResIST's research highlights the importance of external, contextual factors such as national contexts, policy integration, funding schemes for S&T, S&T market strategies, cultural values and others, in the functioning of the cycle of CARE. The cycle operates in a multidimensional space with all these external factors impinging on each of the three elements that constitute the cycle. In our second year of work we have sought to incorporate this understanding in a new version of the model.

To facilitate the analysis we have grouped all these factors in three main groups: political commitments and governance arrangements, cultural norms and values, and economy and resources.

The *political and governance arrangements* comprise the current political vision of the development path, and the associated somewhat longer term values and processes for consultation and implementation that define the role of the Government, its relationship with civil society and other national actors, and with the international community. These arrangements will influence the scope of policy alignment and integration across government, and the balance that is struck between the norms and policies of international frameworks and participatory approaches, accountability and representation within the country. These in turn shape the ability to mobilize capacity for development.

Cultural values are the socio-cultural traditions that are expressed in the way of life of a community. They influence the level of social mobilization of energy for development, its preferred forms, and who participates in it. They can be a strong factor to reduce inequalities, particularly distributional and representational, but can also be an impediment when not taken into consideration during the choice of technologies to be promoted and the specific pathways of innovation and change. In the case of crops, for instance, preferences with regard to taste, texture, and colour are fundamental to the adoption of new varieties and the lines of a breeding programmeme.

Resources is a broad term that encompasses not only financial and human resources, but also the world regional or global mechanisms and organizational instruments that are needed for mobilization of these resources for the implementation of STI policies. This factor plays an important role in reducing distributional and structural inequalities. Unfortunately, in the case of poor countries, the access to these resources is highly dependent on wider bilateral and multilateral policies. A key question is how far these totally reshape the parameters for representation and accountability and thus come to define political and governance arrangements.

The embodiment of these contextual variables in the CARE model is shown in figure 2. Their influence can disrupt the cycle, creating unbalances and unexpected results.

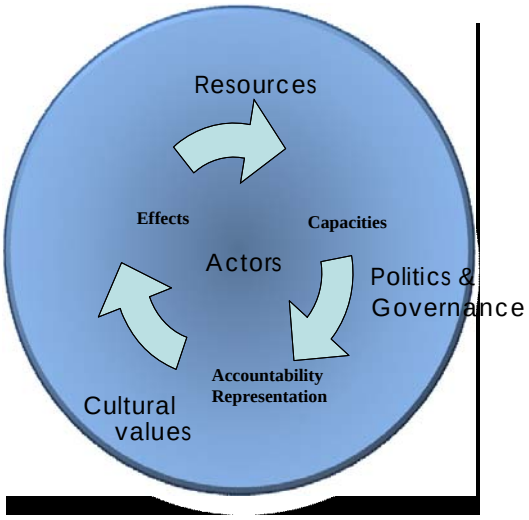

Figure 2 – contextual influences on the CARE cycle

Clearly this model is very far from complete. Clearly the contextual variables are seen as drivers and determinants, at least in shorter time horizons. We will try to elaborate the model in the course of the third year of the project. Our first step will be tol use the elaborated CARE model as one frame for analysis of the case studies in year 3. This will help us analyse our case studies more consistently and fruitfully, and also be clearer about the components and articulation of the model and its ability to inform S&T policy in the context for development.

In part three of this report we start on the more limited but still useful exercise of looking across ResIST's four streams of work – drawing on desk analysis, case studies and meetings with stakeholders - to provide empirical evidence of the different types of inequality.

Part 3 - Contextual influences and the forms of inequality

Structural Inequalities (Capacities)[10]

Many concepts that are used to think about science and technology incorporate terms from economics. Thus, the enterprise is seen to involve several types of capital (including physical, intellectual, human, and social) and several types of flows (including funds, knowledge, research materials, and people). The concept of structural inequalities in ResIST refers to unequal capital assets, and our analysis focuses on the processes (flows) that build up or diminish those assets.

Our particular focus is on human capital and more specifically on scientists and engineers. Several dimensions of inequality characterize the distribution of human capital. National-level data on number of scientists and engineers, either in absolute or per capita terms, show great inequalities between countries and groups of countries.[11] Within countries, scientists and engineers and the institutions they work in tend to be concentrated in capital cities or a few other urban areas, thus often creating urban/rural differences in capacity.

These differences between geographic regions grow on a substrate of other kinds of inequalities within geographic areas, in particular the interactions of socioeconomic, ethnic, gender, and educational inequalities. Human capital theory predicts the relationship. The process of building science and engineering human capital (that is, providing advanced education in these areas) builds on more general forms of human capital investment (that is, primary and secondary education). Thus groups that are disadvantaged at the lower levels will probably be at least if not more disadvantaged at higher levels, through a process of cumulative (dis)advantage. For example, children from families carrying the health burdens of polluted environments are less likely to do well at school, and thus less likely to move forward into higher education or science and engineering careers.

The process of geographic cumulative advantage also characterizes the flows of people in the system. Places with fewer resources provide less attractive environments for scientists and engineers than those with more resources. So there is generally a flow from rural to urban within countries, and from less affluent to more affluent countries.

This situation sets up a tension that ResIST is exploring. National governments invest heavily in human capital by subsidizing education at all levels, including fellowship programmes for scientists and engineers to be trained abroad. But once the investment is made, an individual embodies it and can in principle carry it elsewhere. What is the proper balance between the state's interest in investing in human capital for development at home and the individual's freedom to go where the market and conditions are best for him or her? How can governments in the economically and technologically advanced regions of the world balance the import of highly skilled labour from low income countries with the responsibility to help developing knowledge infrastructures in poor and less developed regions?

[10] ResIST Description of Work, p. 6, 17, 31-33

[11] See Technology Achievement Index, http://hdr.undp.org/reports/global/2001/en/pdf/techindex.pdf, accessed April 22, 2007.

ResIST Work Package Two is exploring these issues, and they came up in our stakeholder consultations as well.

More and more countries are addressing the loss of scientists and engineers through migration with increased efforts to recruit into science and engineering careers domestically. These efforts are often specifically targeted to groups within the country that are currently under-represented in science and engineering careers, usually women and historically disadvantaged ethnic or religious groups. Thus one cycle of cumulative advantage and disadvantage intersects with the other. Work Package Two is exploring the gender dimension of these issues, and stakeholders also raised the ethnic dimensions.

During our second year of research, it has become clear that creation of capacity does not automatically improve representation and the distribution of the effects of S&T. If the capacity created is not quickly mobilized and harnessed to key developmental goals for the country it will have little impact on development, much less in reducing inequalities in society. In effect, it can exacerbate inequalities, when poor countries themselves carrying the burden of educating human resources for richer countries and local elites that are not optimally geared towards achieving towards well-balanced developmental goals.

An interesting example of the effects of intellectual migration can be found on the research done under WP1. Although the S&T and innovation polices analysed articulate quite well the goal of economic growth and issues related to inequalities, in particular for Brazil, Mozambique and South Africa, the programmes implemented under the policy framework do not always lead to the virtuous cycle of CARE. The examples show that reason for the failure of the cycle of CARE lies in what we have called here the politics and governance which may or may not support and promote comprehensive policy integration geared towards poverty reduction as well as catching up socially and economically with the global knowledge society. We argue that S&T and innovation policy, whilst necessary, may themselves not be sufficient. It is as important that S&T and innovation policies are also integrated and aligned with other policies, such as education, economic and industrial policies, labour and employment strategies, and others. Furthermore, S&T policies need to be build up as structural and transversal policies, particular in countries were distributional inequalities are very high, to build the pillars to sustain other policies. S&T should not be a top-down policy, but a bottom-up policy.

The integration of policies and the place of S&T policies in this integration should be analysed not only in a national context but also at an international one. The previous policy of the World Bank not to finance higher education programmes, only primary and secondary education, and at the same time implementing an economic policy that requested highly trained expertise, show the disconnect between policies and had disastrous consequences.

Representational Inequalities

There are a variety of processes that translate capacities into effects. S&T-intensive policy areas are characterized by dependence on technical expertise, which is often given deference over other forms of knowledge. This unequal dynamic then contributes to other processes for example, setting the research

agenda and taking regulatory action. Knowledge and technologies themselves then come to embody unequal relations. For benefits to be distributed widely and costs to be shared equally, S&T-intensive decision making processes must be broadly and effectively participatory and create real accountability to all groups in society. Work Package Three is explicitly developing these issues, and we have already had glimpses of the practical side of these dynamics from our interactions with stakeholders.

Drawing on our roots in science and technology studies,[12] ResIST covers many forms of knowledge in our analysis, from professional expertise through situated traditional knowledge. The S&T policy literature tends to view traditional situated knowledge as a source of intellectual capital, as our stakeholders at the CSIR in South Africa illustrated in their presentation on a new product and local industry developed from indigenous knowledge.[13] But such situated knowledge is often also the key to solving particular problems in particular places and thus plays a more general role in achieving re-distributional effects. Expert and situated knowledge play different roles in accountability and participation processes, and ResIST researchers are remaining alert to these differences in our work on representational inequalities.

Accountability

Accountability is a pervasive feature of everyday life and social interaction. Institutionalized forms of accountability as we find them in politics, the economy, science, the legal field and in civic society are rooted in and build upon mundane everyday processes in which people hold themselves and others accountable for what we do and how we do it. At the institutional level accountability systems "provide for the explicit stating and framing of distributional issues related to the design, development, and social appropriation of scientific and technological resources," as an interim report from Work Package Three explains (Neyland, Nunes et al. 2007). Yet, as these authors point out, accountability systems normally make some things and processes visible but other aspects invisible. The introduction of supposedly better forms of accountability like 'performance indicators' may also produce 'perverse' effects in which the lofty goals to be achieved are replaced by a focus on producing the right statistics.

Accountability systems attuned to the needs of the disadvantaged are a prerequisite for reorienting scientific governance towards greater social inclusion in building S&T priorities and in distributing its products. They are the means by which the potential distributional consequences of science and policy and practices can be recognised and assessed – and potentially incorporated – by formal elements of the political system. Obviously if one wishes to develop accountability with an eye to the needs of the poor with respect to inequalities of a structural, distributional and representation nature the definitions of such needs and hwo tey

[12] Science and technology studies emerged as a distinct field of academic and policy research in the 1970s. It combines deep philosophical and sociological analyses of the role of various forms of knowledge and technology in social life with policy oriented studies on how to harness various forms of knowledge and specifically science and modern technology to enhance economic performance, innovation and sustainable and inclusive social change. For an overview see
Jasanoff, S., T. Pinch, et al. (1995). Handbook of Science and Technology Studies. Thousand Oaks, CA, Sage.
[13] Vinesh Maharaj, "Bioprospecting Research: A Case Study," http://www.resist-research.net/cms/site/docs/Vinesh_Maharaj.pdf, accessed April 14, 2007.

are handled will have to be(come) a matter of inclusive pragmatic policy debate. And as global interdependencies become stronger and local and national forms of government or 'governance' become intertwined with trans-national governance, systems of accountability also change for those reasons. Locally situated forms of accountability become linked to trans-national accountability systems and associated issues and this leads to the mingling of various forms of accountability. The boundary between alternative accountability systems and those of conventional policy and practice is therefore an important site for the analysis of scientific governance, and one in which any reconfiguring of interests will take place (Neyland, Nunes et al. 2007).

It would be naïve to assume that existing and newly proposed forms of accountability in S&T policy are unambiguously geared towards the needs of the poor and towards addressing the various forms of inequality. Accountability systems embody a whole range of normative assumptions about the purposes and uses of S&T, and to explore such systems and how one may improve them and integrate them into more inclusive forms of representation is a key goal of the ResIST project.

A number of commentators have pointed out that economic liberalisation has made issues of accountability particularly problematic at the global level. Socially inclusive interests and values which may inform a developed nation's internal distributive policies, or its approach to development aid, may not be reflected in the position that country takes in multilateral trade negotiations (Stiglitz 2006). In translating the national policy from a national to an international context, a process of what Work Package Three (Neyland, Nunes et al. 2007) calls 'accountability drift' can take place: a narrowing of the issues and interests represented as a national position is distilled. Work Package One has emphasized the raw power politics of the contemporary global knowledge economy, along with the extent of asymmetry of both power and representation as these conflicting definitions of national interest are played out. Under such a regime developing effective STI policies may involve not just playing by the rules of a established game but challenging and attempting to rewrite them as an essential part of the competitive game (Cozzens, Kallerud et al. 2007).

A number of case studies in Work Package Three explore both traditional and alternative accountability systems, particularly in the context of global transport and trade and of priority-setting processes. In the area of textiles, traditional systems include trade protection by national governments and the donation systems for used clothing in affluent countries. An alternative is Fair Trade labeling, a movement that attempts "to get clear labeling on products giving consumers the opportunity to make choices, and to make ethical statements" about what they buy (Neyland, Nunes et al. 2007). With regard to vaccines, traditional tools include tax breaks and extended patents, while new tools include advance purchase commitments and public-private partnerships. The example of a new accountability system in e-waste is the European Union's directives on recycling, which set up a complex audit trail on the production, consumption, and movement of electronic goods. Each system has its own pattern of identifying "publics" and involving them in determining whether the results of the process are acceptable (Neyland, Nunes et al. 2007).

What is clear at this point is the influence of politics and governance and of cultural values in the design of the accountability systems. The political mindset is an important external factor for accountability because it reflects the development concept at national and relocal level. The more people's centered, the more accountable will be the political system, therefore more comprehensihive will be the accountability systems in place.

The cultural values are also an important external factor for accountability, linked strongly to issues of representation. Societies that have a traditional of wide consultation and participation in decision making usually require and request strong and clear accountability systems.

Representation

The global accountability systems explored in the textile, vaccine, and e-waste cases face the challenge of accountability at a distance: production, consumption, and disposal of the technologies escape accountability in part because they are distributed in different geographic locations. As already indicated, other accountability processes and especially formal political ones continue to operate in one place, through governments at local, regional, or national levels. These political systems traditionally tend to hear the voices of the rich more clearly than the voices of the poor and the views of technical experts more clearly than knowledge situated in communities. The issue of effective representation for everyone in government priority-setting processes is thus an important item for the ResIST agenda. A number of case studies in Work Package Three focus on the articulation of new accountability systems in capacity building and priority setting that aim to remediate inequalities. These case studies draw on conceptions of accountability that diverge from the typical focus on the relation between those who govern and those who are governed (Neyland, Nunes et al. 2007). In part the case studies focus on experiments in Spain, Portugal and Brazil with participatory budgeting in urban government and knowledge-based policy-making. Other case studies focus on initiatives in public health and environmental justice in Brazil and Portugal.

In all these case studies new processes are being designed to counteract the elitist tendencies of political systems, including health councils and participatory budgeting, a process that gives real control to user communities over certain aspects of resource allocation. ResIST will seek to draw lessons from these experiments for the development of more inclusive, accountable and sustainable S&T policies in other settings and circumstances and explore how this affects the various forms of inequality and the CARE cycle presented above more generally.

Malaria is one of the key health tragedies of the contemporary world. Although the disease is completely treatable with current technologies, millions die annually from malaria infection. Many of these are children, who are particularly vulnerable. Malaria clearly counts as a "health inequity" in the definition shared in a presentation in Rio: "health inequalities that in addition to being systematic and relevant are also avoidable, unjust, and unnecessary."[14]

[14] Alberto Pellegrini, "Research and Health Inequities," taken from Whitehead 1992. http://www.resist-research.net/cms/site/docs/resistwrm_programmeme_apf.pdf, accessed April 22, 2007.

In Mozambique, over 5 million cases of malaria are reported annually and about 3600 people die from the disease each year.[15] Controlling and eventually eliminating malaria infections and death is clearly on the policy agenda in Mozambique, as it is in much of the tropical world. Because so much is at stake in bringing malaria under control, there are dozens of high-profile international campaigns devoted to the same goal.[16]

These campaigns differ in their approach to the problems and how they relate to local understandings. We are currently exploring what this implies in terms of representation and accountability and for the potentials of various approaches locally and transnationally.

Clinical trials

Contextual factors form the external context for work against malaria in Mozambique, and an easy justification for concentrating efforts in this area. Key national actors are the Ministry of Health and the National Institute of Health. One instrument of change that the Mozambican government is using with regard to malaria is the Centro de Investigação em Saúde da Manhiça (CISM, the Manhiça Health Research Center).

Situated 80 km to the north of Maputo, Manhiça is a small rural town where the health research centre was established in 1996 as part of a joint collaborative programmeme between the Fundación Clinic (Hospital Clínic - University of Barcelona), the Ministry of Health and the Eduardo Mondlane University School of Medicine. Financed by the Spanish Agency for International Co-operation, the CISM forms part of a bilateral co-operation programmeme established between Spain and Mozambique.[17]

In fact, CISM brings a number of international actors onto the scene in Mozambique. It receives funding from six public and seven private organizations outside Mozambique, including the European Union, several sources in Spain, UNICEF, the Bill and Melinda Gates Foundation, and GSK, a pharmaceutical firm.[18]

In the structural dimension of our framework, CISM represents a new institutional capacity for this part of the Mozambican countryside. It is the result of international collaboration, accompanied by mobility of health professionals between the Clinical Faculty of Barcelona, Eduardo Mondlane University in the capital city of Maputo, and rural Manhiça. The center embraces a three-pronged mission: research into the issues facing the district; "an intense training programmeme of Mozambican scientists, physicians and technical personnel in order to strengthen capacities within the country"; and providing health care to the surrounding community.[19] The last part was added due to the need to comply with the requests from the local community that wanted more short-term benefits from the research programme.

[15] World Health Organization, Global Health Atlas, http://www.who.int/globalatlas/DataQuery/default.asp, accessed April 13, 2007.
[16] See a partial list at http://www.artemisininproject.org/Malaria/other_initiatives.htm. accessed April 20, 2007.
[17] http://www.manhica.org/pages/ingles/ingles.htm, accessed April 13, 2007.
[18] http://www.manhica.org/pages/ingles/ingles.htm#, accessed April 13, 2007
[19] http://www.manhica.org/pages/ingles/ingles.htm#, accessed April 13, 2007

A key to the high level of international interest is the fact that CISM has the capacity to run clinical trials on behalf of international firms. CISM was in fact in the news within the last year as the site of a successful clinical trial for a malaria vaccine under development by GSK (formerly Glaxo Smith Kline) in partnership with the Malaria Vaccine Initiative (MVI), a Gates-foundation funded programme.[20]

Within the context of Mozambique, CISM is a model programme, meeting basic needs by providing health care, building national capacity through international collaboration, and sharing that capacity with other regions through the training programme. In terms of representation, CISM itself describes their efforts to maintain good communication links with the local community, stressing the importance of having social scientists on staff to stay in touch with the ways that clinical trial procedures are perceived by the community. This approach, it is in our view, a result of the cultural values and the political attitudes that promote participation and consensus building as part of a successful research programme. So, in a partial way, this Center has reduced both representational and distributional inequalities. However, the issue of resources will remain untapped, the plea from participants -- "When is the vaccine coming?" – is a strong enough voice.

That plea, however, dramatizes the structure of the situation. The people of Manhiça are living with malaria, but GSK and MVI are in control of the anti-malaria solutions. Work Package Three identifies public-private partnerships of the GSK-MVI kind as creating accountability to the partners, but not to developing countries. Perhaps the ultimate form of accountability of a clinical trial to the community participating in the trial would be to assure that when the vaccine is available, it will be available to them. There is no sign of such an assurance for Manhiça. MVI's literature says that in general it supports making medicines available through advance purchase commitments, but no such commitment has been made for the malaria vaccine. Thus Manhiça may get the benefits of a temporary infusion of money to create an environment that is conducive to experimentation, but is not assured of the distributional effects they need so badly: actual access to the vaccine. In terms of the economic distribution issues which are the focus of ResIST's WP4, this is developed world funds for a developed world multinational, using third world salaried researchers. Is this a necessary trade-off for increasing access, if this is what the programme delivers?

Distributional Inequalities (Effects)

Inequalities in effects are important because reducing these is the objective of the overall effort, a goal shared between ResIST researchers and the project's stakeholders. We use the word *effects* in a human-centred and inclusive way, to refer to benefits and costs in everyday life for everyone, from the full population of a country to the full population of the world.

The phrase *inequality in effects* is one way of referring to problems that some people live with and others do not. Our stakeholders provided us with many examples of inequalities in this sense that they wanted to reduce, including health

[20] http://www.malariavaccine.org/files/051511-Press_Release-Extended_Efficacy.htm, accessed April 22, 2007.

and nutritional inequalities like malaria incidence and blindness from Vitamin A deficiency, environmental inequalities like living in proximity to industrial pollution or without provision for sewers; information inequalities like lack of access to the Internet; and the general pattern of deprivation called poverty.

In science and technology (S&T) policy, a standard approach to challenges like these is to try to solve the problem technologically. The attempt to develop a malaria vaccine, reviewed by stakeholders in Maputo and explored in Work Package Three, is an example. But the technological approach addresses only one of the forms of inequality (effects narrowly conceived), and leaves inequalities in capacity, accountability, and participation in place. Technological solutions are less likely to be sustainable under these circumstances, and the solutions miss the opportunity for broader structural benefits. Work Package Four is taking a broader view of the ways new technologies are embedded in different national contexts and thus explicating relationships between a variety of policies and the broad-based distributional effects of new technologies.

At the same time, S&T policy typically relegates the problem of unequal distribution of costs of such projects to other policy areas, such as regulatory policy. But the outcomes of those processes rest in turn on the capacities of the actors involved and how accountability is organized – again reflecting conditions in other phases in the cycle of change.

The preliminary results of WP4 is shown that, likewise for the other forms of inequality (structural and representational), distributional inequalities are deeply influenced not only by the S&T and innovation policies, but also by external factors, in particular the cultural values and available resources.

A good example is found in the insulin study in Mozambique. The health policy treats diabetes as a chronic illness and indicates that a diabetic patient will have the treatment needed at a 20% of the costs. The National Health System should cover 80% of the treatment cost and guarantee the availability of the treatment.

However the reality is completely different. The National Health System does not have the capacity to diagnose all the cases, neither the resources to supply the identified chronic patients with the treatment. The total amount of import is still small: 9330 units of the 100 UI/10 ML mixed and 2370 units of the 100 UI/10ML fast types. Although the daily needs of insulin may vary with a factor 10 depending on the status of the disease, diet, and other factors, it is safe to assume that this quantity would serve the yearly needs between 50 and 100 individuals. There is no domestic insulin production.

The knowledge about diabetes, as a chronic and danger illness, is low in our society, therefore few people ask to be tested. People who fall ill do often not reach the hospital in time to be diagnosed and treated. A medical doctor in the hospital in the northern town of Lichinga for example stated that despite the obvious lack of availability of insulin, the hospital's stock of insulin hadn't been touched for a considerable time. A preliminary study covering Kenya, Tanzania and Mozambique suggests that about 3.4% of the population in Mozambique (60,000 people) suffer from diabetes 2.[21] WHO estimates prevalence at 79,000 persons with

[21] Interview Carla Matos, Head of the Department of Non-Contageous Diseases, Ministry of Health, 29 May 2007.

an expected increase to 99,000 by 2025.[22] This suggests that today's annual demand for insulin would round 14 million units of 100 UI/10 ML, or 1,200 times the current import level, with a likely increase by about 30% over the next 20 years.

In Mozambique, there are several associations of diabetes patients. Their membership outnumbers by far the number of people who can be treated by the current amount of imports. This seems to suggest that most diabetic patients acquire their medicine outside the National System. The creation and operation of the diabetic Associations may help public awareness of the illness and the increase demand for diagnoses and treatment, but the financial resources will continue to be a challenge for the national system and for the poor patients, increasing the inequalities.

So, availability of resources influences directly the reduction or increase of distributional inequalities, independently of public policies that prescribe a better equity in access.

Finally, another important external factor of the cycle, with direct impact in distributional inequalities is the cultural values. Again, under the WP4 the orange pulp Sweet potato has been investigated. Mozambique does not have a specific policy on Sweet potato but has a good national policy in nutrition that promotes improved food products with high nutrition value.

The sweet potato programme being implemented has shown that most of the access of the improved varieties for orange sweet potato is done through the social network of family and neighbours. The value of solidarity has played and enormous role in reducing distributional inequalities.

The case study of the sweet potato brings another dimension to the analysis. The value of solidarity can be used in this programme because it is a crop that is multiplied vegetatively, and not by seeds. Therefore, the technological investment is accessible to all through tissue that is available in the farmer's fields. In crops that are multiplied primarily by seeds, the choice between breeding of new improved varieties versus hybridization can affect distributional inequalities because in the case of hybridization solidarity will not have the same impact.

If cultural values, such as solidarity, are important to reduce distributional inequalities then, the choice of the technology will vary with the crop to be produced. Hybridization, for instance, can be used without much impact on sweet potato, but for maize improved varieties is a better technological choice.

In conclusion, we can say that the cycle of CARE should therefore be seen in a 3 dimensional perspective, that will be heavily influenced by external factors and that can be disrupted if those factors are not taking into account, but can, on the other hand be strengthened if the STI policies take these factors into account allowing the use of these social energy in the implementation programmes.

[22] http://www.santediabetemali.org/newsite/english/Diabete2.htm

Implications for policy

The central challenge for ResIST is to use these concepts and materials to develop tools that would allow policymakers – whether working in developed national, undeveloped national, or international contexts - to assess the effects of their knowledge-intensive programmes, either prospectively or retrospectively. Their decision environments are complex. They need to take into account external factors, relevant actors, rationales for action, and the instruments available.

Preliminary observations suggest that STI policies need to be transversal, bottom-up policies that support other sectoral policies such has education, health, economic and employment policies. So integration and complementary of national policies are of paramount importance for STI policies.

So, the political and governance arrangements, both at national and international level, will promote or not, this integration and synergy between policies.

Furthermore, it is clear that cultural values can be important for reduction of inequalities, so that have to be taken into account both at the policy design phase but also in the instruments and mechanisms for policy implementation. One fits all kind of STI policy will fail and can increase inequalities, in society and between societies.

Resources are the enabling factor for implementation. The mobilization of resources is therefore a crucial step for STI policies, and the design of pubic policies have to assess, realistically, how to go about it. Unrealistic policies may create bigger inequalities.

In weaving together these threads, what kind of (distinctive) recommendations can we put forward for science and technology for development? What kind of development pathways can be built that (a) meet local needs in a socially and economically inclusive manner(b) respond to global opportunities in developing competitiveness whilst (c) retaining locally trained talent and (d) continuing or enhancing the contribution developing countries make to the global commons through, for example, production with low carbon emissions which also conserves natural resources?

The need to develop locally-oriented policies of this kind suggests both new institutions employing new processes to define priorities. What might be required are the processes employed by technology assessment organisations but put into reverse. Conventional technology assessment takes a technology as exogenous and given, and privileges the bilateral and multilateral economic and intellectual property arrangements which produced and sustain technological innovation. Whether ‘upstream’ or ‘downstream’ it largely confines itself to the end-of-pipe processes of trying to maximise social benefits in relation to harms within these given frameworks. By contrast, technology assessment for development would start with the requirements (a) – (d) in the previous paragraph to design complementary S&T, innovation, and education policies to meet local needs and world market opportunities.

The innovative clusters of socio-economic competence technology assessment for development would seek to build would seek to recognise that in the long term global competitiveness is the only game in town: Europe will necessarily try

foremost to compete with the United States in the knowledge economy just as China and India, followed closely by Brazil and Russia, will try to dominate both. All nations are, in this sense, competitive, developing countries. But it is reasonable that countries historically behind the first and second levels of world achievement – sometimes far behind – should in the early stages of pursuing these integrated knowledge based development strategies benefit from a degree of market protectionism which itself enjoyed by most currently world dominant economies at the early stages of their development (Ha-Joon Chang, 2007).

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