

# Managing institutional change: the science and technology systems of Eastern Europe and East Africa

*Jo Chataway and Tom Hewitt*

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## Introduction

The themes of this paper are institutional change, and efforts to create new networks and linkages in science and technology (S&T) systems in Poland and Tanzania. These are as much an aspect of managing social change as they are development programmes directed at socio-economic problems. Many similar concerns are raised, in particular in the need to integrate often dispersed actors. In looking at efforts to establish new types of integration, we are concerned with efforts to enhance domestic technology transfer between different national institutions such as universities, research institutes, industrial support organisations, and industry. The paper shows that the concept and practice of technology transfer is not straightforward and is closely linked to the management of the organisations and institutions involved.<sup>1</sup>

You may be wondering why we have compared Tanzania with Poland. At first sight they are very different. However, on closer inspection there are some remarkable similarities in the form of recent changes, despite differences in content and context. After introducing the context of institutional change based on notions of fragmentation and integration, we explain the nature of markets in a setting of institutional change. We then examine case material from Eastern Europe and East Africa. In particular we look at the breakdown of old state-led systems and recent attempts to encourage market-led institutional change. The conclusions draw out some of the institutional barriers to reforming S&T.

A primary aim of the restructuring efforts in East Europe and the structural adjustment programmes in East Africa is the dissolution of institutions based on state-led planning. In some instances disintegration of state-based institutions has led to high levels of fragmentation and periods of chaos. However, these changes also open up possibilities for new forms of integration and realignment of effort. In the area of reform of the science and technology infrastructure, reforms are constructed on the premise that market-led institutions, based on competition, will serve countries more effectively. In a sense, what these reforms are about is the destruction of old institutions and the promotion of new systems.

In both Poland and Tanzania there has been a breakdown of the idea of the state as the only institution involved in development, and the emergence of a more complex situation with a multiplicity of actors and agencies, often with competing interests and views. Whereas previously, the state played a highly centralised integration role, the emphasis is now more facilitative, on giving more autonomy to different institutions (industry, universities, and research institutes) to establish effective working relationships. While this has generated opportunities for greater and more diverse forms of coordinated public action, it has also led to a fragmentation in the development effort. It has highlighted uncertainty. The state, the market, NGOs, and civil society are now in a more complex relationship, exposing tensions between fragmentation and/or uncertainty on one side, and integration, cooperation, and coordination on the other. Later in this paper, we will look at some key factors which influence the ability to manage multi-actor relationships.

We suggest here that while much effort has been devoted to macro-level reform in the field of S&T, the emergence of new institutions does not happen as a natural consequence of macro-level liberalisation and privatisation. It requires policy efforts aimed at meso- and micro-levels. Thus, examples of efforts to reform the S&T systems in Poland and Tanzania illustrate how the ability to manage change is related to institutional capacity. The need to focus on targeted institutional building, rather than relying on the market mechanism invisibly to guide the emergence of appropriate new structures and skills, is often not appreciated. In a sense, this type of development planning is an effort to strike a new balance, which will always need constant re-jigging, between integration and fragmentation. This requires new types of management and dialogue between the different actors, organisations, and institutions involved.

## Institutional change and stickiness

Unfortunately, changing organisational behaviour, still less, institutional behaviour, is not automatic. Old practices and mind-sets are deeply ingrained. In this way, making a transition to new practices can be described as ‘sticky’.

One of the enduring legacies of the 1980s is the overwhelming rejection of state planning as an alternative to markets. The question that has confronted policy-makers in the 1990s, however, is what kind of institutions make markets function most effectively. This is not quite the same as coping with market failure. The term market failure indicates that some replacement of the market mechanism is necessary, whereas what many are now looking for are ways of supporting, moulding, and shaping markets so that they actually deliver.

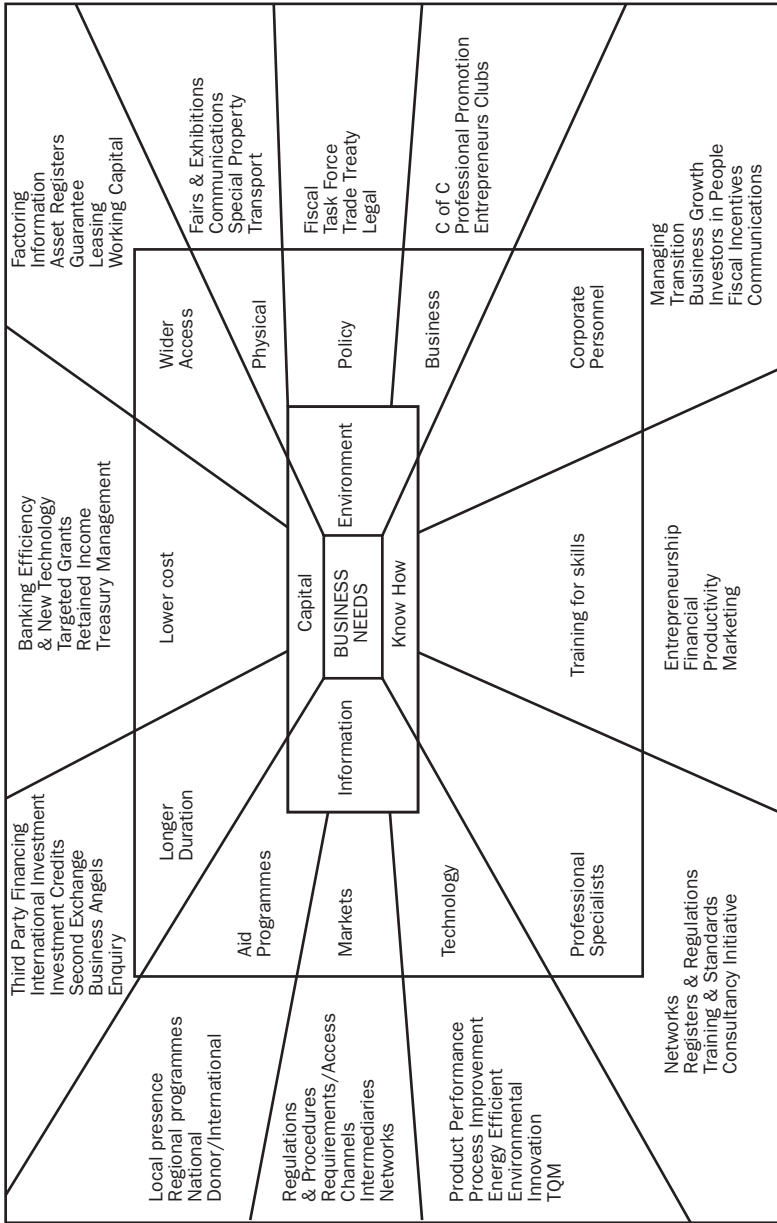
Several things follow from this:

- first, recognition that markets are themselves institutions. This means that markets need to be considered in context.
- second, markets cannot be assumed themselves to give rise to appropriate institutions. If markets are themselves institutions and their effective functioning depends in part on the way in which they interact with other institutions, it follows that simply taking controls off economies and imposing free trade criteria will not deliver uniformly appropriate results.
- third, the desire to implement market reform needs in part, therefore, to create institutions which can make markets work. Figure 1, taken from a needs assessment exercise for small and medium enterprises (SMEs) in Poland, illustrates the type and variety of institutional structures needed to facilitate market-based development.

Figure 1 splits business needs into four categories: information, knowledge, capital, and environment. The second layer of boxes outlines broad categories which can facilitate business growth. The outer layer suggests programmes, initiatives, and infrastructure. Apart from anything else, the diagram shows the extraordinary complexity of private sector development.

There is still wide debate about how the institutional nature of markets should be reflected in policy. In some cases, policy initiatives ignore important institutional factors; in others, ‘reformed’ institutions still have their roots in old systems. Old habits die hard. The language of reform can be relatively easily adopted, but the reality of institutional change—adopting new practices, shifts in power relations, increased organisational agility—is much harder to achieve.

**Figure 1** A framework for sustaining business growth



Source: Chattaway and Joffe 1998

The following sections look at two instances where structural economic reform has brought about limited institutional change despite huge pressures to rearrange the economies. Studies of efforts to promote market-oriented technology transfer practices in a number of Central and Eastern European (CEE) countries during 1995 and 1996 (Chataway 1999) and a study of technological networks in Tanzania in 1996 (Hewitt and Wield 1997), show that macro-level policy to introduce market mechanisms has not led automatically to the emergence of more efficient institutional structures.

## Tracing the changes: linear approaches to innovation

### *Science and technology under central planning*

Prior to the changes which began during the late 1980s and early 1990s, the basic framework for science and technology activity was the same throughout the former Soviet Union (FSU) and CEE. Work was located in three separate types of institutions: universities undertook training and some research work carried out by individual researchers; academy of science institutes undertook basic research; and applied institutes supposedly worked with industry on more practical applications. Universities were for the most part split into separate units along disciplinary lines, such as Chemistry or Philosophy.

This structure reflected a belief, widely held in both Western and Eastern Europe, in the linear theory of innovation which envisions science leading to technology leading to innovation. Critiques of this linear approach to innovation have been widely discussed and the limitations of the approach broadly accepted (Dosi et al. 1988). However, even given the limitations of the approach, the linkages which might have facilitated some productive activity were not strong. On a formal basis, these institutes worked largely independently of one another. Linkages which, in theory, were meant to exist in Eastern Europe often did not in practice. Applied or industrial research institutes were meant to feed their findings into industry. Indeed, rhetorically, services provided by scientists and technologists to industry were often used to justify spending in these sectors. In reality, links were often weak. Industry, which was meant to handle all technology transfer activities internally (there were no intermediary or facilitating organisations), often did not have the expertise to identify the type of technology needed. Radosevic comments:

Although R&D [research and development] systems in socialist economies were very much oriented towards the needs of industry they were not organisations in industry but for industry... R&D was externalised and treated as a separate activity with enterprises seen as passive recipients of R&D achievements ready for implementation' previously developed by the R&D institutes. The neglect of the role of enterprises as a source of technology and emphasis on extramural R&D were at the root of the problems of R&D in the socialist system. (Radosevic 1996: 10)

Product development in itself is not necessarily the problem. Indeed, the product development approach is one way of becoming more market-oriented. Sony is a classic example of this. However, there is a need for robustness of design and constant innovation to avoid the need for major redesign effort for each new product.

The lack of capacity in firms left them unable to specify technological needs or appropriate uses. According to Webster,

...industrial production enterprises never developed a genuinely internal R&D capacity that could have established a basis on which a firm could develop a 'business' (and not merely a production) strategy, shaped by an understanding of its technical competencies, an awareness of how its needs might be satisfied from external sources and an ability to evaluate and assimilate externally supplied inputs. (Webster 1996: 3).

Webster goes on to point out that research in innovation economics has stressed the importance of this internal capacity to absorb R&D, 'even more so, paradoxically, as firms outsource some of their research needs: only by having a genuine grasp of research requirements can external suppliers be properly judged on their ability to meet those needs' (ibid.).

Additionally, effective linkages were made even more rare because institutes were often reluctant to adopt the agendas of others, preferring to work on their areas of interest. In any case, in the context of centrally planned economies, with the emphasis on mass production of standard products and without competitive pressure, there was no need to design systems around constant innovation. Where linkages did operate, product development was the predominate focus rather than R&D or chnological effort focusing on process technologies, cost reduction, and increased efficiency (Radosevic 1996: 10).

While scientific and technological achievement had an important place in ideological and sociological terms under the old system, it was not integrated into economic structures. Given the relatively static nature of the socialist innovation system, even when significant results were achieved, they were seldom incorporated into production of civilian goods. Much of industry outside the military and space spheres was technically stagnant. There was no need to innovate; only to produce large quantities of goods. Despite talk of ongoing 'scientific-technological revolution', neither applied nor basic research institutes were able to make a significant contribution to economic development during the socialist period.

### *Science and technology under the development state*

Although it remains predominantly an agricultural economy, Tanzania has a small but significant industrial base, with quite rapid industrialisation in the 1960s to mid-1970s (Barker et al. 1986). Accompanying industrial expansion was the installation of a range of industrial support organisations whose main function was to service the R&D needs of industry and, to a lesser extent agriculture. Ironically, it was this integrated effort at industrialisation — based on state-owned enterprise — that appears to have led to the fragmentation of S&T effort in Tanzania.

To this extent, Tanzania has a quite different industrial history to Eastern Europe: there was very little industry until the 1960s whereas Poland, for example, had industrial growth from the late 19th century and then, under communist rule, mass higher and secondary education. Tanzania, by contrast, had a tiny proportion of its population in secondary education, and only one university, until the mid-1990s. Nevertheless, there is a strikingly similar story to that of Eastern Europe. The Tanzanian state has been a key player in the development of its S&T infrastructure, funding R&D institutions, university research and other forms of 'support'. However, the extent to which this support was ever effective is questionable, at least in the case of R&D organisations. The similarity lies in the model of internal technology transfer. In both cases there was an assumption that there would be a linear transfer from 'laboratory' to factory. In both cases this model was flawed.

The S&T infrastructure was set up by the Tanzanian state to support industry and agriculture. The example of eight such institutions is sufficient to paint a picture of their situation.

**Figure 2** Industrial support organisations in Tanzania

Name		Function
TISCO	Tanzania Industrial Studies and Consulting Organisation	Government-owned consultancy to industry.
TIRDO	Tanzania Industrial Research and Development Organisation	Government-owned and funded R&D services to industry.
TBS	Tanzania Bureau of Standards	Government-owned. Prepares and establishes standards; testing, certification and training in quality assurance.
TEMDO	Tanzania Engineering and Manufacturing Design Organisation	Government-owned. Designs industrial products/processes; technical consultancy for spare parts and component design; engineering training.
CAMARTEC	Centre of Agricultural Mechanisation and Rural Technology	Government-owned. Supports low-price technology development of farming implements (water tanks, solar cookers, sunflower oil press, wood carts, bricks).
SIDO	Small Industries Development Organisation	Government-funded promotion of small and micro enterprises, regional representatives, offers range of services (loans, hire purchase, consultancy, training, workshop premises).
MEIDA	Metal Engineering Industries Development Association	Self-financing organisation (at least non-state but attracted donor funding), from membership fees. Administers Import Support Fund for members (donor funded). Provides training for members. Association membership has dropped rapidly.

The other organisation worthy of mention is the Faculty of Engineering at the University of Dar Es Salaam. Apart from the provision of trained engineers, many of whom work in the above organisations, the Faculty has run its own R&D unit (Materu 1996).

As in Eastern Europe, these organisations were set up to provide for industry and agriculture with strong links to the government coordinating bodies such as the National Development Corporation, the Commission for Science and Technology, and the Ministry of Science,



Technology and Higher Education. In theory, these were part of a web of development organisations which were to feed off each other and generate mutual and national benefits. As in Eastern Europe, there was a linear 'technology-push' view of how the R&D organisations would function. It was assumed in many quarters that by their mere existence, industry would call on the services offered and that this same industry would take up the 'innovations' produced by them.

This did not happen on any meaningful scale. On the one hand, staff of the research organisations appear baffled when trying to explain why industry does not make contact with them or buy their prototypes. On the other hand, industrialists feign ignorance of the organisations' very existence (or, at best, dismiss them as irrelevant to their concerns). As a result, the support organisations went into financial decline and turned to other activities for financial survival (selling off land, renting out premises, and carrying out individual consultancies out of hours) (Aguirre-Bastos and Materu 1993; SIDA 1996; TIRDO various).

International donors stepped in to support several organisations, particularly Scandinavian aid (SIDA 1996). Donors, however, are losing patience with the continued ineffectiveness of research institutions. The medium-term prospect for this network of organisations looks bleak. Since most of their clients are para-statal firms in the process of being, or already, privatised, there is some doubt about their sustainability. Fragmentation of effort is compounded by isolation and scarce resources. There is now considerable pressure for these organisations to restructure in an attempt to survive in the post-adjustment era. This pressure comes from inside the organisations as well as from the government and from donors.

## Managing technology transfer with multiple actors: a non-linear approach

One of the important characteristics of the reforming S&T systems in Eastern Europe and to some extent in Tanzania is that there are multiple actors involved. No longer are the S&T systems controlled by the state. Multiple actors can imply fragmentation of effort. Johnson (in Chataway et al. 1996) identified three factors which will have a strong influence on the ability to coordinate action in multi actor fields:

- 1 *Negotiating new organisational goals or agendas*: if these differ greatly between organisations and institutions involved in a particular field – for example, science and technology – it may be difficult to establish agreement on an overall policy or action framework.

- 2 *Recognising the resource base of different organisations*: the capacity of different organisations to mobilise resources to meet their goals and agendas is likely to affect their role in any process of negotiation. For low-resource organisations, integration with others could be an enabling process allowing them to be part of a wider and more influential arena. However, it could also limit the effect of their particular ‘niche’ or competencies if they are part of a wider process in which high-resource organisations such as multi-lateral agencies dominate and seek to impose a particular agenda.
- 3 *Promoting organisational capacities to learn, adapt and change*: given that each organisation will (in principle) be working towards its given goals and agenda, the process of working with others may involve new practices, forms of negotiation, and compromise, as well as potential areas of struggle and conflict. Thus an organisation’s capacity to overcome barriers to changing its ‘organisational culture’ and its ability to learn from different approaches, or to work together with organisations and institutions which have different approaches, might well be key.

These three factors have a direct bearing on managing tensions between fragmentation and integration, and in the directions that institutional changes may take.

### *Eastern Europe*

Models of economic reform have differed in Central and Eastern Europe, with some countries — Poland, for example — moving very quickly to adopt the market, and others such as Slovakia displaying a much more ambiguous approach to liberalisation and privatisation. In terms of corresponding reform in S&T systems, there has also been a wide variety of approaches.

In this section, we explore some of the features of reform of the S&T system in Poland and some features of the reform process in other countries. The main point is that macro-level economic reform does not automatically lead to the emergence of ‘market friendly’ institutions. In the area of S&T, and efforts to promote technology transfer in particular, a great many linkages and relationships between market-based institutions and organisations, and between market-based and non-market-based institutions and organisations, create effective systems. These linkages and relationships are fostered by conscious nurturing and shaping, and depend on institutions’ capacity to manage them.

One of the first elements of reform in the S&T system in Poland was to change the institutional structure for funding and S&T policy. The funding of all science and technology research, without regard to the institutional base, is now channeled through one body, The Committee for Scientific Research (KBN). One of the main reasons for establishing KBN was to try and create a level playing field among different kinds of institutes. The new structure was also designed to increase administrative efficiency and introduce a level of autonomy; the KBN as an autonomous institution is less subject to the political whims of other ministries. Scientists and academics, bruised from the high level of centralised control experienced under the previous regime, were keen that autonomy be protected. While autonomy has allowed the new institution to move relatively quickly and to break out of the previous structure, it has meant that integration with other government and non-government bodies has sometimes been difficult.

### *Negotiating new organisational goals or agendas: balancing S&T in the new Polish system*

The fact that S&T has its own policy-making and administrative unit has meant that it has been able to protect itself more than might have been so otherwise. The funding system that emerged out of the new set-up was based on principles of participation and equal opportunity. However, it worked in favour of more scientific activity rather than technological development and transfer.

Additionally, while peer-review is in many ways desirable, members of the sub-committee tend to be respected academics. An OECD report noted, 'It should be noted that virtually all the members of ... [the KBN funding commissions] are elected by a voting population which is heavily dominated by university teachers (80 per cent). As a result a large majority of seats is filled by the latter (70 per cent)' (OECD 1995). In the Polish context, where little credit was given for more applied work and where 'commercialisation' was still viewed with great suspicion, interesting basic or more fundamental work tended to be favoured. Some of the other funding streams which related to commissioned projects, and which could have favoured more applied work, were too small to compensate for the cuts in these two principle mechanisms.

The KBN developed a targeted R&D funding mechanism, as did other CEE bodies allocating S&T funding. These are co-financing mechanisms. Public or private business are eligible and KBN will cover up to 50 per cent

of costs. KBN funds can only be used to support pre-competitive aspects of the project. Co-financing mechanisms are in principle important, but in many contexts have not yet worked well.<sup>2</sup> The problem was that these budgets tend to be small and the lack of money in the private sector meant that the available funds were in many cases not disbursed.

Efforts were being made in 1995 to examine state funding of S&T and may well have gone some way to introducing a new balance in the system. The point here is that even in a situation where a new institution was created with explicit remit of creating systems conducive with the need to foster new linkages and create a S&T system relevant to the new market-based environment, a variety of problems related to institutional stickiness and lack of capacity were experienced.

There have been problems in agreeing action frameworks, with non-academic components of the system frustrated at not being able to find a voice in the new set-up. KBN is, in part, a reaction to the very highly centralised forms of control that went before. Scientists' determination to operate in a very autonomous manner, the lack of effective linkages which would foster technology transfer (with industry and the ministry of industry for example), and the lack of support for applied projects which would require the involvement of others, have to be understood in this context.

### *Recognising the resource-base of different organisations: change at the micro level*

A variety of structures and experiments are taking place at the level of research institutes, small companies, and individual researchers. In many contexts, individuals from applied institutes, academy institutes, and universities are setting up small technology-oriented firms. They are often driven to do so by low salaries or redundancy. In many cases, the firms are set up within the walls of their parent organisations, sometimes with no legitimate rights and usually with no official recognition or assistance. Lack of knowledge in managing a business, patenting, licensing, and forming useful partnerships, not to mention lack of finance, often makes life very difficult for these firms.

Institutes' ability to adapt to the new economic situation depends on a number of factors: the sector in which the institute operates, the strength of that economic sector in the country; decisions made within the institute; reforms at the macro level; access to foreign expertise and finance. In Poland, while many institutes have been supported by statutory funds, the level of funding has been very low in many instances. Some institutes, even

when a clear need for their output has been identified, have found it difficult to adapt and fit into the new environment.

The Packaging Institute is an example of an institute which provides a much-needed service for many Polish firms, including emerging SMEs, but which has suffered from a lack of effective demand from firms. Several consultancy studies and needs assessment exercises have concluded that packaging is an essential element if Polish firms are going to be able to compete in increasingly competitive national and international markets. The Institute has worked hard to form links with industry and has had some success in reorienting itself to new conditions, providing testing, consultancy, and information services. Nevertheless, new small firms are not in a position to pay the full cost of services and development of new projects. The Institute is also classified as a 'B' category institute and 80 per cent of its funding comes from non-statutory sources. KBN has additionally funded a 'special project' relating to recyclable packaging. However, there is still a serious shortfall in funds to work on a wider range of projects.

The Packaging Institute is beginning to provide key services to a number of firms, but is operating in a difficult context. Its success depends of firms identifying packing and marketing as important areas for them to improve — and having funds with which to invest in improvements in this area. The 'push' factor of cuts in statutory funding has indeed provided an impetus for the Institute to change direction, but private sector lack of funds and low levels of project funding and co-financing mechanisms have been major constraints. Efforts to stimulate demand and to educate and inform about packaging have been limited. Attempts to integrate the perspectives of firms and needs of new entrepreneurs into the work of the institute have also been very limited. This type of networking and learning between different actors involved in technology transfer is rare.

The very different levels of resources available to organisations means that their ability to engage in effective technology transfer will also differ. The Packaging Institute which potentially has a key role in improving the competitiveness of Polish firms, is effectively constrained by very limited resources.

### *Promoting organisational capacities to learn: reforming the old and responding to the new*

Technical consultancy firms are emerging in some CEE countries, but these firms often need a significant amount of non-technology business, usually trading, in order to survive. A variety of 'science and technology parks' and incubator-type institutions are being created. These terms are

used to describe a wide range of outfits. Sometimes all they amount to are attempts by a research institute to rent out unused space. As noted above, often the extent to which these new organisations network with others is limited, although in many cases they would benefit from doing so more. Benefits could well be felt both in terms of the substantive gains to be had from creating links with other S&T-based outfits, but also in terms of marketing themselves.

The rather insular way in which both old and new organisations tend to work constrains their capacity to respond to a constantly changing external environment. In part, at least, this limited openness can be explained by the way in which organisations operated in the past. There is a tendency to try and maximise the range of activities within an organisation rather than creating relationships with others (Jasinski 1996).

Another way in which the past still influences current modes of operation is in the belief that technology alone will create successful products and demand. The 'logic of technology push' which so dominated the past often re-emerges. In some cases it can it reinforces a desire to create new institutions, rather than to learn from, work with, and reform existing ones. Work in Romania in 1996 showed that there is a tendency, among research institute directors and national policy-makers, to think that if there is a lack of demand it is not because the technology being offered is inappropriate; it is because companies do not realise the potential. Therefore, the answer is to encourage the growth of state-owned new companies. This is perhaps an unlikely outcome to a set of reforms meant to promote market institutions! It also ignores the needs and problems of existing companies.

The extent to which technology transfer can be made more effective then is hampered by the limited learning between organisations. Firms, research institutes, and universities tend to work in relative isolation. New organisations, which have emerged in part, at least, with the remit of facilitating new linkages and promoting transfer, tend, themselves, to be inward-looking.

### *Restructuring S&T in Tanzania*

There is little question that restructuring of Tanzanian industry and S&T is long overdue. Our interest here is how this restructuring is taking place. The short answer is that it is piecemeal, slow, and entrenched in previous practices. Through the 1990s there has been considerable fragmentation as a result. But there are also (potentially) new forms of integration.

The fragmentation is partly an outcome of the operation of the ‘old’ system. Industrial output from state-owned firms was well under capacity. Research institutes such as those identified above, were not working in areas relevant to industry, and a cumbersome bureaucracy was left with little or nothing to coordinate, in particular in the National Development Corporation (NDC). In short, the fledgling industrial structure of the economy as well as its component parts were crumbling before everyone’s eyes.

The research organisations were, with one exception:

- running operational and market share losses;
- losing their market share to private companies (particularly in consultancy work);
- suffering from declining staff productivity and morale;
- selling fixed assets to finance recurrent costs.

The exception is the Tanzanian Bureau of Standards (TBS). TBS has a clear role to play in providing a service that is in demand to Tanzanian business. The singular success of TBS compared with the failure of other industrial support organisations raises an important point: while the state has concentrated on organisations – maintaining them because they are there, not because of what they do – there is a need to focus on function: what kind of support does business need in order to flourish? TBS is thriving because its function is required by business.

The quandary for development management is how to reverse or halt this decline. Perhaps more crucial still is the answer to the question asked by one weary-sounding donor’s report: ‘who can do what?’ (SIDA 1996).

Success (actual or likely) in turning these organisations around is, we would argue, largely dependent on the three factors we introduced at the beginning of this section. S&T is a multi-actor field and, in Tanzania, the relevant actors are not able to talk to each other. It is questionable whether they have ever been able to work together.

### *Negotiation of organisational goals or agendas*

Despite the despondency, there have been some attempts to realign goals and agendas. Organisations have made business plans and survival strategy documents in recognition that the situation is dire, but government response is minimal. There appears to be an expectation that government will (or should) continue to support R&D as in the past. Government, whether it wants to or not, is disinclined to supply this. The view is that R&D organisations should begin to stand in its own feet

without subsidy (the irony is that these continue to be state-owned). This is the first difference in goals hampering restructuring. The second is that already mentioned: R&D organisations' potential customers (and, therefore, source of financial support in the absence of government funds) is industry, which also has differing agendas. Industry is either not interested in R&D, or it sources technology elsewhere. Donors, finally, have developed a certain fatigue in supporting R&D organisations.

### *Recognising the resource-base of different organisations*

The resource-base of R&D organisations went into steep decline in the 1980s and continued into the 1990s. The capacity to mobilise resources had depended primarily on the state and, in a small number of cases, on subscription. As a result, other forms of resourcing had to be found. At first, the organisations turned towards international donors. Of late, even this source is drying up. This fragmentation (every organisation for itself) has reduced the chances for meaningful industrial support activity.

As a result, these industrial support organisations have moved towards 'soft' consultancy activities as a means of survival. This has brought with it its own problems and is the source of human resource fragmentation in Tanzania. Donors and NGOs are in the practice of using consultancy as a route to 'nabbing' the best Tanzanian experts (invariably with individualised payment well above the going rate in Tanzanian institutions). In theory, such a strategy could be seen as a source of learning. In practice, however, it has heightened the sense of fragmentation.

### *Promoting organisational capacity to learn, adapt, and change*

As we have said, the ability to learn from other approaches, and to work with organisations which have different approaches, may be key to getting out of the impasse. The key players in any process of institutional change intended to achieve greater integration with the Tanzanian economy are:

- the government, particularly relevant ministries;
- the Boards of Directors of industrial support organisations (ISOs);
- the Management of ISOs;
- the staff of ISOs;
- the clients of ISOs.



All have a part to play in the management of the tensions around the fragmentation and integration of S&T. For example, the government needs to decide on whether it continues to want the ISOs and, if it does, to resource them appropriately. Resources, however are only the start. Relevant ministries need to set measurable objectives and ensure that they are monitored by a competent board. Managers require the confidence, wherewithal, and tools to put in place plans for action; and ISO staff need a purpose for turning up for work. This action needs to be focused on the production of things of value to clients. Clients in turn need to make demands on R&D organisations to be a part of the decision making over which products are of value. It is the dialogue between these last two which is perhaps the most crucial, and yet it is the one which has never taken place (SIDA 1996).

## Conclusions

A primary aim of the restructuring efforts in Poland and — though less advanced — in Tanzania is the dissolution of institutions based on state-led planning. In some instances, disintegration of state institutions has led to high levels of fragmentation and periods of chaos. However, these changes also open up possibilities for new forms of integration and realignment of effort. In the area of reform of the S&T infrastructure, reforms are constructed on the premise that market-led institutions, based on competition and the profit motive, will serve economies more effectively. Thus, these reforms are about the destruction of old institutions and the promotion of new systems.

Enhanced internal technology transfer depends on new funding systems for S&T and new networks and forms of integration and cooperation between different actors. Yet, macro-reform packages based on privatisation and liberalisation have had very limited success in promoting these new interactions. As stated at the start of this paper, market-based reforms in themselves are no guarantee of useful outcomes. Institutional reform has tended not to address the need for integration with other actors. Lack of resources and resistance to change in funding bodies, research institutes, and industry are all barriers to change

In relation to Poland and Tanzania a number of specific issues arise:

- Government funding and policy is not oriented toward internal technology transfer (that is, the useful transfer of products and processes from research organisations to firms), whether the focus is on basic science as in Eastern Europe or fosters R&D in a vacuum as in

the case of Tanzania. Cultural legacies mean that disjointed scientific and R&D efforts tend to be thought of as more important than technological development. It is also in some important respects easier to classify the quality of scientific achievement, and there are very well established mechanisms for evaluating research. The mechanisms in both Western and Eastern Europe for evaluating projects oriented more towards development tend to be more difficult to implement. The difficulties in constructing policy with regard to applied institutes, and adopting a framework for promoting technology transfer, have meant that change in this area is slow.

- There is a lack of knowledge and experience of the technology transfer process. This manifests itself in a number of ways. For example, many research institutes see technology transfer principally as an attempt to market the results of their research and their technology artifacts. Strategy is based on technology push. For most companies, however, output from research institutes in artifact and prototype form is unlikely to be of any use. Companies need forms of technology and technological assistance which relate much more closely to their business and their existing operations. It is the process of communication over the longer term, which could lead to jointly conceived projects, that is lacking. The experience of this type of partnership and way of working is often absent both in research institutes and in companies. There is also an absence of experience in managing patent portfolios, licensing technology, or evaluating technology in terms of market need.
- A great deal of faith is often put in establishing databases which detail research projects. It is thought that these databases will facilitate a 'supply and demand' match. In practice this is rarely the case. While information about where institutional and individual expertise might be located is useful, very detailed accounts of particular research projects are less so, for the same reasons as mentioned above.

In sum, the concept of technology transfer among policy makers in the two cases examined is still linear. The idea of science leading to technology leading to innovation, which prevailed under the old system, is very much predominant in policy thinking today. If the creation of a centralised integration or coordination system has failed to work in the two cases, what should be the overall aim of S&T restructuring? From the above evidence, our view is that it should be the creation of a system which allows multi-agency action, not top-down, hierarchical coordination or market 'free for all'. This at least opens up the possibility of adopting non-

linear approaches to technology transfer. We have argued that a good starting point for this is a consideration of organisational goals and agendas, the resource-base of different organisations, and fostering organisational capacities to learn, adapt, and change.

## Notes

1 This paper combines two elements. The first is research carried out by the authors in Eastern Europe and Tanzania in 1995, 1996, and 1998. The second is a reflection on The Open University's teaching on development management in which we have been involved over the last three years. We are grateful to Hazel Johnson and David Wield for comments on earlier drafts.

2 In Romania the co-financing mechanism has been slow to become operational and only covers 20 per cent of the overall costs of the project, further limiting the uptake of available funds.

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