The innovation landscape of Pakistan's North West Frontier Province

Tariq Bashir, Khalid Khan and Khaleel Malik

This paper examines the industrial innovation landscape of Pakistan's North West Frontier Province (NWFP) presenting results from its first innovation survey (2008). Analysing data collected from 304 industrial firms, this paper confirms that only 14% of the surveyed firms possessed an in-house research and development unit and around 50% of firms have no scientists or engineers working for them. Science and technology (S&T) indicators are used to provide a better understanding of the current weaknesses and strengths of industry in the NWFP. The involvement of the private sector is essential for industrial competitiveness, which in turn is crucial to formulate and implement S&T policy. This is a major challenge for Pakistan, since its national security and other geopolitical concerns currently dominate most other public policy issues.

THERE IS AN INCREASING recognition of the potential contribution of the private industry sector towards employment and economic growth in Pakistan. However, industrial firms in Pakistan remain largely owner-operated and resistant to developing professional management and recruiting good-quality scientists and engineers, which are a basic requirement for any innovative business. Thurik and Wennekers (2004) emphasise the point that educational systems develop the skills of entrepreneurs as well as those of the workers to foster an entrepreneurial economy. While some management schools have emerged, technical and skill-based professional education remains in short supply in Pakistan. Interestingly, technical skills do not appear to be adequately rewarded by employers, nor are blue-collar jobs held in esteem by society (Haque, 2007).

The NWFP is the smallest of the four main provinces of Pakistan by geographical area (third out of

the four by population size). NWFP borders Afghanistan to the northwest, the Northern Areas to the northeast, Azad Kashmir to the east, Federally Administered Tribal Areas to the west, Punjab province to the southeast, and Balochistan province to the southwest. The principal language is Pashto and the provincial capital is Peshawar. The province has a population of approximately 21 million people.

Although agriculture remains important and the main cash crops include wheat, maize, rice, sugar beets, as well as various fruits grown in this province, some manufacturing and high technology investments in Peshawar have helped improve job prospects for many locals, while trade in the province involves nearly every product known to man, as the bazaars are renowned throughout Pakistan. Un-

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employment has been reduced due to the establishment of industrial zones. Numerous workshops throughout the province support the manufacture of small arms and weapons of various types. The province accounts for at least 78% of the marble production in Pakistan. The trend towards higher education is rapidly increasing in the province and the NWFP is home to Pakistan's foremost engineering university, the Ghulam Ishaq Khan Institute, which is located in Topi, a town in the Swabi district. The University of Peshawar is also a notable higher education institution (HEI) (World Bank, 2006). The industry in NWFP is spread over 22 districts of the province with the majority of firms located in the districts of Peshawar, Bunir, Swat and Nowshera. There are over 1500 firms operating in the province and industry currently provides employment for over 66,000 people. The businesses in the NWFP are divided into eight industrial sectors, with 'mineral products' and 'food, beverages and tobacco' being the largest sectors. Other sectors include chemicals, textiles, wood, metal and other manufacturing industries.

Before we analyse the innovation landscape of the NWFP, it is helpful to briefly look at some national-level implications of 'doing business in Pakistan', since one can then better appreciate some of the regional-level industrial innovation issues to be presented later. Pakistan has a rapidly developing infrastructure; well-established legal systems; comprehensive road, rail, and sea links; and good-quality

telecommunications and information technology (IT) services. The country is strategically located and serves as a regional hub for access to the Middle East, Southeast Asia, China, Turkey, and the Central Asian republics (Board of Investment, Government of Pakistan, 2009). There is a very large domestic market in Pakistan, with consumers in a variety of income classes. The growing middle class is moving toward sophisticated global lifestyles and consumption habits, consistent with high levels of education, professional expertise, and global awareness. Expected directions for economic development include continuing trends toward liberalisation, deregulation, and privatisation. Critical questions still remain to be considered about the future of international business in Pakistan, not least of which is the political instability caused by the long-standing dispute with India over Kashmir, as well as by the instability of Pakistan's neighbour, Afghanistan. On the social front, there are some serious delays in social development, and quality of life for most consumers is still low by world standards (Khan and Amine, 2004). Also, as has been well documented in the international news, Pakistan is currently facing huge security concerns as the country's armed forces are overstretched in the north of the country and along the Afghanistan border fighting the Taleban and al-Qaeda extremists, who have been responsible for a string of deadly suicide bombings across the country that have killed hundreds of people (as of late 2009). The military operation has also resulted in 2.5 million people being displaced from their homes.

In developing countries it is generally accepted that many small firms, which constitute the nuclei of their production structure, rarely have the possibility to devote human and financial resources to research and development (R&D) and innovation activities. For this reason small firms often experience market failures as, despite the (relative) demand for innovation that they face in their own countries and abroad, they are not able to provide it (Stiglitz, 2003). From a public policy perspective, Inzelt (2008) mentions that business involvement in science and innovation policy can provide abundant opportunities for policy learning. Here policy-makers can learn from interactions with other stakeholders including private industry businesses. Public policy may have been used in some developing countries to target universities, private and public laboratories, business incubators, science parks, industrial clusters and venture capital providers to build up a system that generates new ideas about product, process, organisation and markets, which should help to support innovation (Parilli, 2007). However, there is limited evidence to show how effective these policy initiatives have been in developing countries like Pakistan. One well-known example of an industrial cluster supporting innovation in smaller firms is the 'Sialkot Surgical Instruments' cluster in Pakistan's Punjab province. Sialkot had a deeply rooted manufacturing tradition notably in the steel industry. In the 1990s

this cluster comprised of some 300 manufacturing small- and medium-sized enterprises (SMEs) of which 98% had less than 20 employees, surrounded by 1500 small sub-contractors, 200 input suppliers and 800 service providers, producing one-fifth of the world's output of stainless steel surgical instruments and generating exports in excess of US\$125 million. One example of cooperation between the public and private sector in this industrial cluster was the critical role played in upgrading quality of product output of the cluster firms, by the publicly funded Metal Diagnostics Development Centre, particularly for heat treatment technologies and metal testing. It was the only laboratory facility in the cluster, and some 90% of the local SMEs made use of its services (Nadvi, 1998). Another example of an industrial cluster is the Electrical Fan cluster in Gujrat (Punjab), which has been quite successful with the export of electrical fans to countries in the Middle East and Asia. A 'Fan Development Institute' was established in this cluster in 2001, which helped SMEs in the cluster with industry testing and training support.

Here, we believe it is helpful to summarise the current major players in Pakistan's innovation system, before concentrating on the innovation survey of NWFP. According to the PCST Science & Technology Data Book (2009) there are currently 85 R&D organisations in the country. From these the major national research organisations are considered to be: the Pakistan Atomic Energy Commission (PAEC); Pakistan Council for Scientific and Industrial Research (PCSIR); and Pakistan Agricultural Research Council (PARC). The majority of national R&D organisations are working under the Ministry of Science & Technology, Ministry of Food, Agriculture & Livestock and Ministry of Health. Other government departments such as the Ministry of IT & Telecommunication, Ministry of Industries and Production and the Ministry of Water and Power also have relatively small-scale R&D organisations working under their administrative control. Strategic organisations such as PAEC work directly under the control of the prime minister. A significant number of R&D organisations also work under the administrative control of the provinces. Most of these organisations are working in the areas of agriculture, forestry, livestock and fisheries (Bashir, 2008). There are 128 HEIs in Pakistan. The national R&D expenditures of Pakistan during the period 2007–2008 were US\$966.07 million (0.59% of gross domestic product (GDP)), out of which 73.48% was expended by public sector R&D organisations while the remainder (26.52%) was expended by the universities/HEIs (PCST, 2009). No exact information is available about the R&D expenditures of the industrial sector in Pakistan. However, it is generally accepted that share of industry in the national R&D expenditure of the country is negligible. For overall coordination of the National Innovation System, a high-level National Commission for Science and Technology (NCST) was created in 1984 with the

prime minister appointed as its chairman. The 27-member commission includes the federal ministers for S&T, education, agriculture, industries and finance as its members. Its membership also includes heads of a few R&D establishments and renowned individual scientists and technologists. Industry is also represented through the president of the Federation of Pakistan Chambers of Commerce & Industries and two other leading industrialists. By virtue of its influential and all-inclusive membership, NCST can play a role in building a National Innovation System that links the knowledge production with knowledge utilisation and exploitation to enhance national industrial competitiveness.

Survey sample frame

This section now introduces the NWFP Innovation Survey 2008. This survey was sponsored by the government of NWFP's 'Department of Science and Technology' and was the first survey of its type in this province of Pakistan.

The 'Directory of Industrial Establishments 2007' held by the Industries, Commerce, Labour, and Mineral Division: Technical Education Department, Government of NWFP was used as the sample frame. This directory lists details of 1554 firms operating in the province. A total of 304 firms responded to our questionnaire survey after we had contacted over 622 firms in 2008. The initial list of firms was selected from the directory using a stratified random sampling method. The number of firms selected from each industrial sector was proportionate to the total number of firms in that sector. The firms providing a valid response to the survey are positioned in the following industrial sectors:

- mineral products (97 firms);
- chemical, petroleum, rubber and plastic goods (72 firms);
- food, beverages and tobacco (39 firms);
- wood and wood products (34 firms);
- metal and metal products (29 firms);
- paper and paper products (13 firms);
- textiles, wearing apparel and leather products (11 firms); and
- other manufacturing industries (9 firms).

Although this innovation survey of NWFP is a sample survey which covers about 20% of the total number of firms operating in the province and can be described as a pilot survey, the significance of the survey cannot be overemphasised on two accounts. First, no innovation survey has ever been conducted, either in the NWFP or in Pakistan as a whole. Secondly, the survey attempts to explore the innovation system in the industrial sector. R&D and innovation in the industrial sector of Pakistan can be considered a 'black box'. It is generally assumed that the contribution of industry to the country's total volume of

R&D is negligible and that very little innovation is actually undertaken in industry. However, this assumption has never been substantiated with factual data in the real sense. 'Innovation surveys' can be called a more recent practice which is still quite new to the developing world but in Pakistan even simple R&D statistics on industry are not available.¹ In relation to the issue of innovation surveys, Figueiredo (2006) points out that knowledge about innovation in developing country firms has been constrained by the fact that the available evidence has been overwhelmingly qualitative in character. This paper provides some quantitative data to help address this limitation. It is also worth stressing that the real value of this survey is not so much the results of innovation activity in Pakistan's NWFP, which it reveals (as it was expected at the time of undertaking the survey that majority of the firms may not be reporting any significant outcomes of their innovative activities), but the process it would initiate to understand the innovation system and innovative behaviour of the Pakistani industry. This would be crucial in helping to construct policies for supporting innovation in industry, which plays a great role in determining the success or failure of firms in the local and international market.

Innovation is acknowledged as an important factor in boosting economic growth as it contributes to increases in productivity, market share, added value and employment (Lundvall, 1992; Nelson, 1993). It is also seen as a differentiating factor between successful and unsuccessful firms in an increasingly competitive global marketplace. The present survey was designed to develop an understanding of the innovation system and process in the industries of the NWFP. It aimed to examine the volume and nature of innovation activity being carried out in the province, what helps or hinders it and what the implications are for businesses who innovate. Lundvall *et al.* (2002) state that innovation systems work through the introduction of knowledge into the economy (and into society at large). It requires active learning by individuals and organisations taking part in processes of innovation of different kinds. The efficiency of these learning activities and, hence, the performance of the innovation systems depends on economic, political and social infrastructures and institutions. One of the major drawbacks in developing economies like Pakistan is the lack of institutions and policy direction that could help to support innovation activities in the country. Therefore our innovation survey was designed to help shed some light on whether any local- or national-level innovation support is available to industrial firms who need to be competitive in order to grow and prosper in the future. Also, the capacity to formulate and implement policies that support innovation should not remain an exclusive privilege of the state in developing countries (Wagner *et al.*, 2001). Perhaps other stakeholders such as firms, research organisations, universities, financial and legal insti-

tutions need to develop the capabilities to participate in the policy process.

Innovation survey findings from NWFP

The NWFP innovation survey results enabled us to analyse responses from 304 industrial firms in the province. In this paper we present findings related to a number of important S&T indicators in the context of a developing country, as well as some perceptions that firms hold about government support for innovation and any barriers to innovation that they are facing.

Often, the level of R&D expenditure is measured as a percentage of GDP or per capita to assess R&D performance and origin of funding. However, in addition to financial resources, human resources are central to industrial innovation activities. Human resources in S&T (such as, the number of science and engineering graduates and the number of scientists and engineers employed in R&D) are one of the key resources for economic growth and competitiveness. In the NWFP survey nearly 50% of the firms who responded do not employ any scientists or engineers (staff with professional training background in science and engineering). 41% of the firms employ 1–5 scientists/engineers (see Figure 1).

Only 14% of the firms possess an 'R&D unit', while the vast majority of the firms (86%) do not have an R&D facility. However, it must be acknowledged that about 25% of the firms surveyed were very small in size as they employed less than ten members of staff. From the firms who possess an R&D unit (42 firms), 64% of these firms reported that they employ 1–5 R&D personnel working in their R&D unit and 21% of these firms reported that they employ 6–10 R&D personnel (see Figure 2). In addition, firms who did possess an R&D unit are only investing a negligible expenditure on R&D, typically no more than PKR2 million per annum (approximately US\$25,000).

Diffusion of information communication technologies (ICTs) in the routine work of the firm is an important indicator of its acceptance for new technologies and readiness for innovation. The internet is particularly important in this regard as it is not only an efficient mean of communication but is also an important source of information. The survey revealed that 48% of firms are using the internet for their routine official work, which highlights the fact that over half of the firms surveyed report that they are not using the internet in their official work. This may indicate that some of these firms do not have access to the internet, or where there is access there is very limited use of this technology. From the 146 respondents (48% of total survey population) who confirmed that they are using the internet, the majority of these firms (68%) mention that they use the internet for email. Other purposes of using the internet are for searching the worldwide web, for selling

Figure 1. Number of scientists/engineers employed in firms surveyed

products and services to customers, and for advertising through a company website page (see Figure 3).

External collaboration is increasingly acknowledged as an important component of innovation. To explore innovation collaboration in the NWFP, respondents were asked to state whether or not their firms were engaged in any formal collaboration or joint activity with different actors that had enhanced their innovation activities. About 40% of the survey population responded to this part of the survey, which indicates that the other 60% have had no or very little form of external collaboration. The firms who have had some form of formal collaboration identified ‘customers’, ‘suppliers’ and ‘competitors’, the three most important actors in their innovation cooperation. About 46% of these firms confirmed that they collaborated with their ‘customers’ for help with their innovation activities. The second most important actor in the innovative activities of the firms was ‘suppliers’ where 35% of the firms mentioned suppliers as an external collaborating actor. 32% of the firms had some formal collaboration with ‘competitors’. Public research institutes,

universities or HEIs and government ministries were among the less important actors of the innovation cooperation in the NWFP. The comparative importance of different actors for innovation cooperation is shown in Figure 4.

In addition we analysed who the respondent firms would mostly collaborate with from different industrial sector perspectives. Here the survey results confirmed that ‘customers’ were considered to be the most important actor for innovation collaboration for firms operating in the following industrial sectors:

- wood and wood products;
- chemical, petroleum, rubber and plastic goods;
- mineral products;
- metal and metal products; and
- other manufacturing industries.

For the firms surveyed in the other industrial sectors not listed above, they confirmed that they would mostly collaborate on innovation-related projects with their competitors (possibly via networks or industry associations) and with their suppliers.

Figure 2. Number of R&D personnel

Figure 3. Main purpose of Internet use

As mentioned earlier, government (national or provincial) and public sector research institutions are seen as less important for industrial firm external collaboration to help with innovation in the NWFP industries. This raises the question of whether or not the government should be doing much more to help support innovation in the region. For developing countries the efficient operation of a system of innovation involves not only the activities of its components, like industrial firms, but also the interaction among the components. Such interaction is important for promoting innovation in industries and for developing policy (Edquist, 1997). The NWFP innovation survey asked respondents whether or not they had received any government support and assistance in helping with their innovation efforts. The respondents provided feedback on different forms of

government support for industrial firms to confirm whether or not they had received support in any of the categories listed in Figure 5.

As shown in Figure 5 for all forms of support listed, the vast majority of firms reported that they had not received any form of government support to help with their innovation efforts. From the different forms of government support listed in Figure 5 the firms confirmed that they had received some form of support in areas such as: ‘infrastructure support’ (17% of survey population reported this); ‘loans and grants’ (9% of survey population reported this); ‘tax rebates’ (7% of survey population reported this); ‘subsidies’ (4% of survey population reported this). It appears that a very small number of firms benefitted from government support in the forms of ‘technical support/advice’, ‘training’ and ‘direct R&D funding’.

Figure 4. Important actors for innovation cooperation

Figure 5. Government support for innovation in firms

To investigate the obstacles faced by industry in the NWFP in undertaking innovative activities, respondents were asked to indicate the extent to which any of the given choice of factors (see Figure 6), have been a hindrance or barrier to their innovative activities. This part of the survey results provided further evidence to confirm that some factors do indeed appear to hinder innovation in the NWFP industry, since these had also been mentioned elsewhere in the survey responses. As illustrated in Figure 6, ‘lack of skilled personnel’ is one of the major problems faced by industry in NWFP in relation to their innovation activities and 53% of firms mentioned this to be the most significant barrier to innovation. 41% of firms mentioned ‘lack of financ-

ing’ as the most significant barrier, while 39% of firms mentioned that the ‘domestic economic conditions’ act as the most significant barrier, and 37% of firms mentioned ‘high cost of innovation projects’ as the most significant barrier.

This survey also collected some basic data that helps us to gain limited insights into the export orientation policies of industrial firms in NWFP. For example, although most industrial firms in this province mainly cater for the domestic market, there are a small number of firms (20% of all surveyed) who report that they export some proportion of their output, with a few exporting as much as 50% of their output. These firms with a higher volume of exports also appear to be more innovative compared to the

Figure 6. Barriers to innovation

rest of the firms surveyed, perhaps due to the fact that they need to comply with higher technical specifications when selling their products abroad, thus initiating more need for additional product and process innovations. Another indicator often used to measure innovation performance in many countries is 'number of patents granted'. However, in our survey it was evident that this is not seen as an important indicator of innovation amongst the firms surveyed since none of them had any patents granted at the time of the survey. In fact, follow-up discussions with some of the same firms in 2009 also confirmed that they do not hold any patents. Therefore it seems that the possession of patents is not an important concern for the firms in NWFP, which can partly be explained by the fact that the industry sectors surveyed are on the whole low- to medium-technology sectors, where patents are not as prominent, compared to high-technology sectors.

Overall, the survey findings confirmed that smaller firms in the NWFP, who have less than 25 employees, are much less likely to engage in innovation projects or try to become more innovative themselves. Firms employing less than 25 staff make up 55% of the total number of firms surveyed. This gives some indication of where the governments support for S&T may have to be concentrated in the region. In developing economies promoting innovation processes is not an easy task; in this context innovation may simply mean adopting techniques and producing goods that were not previously produced in the country (Parilli, 2007). Therefore, creating or strengthening innovation structures such as universities, public R&D structures, business associations, public and private laboratories, business incubators, university spin-off activities, venture capitalists and technical schools help to provide the essential structures for innovation generation in developing economies that are mainly based on small firms. Policy can then be targeted at setting up a number of relevant institutions and agencies, which may help create complementary capabilities in a number of related sectors where the local and regional governments identify their priorities (Cooke *et al.*, 2007).

Implications for S&T policy

On the whole, the information generated through the innovation survey of NWFP industry should provide a helpful input to local- and national-level policy-makers, who could use these findings to make more informed decisions regarding industry, S&T policies in general and to raise awareness of the importance of innovation to industry in the country. One important lesson learned from this survey is that firms attached more value to collaborating with other local firms (customers, suppliers and competitors), rather than universities and public sector R&D organisation in their endeavours to improve their level of innovation activities. This shows that sometimes the

knowledge required for innovation arises from fundamental research, but most of the time it comes from interacting with customers and suppliers, observing competition, talking to potential users. It is important to bear in mind that innovation in SMEs is primarily motivated by the daily efforts to survive rather than by a long-term strategic development plan (Davies, 1999). Therefore one implication for S&T policy is to focus on the need to strengthen the demand for knowledge in the business sector, and to support investments in R&D that respond to the types of demand encountered by different industry sectors in the country. In Pakistan as a whole, there is very limited evidence of private sector involvement in the S&T formulation process, which is traditionally a 'top down' approach with little stakeholder engagement.

It appears that very few industrial firms in the NWFP have benefitted from technical support and advice or linkages with universities and training institutions. The implication for policy is to ensure that policy measures can be introduced that help firms to link up with universities and business services, which can assist industrial firms to collaborate with such actors in the development and commercialisation of their own innovative ideas. Many universities in Pakistan could also be more entrepreneurial with respect to innovation, and policies could assist in terms of facilitating spin-offs and stimulating interactions and collaboration with industry (Markman *et al.*, 2005). Of course, this has to be compatible with the maintenance of scholarly standards. Training institutions such as technical colleges as well as business and management schools should be encouraged to provide high-quality training in innovation and entrepreneurship-related matters, which not only benefits new students but also gives industry incentives to send technician- and professional- level staff on short and extended courses that help to address the problem of 'lack of skilled staff' highlighted in the survey findings. One crucial implication of the NWFP innovation survey is that people and institutions matter. If there is little linkage between the innovation capacity of this province and the higher education system in Pakistan it is because they appear to operate at two different levels. Pakistan has been dramatically reforming its higher education system since 2003 where the reforms were designed to reverse years of chronic underfunding, to invest in the academic workforce and to revitalize a moribund research enterprise. According to Osama *et al.* (2009) the highs of this reform include more research papers, more PhDs and greater visibility for Pakistani research. The lows include an absence of external peer evaluation and of rigorous impact metrics. If the impact metrics had included the impact of university research effort on industry's R&D, then it could be argued that some of the higher education reform may have resulted in more serious university-industry interaction to ultimately help raise innovation capacity, especially inside industrial SMEs,

such as the type surveyed in NWFP. Osama *et al.* (2009) recommend that Pakistan's Higher Education Commission (lead agency responsible for this reform programme) devotes resources to setting up data-collection systems and processes that would allow it to learn from its past experiences.

In Pakistan and in other developing countries the internet is particularly growing in importance, not only as an efficient means of communication but also as an important source of information for firms, as was confirmed in the survey findings. Policies fostering ICTs continue to be required as the technology itself develops, its uses become more pervasive and manifold, and problems of access and skill remain significant. Here policy measures may be required to ensure that SMEs are not excluded from e-markets by high entry costs, and the cheaper software and support services that are appropriate to SME business processes are available for them to have access to (Lengrand *et al.*, 2003).

To be successful, firms may follow various strategies: they may seek to innovate or they may imitate products and processes brought in by innovating firms. Both of these strategies require that firms accumulate the appropriate technological capability (Cooper, 1994). Qualified and skilled manpower is the most important resource for acquiring and upgrading technological capabilities. The results of the current survey indicated that about 54% of the firms had not undertaken any innovative activity in the last two years and more than 49% of the firms did not have a single scientist or engineer working for them in any capacity. The results also indicated that the firms which had employed at least a single scientist or engineer showed a higher innovation rate (53%) than the firms which did not have any scientist or engineer (38%). It is therefore critical for firms to employ qualified scientists and engineers. This would enhance their capacity to undertake innovation activities.

In developing countries, it may be more realistic for the firms to adopt imitative strategies (based on obtaining licensing contracts) for increasing and diversifying their products. However, obtaining licensing contracts does not guarantee that firms will successfully imitate as learning (including 'learning-by-doing') is not automatic but requires resources of various kinds, as well as skillful organisation and management (Cooper, 1994). In the current survey,

results indicated that more than 52% of the firms had obtained licensing contracts for product or process technology. However, only 45% of these firms stated that they can develop the product or process on their own for which they had previously acquired a licensing contract. This clearly indicates that majority of the firms which had obtained licensing contracts did not have the capacity to learn. This reinforces that firms should allocate some resources for their capacity building for learning which is crucial for their long-term success.

Pakistan's S&T spending is spread across different government ministries and departments. The S&T spending budget has decreased in 2008, which is likely to have detrimental effects for supporting innovation activities in industry. For example, the Ministry of Science & Technology's 2008 allocation of US\$35 million shows a 16% reduction compared to the previous year. The Higher Education Commission will spend US\$181 million of its unchanged US\$267 million budget on S&T-related research and education projects, including establishing six science and engineering universities. The Ministry of Food, Agriculture and Livestock has been given US\$27 million in 2008, a cut of 17%, for projects including establishing and enhancing crop research centres and the Ministry of Information Technology has been allocated US\$24 million in 2008, which represents a 23% decrease on the previous year. The PAEC's share is US\$228 million, an increase of 25.5%, for power generation and medical imaging projects (SciDev Net, 2008). Although there is almost always a lead ministry in policy terms (Ministry of Science & Technology in Pakistan's case), funding of innovation and industrial R&D is generally drawn from several sources depending on the types of policy actions. Some developing and industrialised economies have witnessed the emergence of new stakeholders concerned by issues related to innovation and technology transfer in recent years. These organisations range from associations of entrepreneurs or innovators, to business clubs or associations, to specialised institutes or technology parks. This has led to a gradual acknowledgement by governments of the importance of innovation as a policy theme. One clear implication for Pakistan is a need for S&T policy and other policy areas (e.g. higher education, IT, agriculture etc.) to acknowledge the importance of innovation across national and provincial governments in order to help promote innovation in industry more widely. This type of policy should then address such barriers to innovation like lack of training or lack of finance, as highlighted in the NWFP innovation survey.

Conclusion

This paper has assessed the status of S&T in the NWFP through a range of innovation indicators. It has been confirmed that only 14% of the firms

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surveyed in the NWFP possess an R&D unit, while the majority of firms (86% of survey respondents) do not have an R&D facility. For the firms who do possess an R&D unit, they are only investing a negligible amount of expenditure on R&D. Although customers and suppliers are mentioned as important external collaborators, there are only a small number of firms collaborating with external actors including public/private research institutions, government departments/agencies or universities. In our survey firms indicated that the biggest obstacles to innovation are lack of skilled personnel, lack of financing, high cost of R&D and the poor domestic economic climate.

A number of the issues associated with lack of innovation activity in NWFP industrial companies can be linked to the fact that Pakistan has not had any established tradition of interaction between the public and the private sectors in S&T policy-making, and even though there have been signs of some initiatives in this area, this is a very slow and gradual development. Given the budgetary constraints of this region, some fairly low-cost initiatives could be considered at the provincial level in the NWFP to help improve the innovation landscape of the region. For example, one could consider enhancing the innovation capabilities of industrial firms by promoting some university–industry interactions starting with something similar to the UK's 'Teaching Company Scheme' (TCS) concept (now known as 'Knowledge Transfer Partnerships'). This would enable a recently qualified graduate to spend 2–3 years working as a TCS associate, usually for an SME. As well as being paid a salary, the TCS associate is given the opportunity to gain a higher degree, guided by a university mentor. Businesses can benefit from being able to tap into expertise such as the latest developments in computer-aided design. Very often this can mean the difference between making a healthy profit and going bankrupt. For the university this fosters links with small businesses and the university receives some financial benefits to support its research activities. Another international example that Pakistan could consider learning some lessons from is the National Research Council Canada's Industrial Research Assistance Program (NRC-IRAP). The NRC-IRAP has been the Government of Canada's premier innovation and technology assistance instrument for SMEs for over 60 years. NRC-IRAP helps SMEs to understand the technology issues and opportunities and provides linkages to the best expertise in Canada. With a national network of more than 100 partners and a field delivery staff of 240 industrial technology advisors, NRC-IRAP's programs and value-added services stimulate R&D and innovation in businesses and communities across Canada, including rural and remote areas. The longevity and geographical reach of this program shows that it has relevance to both advanced and developing country environments.

Here it also worth stressing that many different kinds of knowledge are required for firms to innovate,

and knowledge of market possibilities and the organisation of production and distribution are as important as more formal S&T. Appropriate knowledge need not be sophisticated, formal knowledge. What innovation requires is practically useful knowledge and much of this can only come from experience (Metcalfe, 2002). The study by Wignaraja and O'Neill (1999) of the Mauritian textile industry makes the point that 'simple' managerial knowledge is what is needed to make those industries more competitive. To be more precise, it is the ability to combine different kinds of knowledge and skill that is the essential factor in the innovation process. Again, the ability to combine different kinds of knowledge often means firms must possess the capability to effectively acquire knowledge from external collaborations. This paper has demonstrated that innovation is becoming more widespread among some of the firms surveyed in Pakistan, especially with respect to certain types of collaborations (i.e. with customers and key suppliers). This supports the notion that innovation is dependent on a web of interactions with other private and public actors, as mentioned by Fagerberg *et al.* (2009). This paper adds that: this is not to say that innovation in developed and developing countries is identical in every respect, but that in qualitative terms innovation is found to be a powerful force of growth in both and is therefore an issue that it is imperative to obtain a better understanding of, both theoretically and empirically.

Present-day economic and political problems aside, the NWFP provides a very interesting region to analyse the innovation landscape. However, in order to build a better understanding of this region's innovation landscape there needs to be further research undertaken that could help shed more light on issues like the region's institutional context. Analysing the institutional context of the region using an innovation systems perspective should be useful in that it widens otherwise narrow horizons usually found in developing country studies. Future research should be undertaken to fill knowledge gaps and frame socioeconomic research within a wider context of diverse actors, knowledge sources, institutions and interactions.

Note

1. Pakistan Council for Science and Technology (PCST) is the only organisation mandated to collect S&T and R&D statistics at the national level and prepare S&T indicators. PCST only conducts surveys of public sector S&T/R&D organizations and public and private universities in order to collect S&T and R&D statistics. It has neither covered the industrial sectors nor conducted an innovation survey of the public or private sectors.

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