Chapter 1.

Overall assessment and recommendations

This chapter presents an overall assessment of Malaysia's innovation system and policy, reflecting key findings of the review. It identifies strengths and weaknesses of the innovation system, sets out strategic tasks for innovation policy and develops specific policy recommendations for improving Malaysia's research and innovation performance.

Achievements and challenges

Strong development performance …

Malaysia is one of Asia's great success stories. Its economic and social development since independence has been impressive. Over an extended period of time, Malaysia has achieved robust growth in gross domestic product (GDP), exceeding 7% per year. Today, with a gross national income (GNI) of USD 11 200 per capita in 2014, Malaysia places well in the upper middle-income range, and is now close to becoming a high-income country according to the World Bank definition. Malaysia enjoys the third-highest GDP per head among the ten countries making up the Association of Southeast Asian Nations (ASEAN), exceeded only by the city-state of Singapore and oil-rich Brunei Darussalam. To achieve this level of economic development, Malaysia – like other countries in the East Asian region – used export-led manufacturing based to a large extent on foreign direct investment (FDI) to emulate the success of the first wave of East Asian Tigers (including Hong Kong [China], Korea, Singapore and Chinese Taipei).

Malaysia's success has not been confined to the economic sphere. It can also be demonstrated in a much broader set of indicators on areas impinging on many important aspects of life. This is reflected, for example, by Malaysia's position in the United Nations Development Programme's (UNDP) Human Development Index (HDI). Among the 185 UN member countries listed in the Human Development Index, Malaysia ranks 64th – above Turkey, Mexico and Brazil. Moreover, during the past half-century it has built world-class physical infrastructures (roads, air transport facilities, rail, energy and water supplies) and major knowledge infrastructures (notably an extensive system of universities and research institutes) that bode well for the future.

… underpinned by structural change

Malaysia's economic success would not have been possible without the profound transformation of its economy. Since its independence, Malaysia has moved from an economy based on primary commodities to one driven by manufacturing and services. Throughout the colonial period, and into independence, Malaysia's economy was based on a number of resource-based industries: tin mining and processing, rubber, cocoa, timber and rice. Since then, new resource-based industries have emerged, namely oil and natural gas, and palm oil. Post-independence development has maintained the growth of resource-based industries but added major manufacturing capacity, especially in electrical and electronic products (E&E). During this process Malaysia became a major global exporter of electronic components. Other significant manufacturing activities are chemicals, food and beverages, metal products and machines. The service sector has developed, among others, around the expansion of financial services and a large tourism sector.

Challenges: Losing dynamism over time

While Malaysia has been expanding rapidly for a prolonged period of time, it has also experienced episodes of turbulence. A period of robust high growth that started in the late 1980s was brutally interrupted by the Asian financial crisis that began in 1997 and which had lasting effects. While the Malaysian economy recovered from the crisis, pre-crisis levels of economic growth remained out of reach. In the 2000s, Malaysia also lost ground to other Southeast Asian economies, with economic growth averaging close to 5% over the decade 2000-09. Malaysia was hit again by the global financial and economic crisis of the second half of the 2000s, with GDP contracting in 2009, albeit less severely than a decade earlier.

Overall, the dynamism of the Malaysian economy has lessened over time. In summary, economic growth slowed in the aftermath of the Asian financial crisis while powerful sources of growth have dwindled: the rate of investment dropped, productivity growth slowed and some export market shares declined. Malaysia has fallen short of the dynamism of the People's Republic of China (hereafter "China"), India and newly emerging Southeast Asian countries such as Viet Nam – which have recently embarked on a process of catching up, starting from very low levels of income per capita – as well as the dynamism achieved by much more advanced East Asian economies such as Korea.

These developments illustrate that in a long-term perspective, the previous "virtuous cycle" – driven by a combination of comparative advantage of low labour costs, conducive framework conditions, and well-developed infrastructure and targeted incentives to attract FDI – which transformed Malaysia into a thriving manufacturing export platform has lost momentum as its economy matured moved up the income scale.

While Malaysia has greatly gained from a close integration in global value chains (GVCs), it has not fully reaped the benefits of participating in such GVCs. Upgrading in value chains turned out to be slower in some areas, such as E&E, especially when compared to the best performing economies in Asia (e.g. Korea and Chinese Taipei). This makes Malaysia more vulnerable to fiercer competition in higher-end products and services on the one hand, e.g. from China which has been gaining in manufacturing strength through backward integration and upgrading final products, and, on the other hand, to competition from a new cohort of emerging economies which compete on low labour costs (e.g. Viet Nam). In order to prepare for the future, Malaysia has to become a more innovative economy and society.

Malaysia's innovation imperative

To respond to these challenges, the Malaysian economy will have to rely more on innovation-driven productivity gains. As the examples of Korea and others have shown, continuous improvements in domestic innovation capabilities can be translated into sustained growth in productivity and GDP, even in a high-income context.

Malaysia has recognised the challenge: it has made many efforts to advance its science, technology and innovation (STI) base and capabilities and important investments in education and research. Malaysia's research and development (R&D) expenditure grew from 0.2% in 1996 to 1.13% in 2012 and 1.26% of GDP in 2014. There has been a strong increase in the number of researchers, and new universities have been created. However, the results of this effort have not lived up to the high expectations that were set. Continued efforts will be needed to build a mature innovation system.

As recent OECD work demonstrates, innovation has become an important arena of policy making in many countries – including both advanced and emerging economies – in recent years. Policy makers today see innovation as central to achieving a wide range of economic and social objectives. There are three broad reasons for the new centrality of innovation in development policy. First, innovation generates qualitative improvements in products and processes, and through this it produces output and productivity growth. Second, real incomes and economic welfare are affected by the ways innovation shapes levels of technology. Third, innovation is central to establishing and maintaining competitive trade positions that both accompany and enable domestic growth strategies. Because of these wide effects, innovation is central not only to economic performance, but in the long term to the financial position of the government and the welfare of the population as well. At the same time, innovation policy involves multiple challenges

across a range of policy arenas, including education, research, finance and organisational development. This makes innovation policy making a demanding, cross-cutting endeavour.

Strengths and weaknesses of the Malaysian innovation system

Table 1.1 presents the results of a SWOT analysis of the Malaysian innovation system.

Table 1.1. **SWOT analysis of the Malaysian innovation system**

Strengths	Opportunities
– Successful socio-economic development trajectory – Good business environment and well-developed infrastructure – Rich natural resource endowment and biodiversity – A coherent vision for the country; well-designed and comprehensive strategic plans – Capacity to launch comprehensive and ambitious (cross-)sectoral reforms – Embracing consultation processes for policy making and experimentation – Research capabilities in certain areas, e.g. agricultural commodities – Islamic banking and finance centre – A sizable R&D system	– Strengthened innovation capabilities within business firms, including small and medium-sized enterprises (SMEs) – Learning and upgrading in global value chains towards higher value-adding activities – Newly emerging industries (e.g. in green technologies) and services (sustainable tourism, hub for higher education) – Enhanced and better aligned technical education and training – Enhanced governance of the higher education and research institutes sector – Stronger contributions of public research institutes (PRIs) and universities to business innovation – Opportunities to lead ASEAN integration, including in science, technology and innovation (STI) (R&D co-operation, research infrastructure) – Cultural diversity
Weaknesses	**Threats**
– Mismatch of skills, shortcomings in education – Low R&D and innovative capacity, notably in domestic firms and SMEs – Weak connections between innovation actors – Lack of co-ordination of science and technology policy and overlapping policies and initiatives – Weak implementation of strategies – Lack of prioritisation, critical mass and stability of funding for research – Weak evaluation culture and practices – Institutional fragmentation in STI governance – High disparity in research capacity and performance across PRIs and universities – Weak incentives to innovate in some sectors	– Increasing sustainability challenges – Instability in the international political and macroeconomic environment – Growing exposure and loss of opportunities due to failure to upgrade to higher value-adding activities – Political and social polarisation – Brain drain

Strategic tasks and guiding principles of science, technology and innovation policy

Strategic tasks

Science, technology and innovation (STI) is the most important driver of sustainable growth and improving living standards in the long term, and is indispensable for tackling societal challenges effectively. The overall task of Malaysia's STI policy today is to contribute to the country's goal of becoming a fully developed economy, to narrow the gap with the advanced economies, and achieve the economic, societal and sustainability objectives the country has set for itself more broadly.

To achieve these goals, Malaysia has to strengthen its domestic innovation capabilities and build an innovation system which can contribute effectively to these goals. These capabilities are critical for driving the productivity growth of enterprises in manufacturing as well as in services industries – a high priority of the Eleventh Malaysia

Plan – and improving their competitiveness in local and international markets. Improved innovation capabilities are indispensable for upgrading towards higher value-added activities which often take place within GVCs. The challenges in this regard are manifold: one is the need to transform industries, including the erstwhile predominant and still very large E&E industry, by moving along the value chain, from simple high-volume assembly operations and component manufacturing towards higher value-adding activities. The second is the need to initiate and facilitate new development dynamics in resource-based and traditional industries, extending upstream and downstream and into areas of high potential. The third is in fostering the reallocation of resources to new and emergent industries, including in advanced manufacturing and knowledge-intensive services.

Implementing an innovation-based development strategy that can achieve the required transformations calls for action in several domains:

- Continued attention to and investment in developing the human resources and skills which are at the core of STI capabilities.
- Gradually building a mature, well-performing national innovation system with healthy interactions between its constituent parts and Malaysia's international environment. This entails:
  - Fostering the innovation capabilities of business firms through innovation-friendly framework conditions, complemented by a set of dedicated and responsive innovation policies that help Malaysian firms across sectors to become more innovative.
  - Strengthening the contribution of universities and research institutes, notably though improved mechanisms of steering and funding, taking due account of the full range of these institutions' functions (from educating skilled personnel for STI to performing advanced research and commercialisation).
- More effective overall STI governance arrangements and mechanisms, including both a streamlined framework and institutional setup as well as efficient processes to strengthen policy co-ordination and implementation, sending clear signals and incentives for innovation in businesses, universities and government research institutes.

Guiding principles

In formulating and implementing policies to carry out the strategic tasks of innovation policy, the Malaysian government should consider applying or continue to apply the following guiding principles:

- **Long-term commitment.** Sustained commitment at the highest level of government and broad stakeholder consensus are key factors of success of STI policy. This was demonstrated impressively by a series of countries in East Asia, from Japan and Korea, to a number of smaller Southeast Asian countries, and lately China, which has maintained a persistent financial and political effort to transform and upgrade its innovation system over some decades now.
- **Business at the centre of the innovation system.** It is the innovation undertaken by business enterprises and other producers – often in interaction with other businesses and drawing on knowledge inputs from universities and public research institutes – that generates more and better jobs, income and welfare. Policy priority should therefore be given to improving the innovation performance of a greater number

and variety of enterprises, and accompanying policy measures tuned to developing a well-integrated innovation system that responds to their needs.

- **Broad approach to innovation.** Taking a broad approach means addressing not only technological but also non-R&D-based forms of innovation that draw on all types of creativity, such as organisational and marketing innovation, new business models, innovation in services, and social innovation. Care should be taken to avoid too narrowly focusing policy on "high technology", as can be observed in other countries. Malaysia has a good track record of research and innovation in "traditional" sectors.
- **Effective STI governance.** The effectiveness of STI governance can be improved by simplifying and streamlining the institutional configuration and the processes applied. Better co-ordination across government (both between line ministries and different levels of government), its agencies and public research institutions is an important part of this effort. International experience provides numerous examples of how to implement effectiveness-enhancing arrangements, such as separating strategy and operational functions.
- **Participatory approach to STI policy.** Greater interaction and better information exchange within the policy-making community needs to be accompanied by dialogue and the active involvement of all relevant stakeholders of the innovation system, including businesses, in policy formulation, implementation and assessment. While there are already good practice examples in Malaysia, policy making and implementation still tend to be fragmented and there remains scope for greater stakeholder involvement.
- **Evidence-based policy making.** A sound basis for policy makers to take decisions to improve the performance of the innovation system requires systematic evidence on the performance of the innovation system and its actors in the form of statistics, qualitative analysis and feedback from (independent) evaluations on the effectiveness of policy interventions. These elements should become an integral part of national practices.
- **Objective, independent and transparent resource-allocation processes.** A variety of resource-allocation mechanisms are used for research and innovation policy purposes. These processes used should be objective, independent and transparent as clarity and the use of decision criteria that reward projects and institutions of high quality and relevance tend to result in greater efficiency than allocation processes based on other criteria. Objective and transparent processes are also conducive to building trust in the innovation system.
- **Inclusiveness of the innovation system.** Inclusiveness is desirable not only in itself but also because it generally supports effective and efficient innovation. Malaysia has made much progress in this regard, e.g. through wide access to education. Social inclusiveness also helps, e.g. in fully mobilising the pool of talent for R&D and innovation and better translating societal needs into signals about innovation needs and eventual demand.

Key issues and recommendations

Taking due account of Malaysia's innovation-related strengths, weaknesses, opportunities and threats (see Table 1.1), a number of key issues have been identified.

The recommendations relating to each of these issues are in line with the strategic tasks and guiding principles outlined in the previous section.

Improving the public governance of science, technology and innovation

The government has played an important role in guiding and fostering Malaysia's transformation at different stages of its development. Malaysia has proven its strengths in identifying major challenges and producing the diagnostics for an ambitious set of interlinked economic and innovation strategies. These strategic frameworks are most often well-designed, comprehensive and formally innovative, in some cases even paving the way to the creation of genuine integrated "thematic innovation systems" (e.g. in the area of green technologies). Against this backdrop, the five-year Malaysia plans have diversified the national portfolio of policy instruments to cover all the needs of research and innovation performers from higher education institutions (HEIs) and public research institutions (PRIs) to multinational enterprises (MNEs), small and medium-sized enterprises (SMEs) and, more recently, various communities.

Malaysia's STI governance is characterised by a multiplicity of institutions (e.g. horizontal, thematic and sectorial advisory committees and councils) and organisations of various types (ministries, agencies, government-linked corporations, etc.) engaged in STI policy making, funding and implementation, each of which is equipped with its own strategic framework and policy instruments. To some extent this is a reflection of the cross-cutting and multi-faceted nature of innovation. This has, however, rendered the governance of science, technology and innovation dysfunctional and hinders it from fulfilling its objectives, as the multiplicity of actors and support instruments entail excessive fragmentation and overlapping competencies. This is exacerbated by a lack of co-operation and information exchange across "governance silos".

The advisory committees have set priorities, devised roadmaps or strategic research agendas, most often derived from multi-staged processes involving wide-ranging consultations. Not only has the wealth of priorities run the risk of conflicting guidance, but it has also rendered unclear how these priorities could be turned into action through the various programmes and policy instruments available. The links between research priorities and key sectors also remain blurred.

The multitude of institutional actors and overlapping responsibilities and the ensuing lack of co-ordination and direction have made policy implementation a difficult task. Furthermore, weak monitoring and evaluation, excessive bureaucracy, and a lack of middle-management skills in various parts of the administration have limited the capacity to deliver on well-crafted strategic plans. Most of these systemic failures have been identified repeatedly since the beginning of Malaysian STI policy in the mid-1980s and are echoed in various policy areas.

The proliferation of STI-related strategic frameworks, organisations and policy tools is also partly responsible for the significant fluctuations of funding assigned to each of them, in particular over the last 15 years. The lack of long-term stability in funding has had a negative impact on the research system as its objectives can only be achieved over a longer time horizon.

The government has made attempts to address these issues through the creation of new government agencies, strengthening centre of government STI prerogatives, the launch of comprehensive cross-sectoral programmes, as well as the establishment of

co-ordination councils and committees. However, many of these initiatives have failed or succeeded only partially, and have further added to the system's complexity.

A rationalisation of Malaysia's STI governance structures is therefore urgently needed in order to ensure better co-ordination across government, provide stable funding, improve policy implementation and, ultimately, achieve higher impact at lower cost. A new reform of the STI governance architecture was brought on the way in the recent past. The three main strands of this reform have been new STI legislation, the establishment of a high-level committee in charge of STI strategy and policy orientation, and the creation of a central research agency. After intense discussions, the Science Act was put on hold. The National Science Council (NSC), chaired by the Prime Minister, held its first meeting in early 2016, and is meant to streamline the various STI committees. The establishment of a national Research Management Agency (RMA) was endorsed by the Eleventh Malaysia Plan, in line with recommendations made in the Public Research Assets (PRA) Performance Evaluation undertaken under the National Science and Research Council (NSRC) in 2013.

The NSC and RMA have the potential to significantly improve the co-ordination of STI activities, provided that some principles drawn from international experience are observed: a clear separation of the strategy and implementation functions; realistic and distinct mandates for the organisations in charge of these two functions, both in terms of tasks and the range of research or broader STI activities covered; the establishment of efficient information loops between these two functions; the consistency between the mandate of these organisations and their organisational, legal and budgetary status; systematic monitoring and *ex post* evaluation of activities.

Main recommendation

Implement the continued effort to create a simplified and efficient architecture of STI governance with the NSC providing consistent mid- to long-term strategic orientation and government-wide co-ordination, and the RMA managing the allocation of research funding based on an efficient and transparent selection of research proposals and evaluation of results.

Other recommendations

- *Task the NSC with setting the mid- to long-term strategic priorities which feed into the planning process of the Malaysia plans and guide the immediate operations of the RMA and STI-related ministries and agencies.*

  The NSC includes representatives of all ministries involved in a significant way in research and innovation; its decisions and recommendations regarding strategic orientation and co-ordination should encompass the entire STI system and policy spectrum. Previous experience suggests that the following three conditions are necessary for it to succeed: 1) the remit and the authority given to the NSC should reflect a commitment to change at the level of the whole research and innovation system; 2) the implementation of the NSC's recommendations, even if non-binding, by the agencies in charge should be systematically monitored; 3) priorities set by the NSC should not consist simply of a list of themes, areas or sectors but should clearly identify the ministries and agencies in charge of implementation, including a "lead body", and the injunction to devise an action plan within a certain period of time, which will be submitted to the NSC.

- *Task the RMA with focusing on the efficient and transparent management of the competitive allocation of funding for research projects, from fundamental to applied research and development, and the commercialisation of research results.*

  The RMA should have a clearly defined mission to address the main research weaknesses identified in the PRA assessment and other studies (lack of efficiency and transparency of R&D and commercialisation programmes and instruments, overlap, weak monitoring and *ex post* evaluation, insufficient linkages with industry, etc.). The remit of the RMA's mandate includes the allocation of research funds through competitive mechanisms, and the monitoring and *ex post* evaluation of research activities at project, thematic programme or "call" levels. The task of initiating and designing top-down strategic programmes to address issues of national interest can be either managed by the RMA or left with the relevant ministries. In the latter case, co-ordination with the related research projects managed by the RMA should be ensured, as necessary.

- *Improve the alignment between the R&D support instruments and the current and future needs of key industries and sectors.*

  A better alignment of publicly funded research and demand from industry can be achieved in different ways. The RMA could better match research calls with the needs of industries and sectors based on industrial/technology road mapping and other types of technology foresight exercises. Balancing the representation of academia and industry on selection panels plays an essential part in improving the relevance of the R&D policy instruments. Finally, the government could initiate and support the creation of selected top-down strategic and targeted programmes operated by consortia of actors (universities, PRIs, small and large firms) around issues of national interest, following a collectively agreed upon research and innovation agenda. These programmes could be either managed by the RMA or left with the relevant ministries/agencies. In the latter case, co-ordination with the related research projects managed by the RMA should be ensured.

- *Ensure efficient information flows between the NSC and the various ministries and agencies, including the RMA, in charge of implementing its decisions and recommendations.*

  Ministries and agencies implement the priorities defined by the NSC and feed information back to it, drawing in particular on monitoring and evaluation results. The ministries have an essential role in maintaining a clear and consistent relation between the strategic orientation and implementation functions since they are represented in the NSC and are regularly in contact with their agencies. They can therefore provide essential inputs that feed into the NSC's decisions and set the appropriate conditions (budget, information, incentives) for their implementation by the agencies and departments under their remit.

- *Ensure that the RMA is built upon an organisational model which allows it to fulfil its mission with sufficient resources and autonomy.*

  This would imply that the RMA has a stable annual budget of its own, or clearly earmarked funds originating from various ministries. More generally, all of the necessary conditions should be met to ensure high legitimacy of the new agency *vis-à-vis* the other public institutions as well as public and private research performers. A study has been commissioned to propose an appropriate model and governance structure for the RMA.

- *Seek co-operation between the RMA and the relevant ministries and other specialised agencies as required and seize all opportunities for synergies.*

  Entrusting the delivery of programmes of different ministries to the RMA could facilitate and provide an incentive for joint programming and streamlining programme portfolios, and lead to economies of scale; it could facilitate informal co-ordination and break up "silos".

- *Assign clear roles to the NSC and RMA relative to already existing institutions with related mandates. This includes,* inter alia*, the Investment Committee for Public Funds (ICPF/JKPDA), the NSRC, the National Innovation Agency of Malaysia (AIM) and all other committees not under the purview of the NSC.*

- *Ensure that all strategic frameworks include an action plan to guide their implementation.*

  The action plan should feature budget indications (if not appropriations), clearly assigned tasks to the various public research actors as well as concrete monitoring and evaluation principles (i.e. timeline, process and performance indicators to be monitored, succinct and precise qualitative progress report by action, etc.).

- *Set an annual evaluation plan (at least endorsed by the NSC) covering all STI policy instruments (or even a broader scope, for instance in relation to the Malaysia plans process).*

  The implementation of the evaluations under this plan should follow international best practices and their results should be available online.

Fostering innovation in the business sector – Upgrading in value chains

Developing innovation capabilities is critical for Malaysia's future economic development and for responding to growing sustainability challenges. Business enterprises that thrive on innovation – and leverage R&D performed in universities and public research institutes (PRIs) – are at the centre of all national innovation systems that successfully drive growth and development. Improving in-house innovation capabilities – which requires skills to engage in design, engineering, marketing, information technology and R&D – in a broad range of enterprises should be an overarching priority. Malaysia already stands out: it is among the emerging economies where the business enterprise sector is a major performer and funder of R&D. However, there is a continued need to strengthen the R&D and innovation capabilities of domestic businesses, including SMEs. The bulk of domestic SMEs barely innovates and do not engage in R&D.

Considerable effort has been devoted to attracting and supporting business R&D activities, particularly in "high" and "medium technology" sectors. A number of measures have been introduced to promote industrial R&D and innovation, including fiscal incentives, support to consortia and clusters, public-private partnerships, and the promotion of science-industry linkages and knowledge transfer. Despite some success in specific clusters and industries, the upgrading of the electrical and electronic (E&E) industry, which was previously a pioneer and catalyst of structural change, has slowed down in the 2000s. Rapid changes in GVCs, especially in Asia, add urgency to investing in R&D and advanced technological capabilities. Strong innovation capabilities are essential for enterprises to achieve a more favourable position in GVCs. MNEs are restructuring their global activities – and hence GVCs – using the evolving comparative advantages of newly emerging economies such as Viet Nam. It is therefore important that

Malaysia's human resources and innovation capabilities stay abreast of these important new developments. A lack of adequate skills is an obstacle for the growth of innovative domestic enterprises, especially SMEs, and the expansion of higher value-adding activities in MNEs. As for emerging sectors that build upon the E&E resources, such as the solar panel sector, their recent impressive growth remains fragile and dependent on the international context. Some resource-based industries in which Malaysia has strong comparative advantages, such as rubber and palm oil, have made significant progress in moving "downstream" in order to increase value added and remain competitive on export markets. Notable success has also been achieved in sectors like composite materials and services such as Islamic finance.

As noted, very few domestic SMEs engage in innovation, either for lack of adequate skills, funding or incentives to change their traditional business model. With only limited in-house innovation capabilities, SMEs rarely co-operate with academia, do not take part in collaborative R&D with MNEs and barely use shared equipment at universities, while at the same time the Ministry of Science, Technology and Innovation's collaborative grants are short of high-quality applications and equipment at universities is often underutilised. The government has long acknowledged this issue and has taken action to address it, which places Malaysia's SME policy ahead of that of other countries in the region. However, greater efforts to monitor, evaluate and streamline the plethora of instruments available to support the upgrade of SMEs, in particular in the context of the SME Masterplan 2012-20 and the governance architecture set up for its implementation, would help improve its cost-effectiveness.

Recent initiatives to provide SMEs with external technological and managerial expertise (e.g. AIM's Steinbeis Foundation Malaysia, the SIRIM-Fraunhofer partnership and the Ministry of Higher Education's Public-Private Research Network – PPRN) recognise that the first steps towards innovation in SMEs often involve on-demand problem-solving and require collaboration with experienced academics or industrial experts. In order to be effective, support to SMEs, especially those with low innovation capabilities, has to be continuous, affordable and readily accessible in facilities located in their proximity. Several countries have set up such local innovation centres which are fulfilling on the one hand a public mission (provision of information, awareness-raising, promotion of innovation, general capability building, etc.) while, on the other hand, providing project-based support to individual (or groups of) SMEs and initiating collaborative innovation on a more permanent basis.

Supporting SMEs, especially in traditional industries, calls for a broad notion of innovation, including incremental and non-technical innovation – as recognised for example by the creation of the Malaysian Global Innovation and Creativity Centre (MaGIC), the broadening of eligibility criteria of existing support instruments and the creation of new ones. Local innovation centres can be instrumental in establishing links between the relevant firms and communities and these initiatives.

Enhancing domestic firms' innovation capabilities contributes to upgrading their position in GVCs through a shift into higher value-added products and/or processes (product and process upgrading) as well as via the extension of activities from production – upwards to design and R&D or downwards to marketing and services, such as advertising and aftersales (functional upgrading). The latter implies, or calls for if carried out externally, the development of knowledge-intensive services. The Service Sector Blueprint launched in 2015 contains a wide range of actions to support these developments.

Main recommendation

Make raising business firms' innovation capabilities a central priority of Malaysia's innovation policy and implement an accessible, effective and coherent set of public support measures designed to best meet the varied needs of different kinds of firms, in particular those of SMEs, which need continuous and hands-on support.

Other recommendations

- *Ensure that a sufficiently differentiated set of instruments is in place to meet varied needs of firms while taking provisions for maintaining the coherence of the policy mix as a whole.*

  Malaysia will continue exploring, assessing and scaling up policy instruments if they are proven to be effective (for instance low-barrier instruments such as vouchers, public procurement schemes in support of innovative SMEs, co-operative research, or – at the high end – PPPs for research and innovation). To keep the overall policy mix coherent, effective and transparent, instruments with low recorded impact need to be phased out. A priority for the SME support infrastructure should be to address the lack of innovation capability in the vast majority of these enterprises, and strengthen those which have already started to innovate. This entails taking into account firms' evolving needs along all stages of the research and innovation process, from fundamental research to commercialisation, and ensuring the continuity of support over time, helping SMEs to gradually move up the innovation ladder. Supporting SMEs calls, in most cases, for a broad notion of innovation, including incremental and non-technical (e.g. organisational) innovation.

- *Set up local innovation centres to provide domestic SMEs easy access to critical resources for upgrading their innovation capabilities (information, expertise, specific equipment, etc.).*

  SMEs often lack financial, technological and strategic capability to access support in the area of STI. They are in need of specific hands-on support based on proximity and the mid- to long-term commitment of competent experts. Emulating the best international practices of intermediary organisations such as, for example, technical centres, extension services, the local innovation centres should clearly distinguish between and ensure the continuity of their public mission (provision of information, awareness-raising, promotion of innovation, general capability building, etc.) and their specific support activities to individual (or groups of) SMEs (technical assistance and consulting, interface between experts, from academia and industry). These activities should be aligned and in co-operation with existing and newly established organisations and initiatives (SME Corp, AIM, Steinbeis Foundation Malaysia, PPRN, SIRIM-Fraunhofer).

- *Foster relations between MNEs and domestic suppliers, including SMEs, through dedicated schemes and incentives beyond the support already in place, such as the vendor development and technology procurement programmes.*

  Priority should be given to a hands-on approach whereby SMEs are supported financially and non-financially throughout the process of learning and transfer involving the three main stakeholders of these initiatives, i.e. MNEs, SMEs and

the state. Successful regional and/or thematic cluster initiatives, in Malaysia and internationally, could serve as examples to adapt and adopt.

- *Encourage and support networks and collaborative platforms.*

  Such networks and platforms "on the ground" typically include a range of stakeholders from the business sector (including MNEs and domestic firms), public research institutes, universities, government and agencies involved in policy implementation, end users, etc. They can undertake a wide range of activities, from the co-ordination of R&D to capability building and advocacy. The Collaborative Research in Engineering, Science and Technology platform (CREST) in Penang provides a good example, along with the rich OECD experience with sectoral, regional and technology-based networks/platforms. CREST should be assessed to derive concrete lessons for other platforms.

- *Foster the role of government-linked companies (GLCs) in promoting and enhancing innovation, within the scope of their own activities and that of their partners (suppliers and clients).*

  This could include, for instance, setting corresponding objectives, monitored by new key performance indicators (KPIs) and/or developing innovation programmes specific for each GLC.

- *Mobilise resources (both financial and human) to strengthen and upgrade standard-setting organisations, especially for priority products.*

  As a key mechanism for the diffusion of technological knowledge, standards contribute to productivity growth and should be considered as an important component of a growth strategy which seeks to create high-quality jobs in higher value-adding manufacturing and services. Standards should be set at high quality levels, both to ensure safety and to create a source of incentives for local firms, which will have to meet such stringent quality standards to increase their competitiveness by upgrading their capabilities.

Enhancing the contribution of higher education institutions to innovation

Malaysia has profoundly expanded, diversified and reformed its university system over the last decades with some encouraging outcomes, although a number of expectations have not yet been met. Important reforms were introduced with the launch in 2007 of the National Higher Education Strategic Plan (NHESP) – Beyond 2020 and the National Higher Education Action Plan 2007-10. More recently the *Malaysia Education Blueprint 2015-2025 (Higher Education)* (hereafter "Higher Education Blueprint 2015-25") set the roadmap and action plan for the transformation of the higher education sector. The government has increased public expenditure for education consistently over the years. Today, Malaysia invests much more in tertiary education than its peers in the region.

Several regulatory reforms have been enacted to enhance the autonomy of institutions and improve the governance of the sector, and new monitoring and performance evaluation instruments have recently been adopted. Mechanisms for quality monitoring and accreditation have been reinforced and public funding for R&D has expanded substantially through the introduction of new performance-based block funding schemes (e.g. Research University Programme) and competitive funding for projects (e.g. Science Fund).

New funding regulations now require HEIs to diversify their sources of finance and increase revenue generation. The best performing universities have been granted more autonomy in exchange for a commitment to raise a significant share of funding externally. A comprehensive, multi-layered system of monitoring increasingly determines the level of block funding allocated to universities and government research institutes. While this is a positive development, overly tight financial constraints might create difficulties, at least for some universities – especially new and smaller ones which lack capabilities and experience in revenue generation.

The national plans mentioned above resulted in improvements in higher education in a relatively short period of time. The sector has expanded significantly, which reflects growing demand, and quality control mechanisms have been reinforced, enrolment ratios and number of graduates have expanded at all levels of tertiary education. As regards the democratisation of education and raising the number of university graduates and post-graduates, important results have been achieved. However, in terms of overall quality Malaysia stills lags behind. Responsiveness to industry needs remains an area of concern, as is ensuring quality education in private universities. No Malaysian institution is on the list of the top 100 in the Asian QS University Rankings – in contrast to universities from Singapore, Hong Kong (China) or India, who have recently joined this list. The quality and supply of science and technology graduates needs to improve to respond to the business sector's growing demand for such skills.

In recent years, efforts have been bolstered to foster university excellence, increase funding for research and improve technology transfer. HEIs saw their R&D expenditure multiply by a factor of 11 between 2000 and 2012 and the number of researchers expand five-fold between 2006 and 2012 – from 12 152 to 64 962 researchers. However, most of the new funding for R&D has remained concentrated in a small number of research universities, while other, more recently established HEIs are confined to their mission in higher education, with very limited research activity. This expansion has been driven by enhanced public support through a variety of competitive funding instruments and the creation of the Research University programme. The latter, however, has had a varying level of funding over the last three years.

So far, results from increasing investment in research are mixed – although it has to be recognised that it takes time for results in investment in R&D to materialise. Research and innovation capabilities at HEIs show signs of improving, but mostly in terms of quantity of publications rather than quality and impact. While there has been an unprecedented surge in the number of publications (owing partly to new research evaluation criteria), their impact measured by citations has been very low. Similarly, the number of HEIs' patents has increased very rapidly, including those resulting from residents' research, but a lot of the intellectual property created by research remains uncommercialised. The attractiveness of university patents to industry and their practical applicability seems weak; this is in part due to the lack of relevance of research to industry and weak communication between the two sectors. The quality of these patents remains a concern given the high costs of patenting and renewing intellectual property rights (at both national and international levels).

In spite of new public support mechanisms for technology transfer and more enabling intellectual property regulatory frameworks, results are yet to materialise. Collaboration with the business sector remains underdeveloped. Only a few universities have started to collaborate with industry in R&D and technology transfer activities. Overall, enhancing interaction/consultation with the business sector in the definition of curricula and

education programmes or in research agendas remains an important challenge for most universities.

While universities have taken steps in articulating research policies and research management offices, research efforts remain fragmented both across and within universities and lack effective strategic prioritisation. There are many economic priority and research areas – and their inter-linkages are often not clearly established. Currently there are many small research centres (centres of excellence) spread across universities. A lack of critical mass in many scientific areas reduces the potential impact of research in areas of importance for the Malaysian economy and society, as well as its international visibility. Malaysia also lacks platforms or programmes that encourage interdisciplinarity and multi-perspective approaches.

An additional handicap to universities' research excellence is the lack of research infrastructure management and policy. Malaysia has not developed a national policy in this regard – neither an inventory nor roadmaps have been formally set up. The Ministry of Science, Technology and Innovation has begun efforts to conduct a national inventory but no co-ordination mechanisms are yet in place. Guidelines for the collective use of infrastructure also need to be established to ensure a cost-efficient use of infrastructure and equipment. A competitive and well-managed research infrastructure is critical to foster research excellence, enhance the quality of research and attract talented young researchers, including from abroad.

Main recommendation

Enhance the higher education institutions' contribution to research and innovation by emphasising the provision of high-quality education and skills needed to upgrade businesses, while continuing efforts to strengthen excellence and relevance of research with enhanced potential for commercialisation and for addressing societal challenges.

Other recommendations

- *Put human capital formation at the heart of the priorities of universities.*

  Universities should not be detracted, e.g. by the focus on commercialisation, from progressing in their contribution to innovation through the formation of highly qualified graduates with skills relevant to the Malaysian economy. In doing so, the higher education sector needs to address the challenge of ensuring a better balance between quantity and quality, reinforcing the quality of higher education – as stressed in the Higher Education Blueprint 2015-25. This will require improving and updating curricula to reflect the demand for new skills as well as improving methodologies and pedagogy to encourage creative thinking, problem solving and a more entrepreneurial culture. Enhancing the quality and supply of science and technology graduates remains an important priority in this area.

- *Review and streamline monitoring and performance metrics, taking into account the whole range of contributions HEIs may make to innovation and development.*

  The monitoring system should contribute to achieving an adequate balance of education, knowledge generation, and technology and knowledge transfer. The monitoring system should allow HEIs sufficient flexibility to be able to innovate and develop their own strategies to respond to the overall objectives.

- *Enhance stability in research funding by providing appropriate time horizons for research (e.g. at least five years for the Research University programme; three to four years for basic research projects), especially in collaborative schemes and fundamental research.*

  Based on this new framework, evaluate the results of research activities in HEIs on a multi-annual basis. This should allow pursuing the efforts toward a performance-based allocation of research funds while providing institutions with sufficient stability to engage in multi-annual research programmes and projects.

- *Consider strengthening research through larger scale collaborative programmes, e.g. by consolidating certain centres of excellence under a single entity.*

  An option in the strategy to foster critical mass in key areas could be to merge/consolidate certain centres of excellence. These may perform multi-disciplinary research addressing an agreed agenda (corresponding to national demands) and engage in collaboration with industry through research consortia. Larger initiatives would require an adjustment of funding, timelines and performance criteria.

- *Improve the focus and impact of university research. It is important to involve the higher education sector in the priority-setting process to better align demands with current research competences (and their future development).*

  It is important to provide more clarity regarding priority areas and the linkages between science (public research) and the research requirements of key economic areas and sectors. Priority setting should be streamlined and simplified – and the connections between scientific and economic priorities better aligned. In doing so, research capacity and competences should be assessed and compared against industry necessities. It must be acknowledged that academic research might not currently have all of the competences and will need to concentrate in a few key strategic areas while at the same time reinforcing multi-disciplinary research.

  Sectorial research programmes could be launched in priority areas with specific thematic lines of research, and bringing together public stakeholders as well as industry to achieve agreed-upon common objectives. The development of technology roadmaps (taking into account lessons learnt from roadmaps carried out previously in the health, biotechnology and cybersecurity sectors/areas) and consultation with stakeholders will help define research necessities in priority sectors. This, in turn, should become the thematic lines of research in sectorial competitive research calls. It is fundamental to ensure the appropriate allocation of resources for the implementation of sectorial (industry/sector or technology-focused) agendas.

- *Support and encourage universities to develop clear strategies guiding their research and technology transfer activities.*

  Specific financial support could be provided to encourage HEIs which commit to develop and implement institutional strategies (e.g. the Institutional Strategies scheme under the Excellence Initiative in Germany). Some of them, in particular smaller sized local universities, could play a pivotal role in developing technology transfer projects in co-operation with local producers, including SMEs and service providers, and in close contact with local public authorities (e.g. through innovation centres – as proposed earlier). These universities should also have

access to public support for their technology diffusion activities. They could become key partners of the regional innovation centres proposed earlier.

- *Widen the approach to university technology transfer and recognise this diversity of channels in performance evaluations for both research organisations and scientists.*

  A better balance is needed between intellectual property-based technology commercialisation and traditional technology transfer activities such as R&D collaboration and contracting research for industry, training, technology extension services, two-way mobility of researchers or joint PhD programmes. Given the low level of R&D in the business sector, these traditional modes of technology transfer should potentially have a higher impact on industrial innovation than intellectual property.

- *Adopt clear policies for strengthening research infrastructure, its development and maintenance, establish a national research infrastructure plan and conduct periodical inventory assessments.*

  Developing a national strategy for research infrastructure could facilitate the development of regional to world-class research groups in selected and strategic areas, as research infrastructures act as focal points to attract top scientists wishing to benefit from unique facilities. In the Malaysian case, medium-sized research infrastructure could optionally be developed in various domains such as health (e.g. biobanks related to selective diseases), agronomy (e.g. seeds and biodiversity collections), nanotechnologies (e.g. clean facilities), computing (e.g. super computer node). This could put Malaysia in a privileged position to participate in the possible development of an ASEAN research infrastructure roadmap and lead collaborative projects on research infrastructures at regional level.

Enhancing the contribution of public research institutes to innovation

PRIs play an important role in Malaysia's innovation system, basically through their activities in applied research, technology transfer, or information and monitoring services. There is no unique profile of a PRI; their level of development and types of activities vary widely, reflecting differences in mission, governance and funding structures. The degree of autonomy differs as well but is weak in many cases, particularly in ministry-related PRIs. For these, the governing ministry has complete oversight regarding the management, funding and regulatory issues governing the individual institutions. In an effort to enhance the efficacy and efficiency of public sector organisations, the government has initiated the corporatisation of several public research-related institutions since the 1990s, such as the Standards and Industrial Research Institute of Malaysia (SIRIM), the Malaysia Institute of Microlectronics System (MIMOS) and Technology Park Malaysia.

Overall, the research and technology transfer capacity of these institutions remains underdeveloped – which reflects difficulties in funding and a lack of strategy. The government is the main source of finance for R&D in PRIs, providing, on average, more than 90% of funding. Research funding is distributed through a multitude of sources, including managing ministries (in the case of sectorial PRIs with a public good orientation), the Economic Planning Unit (EPU), the Ministry of Finance, etc. Often, the

EPU in the Prime Minister's Department provides block grants to various PRIs to carry out top-down directed research.

PRIs have seen their R&D funding and personnel vary drastically over time. Exceptions are cess-funded (commodity-oriented statuary) PRIs, which seem better funded than the rest. Cess-funded PRIs like the Malaysian Palm Oil Board (MPOB), the Malaysian Cocoa Board (MCB) and the Malaysian Rubber Board (MRB) have higher R&D budgets – their expenditure is twice the expenditure on agricultural research conducted by the Malaysian Agricultural Research and Development Institute (MARDI), the main agriculture research agency.

As stated in the PRA assessment, a number of PRIs still do not have the critical mass to make a significant contribution and fulfil their mandate. Infrastructure and the quality of equipment widely differ across organisations, and some PRIs have not seen their equipment updated in years. Over the years, several PRIs have expanded their scope by engaging in new activities and disciplines, although somewhat missing the focus of the original mission for which they were created. Changing policy priorities and regulations, the multiplication of funding sources and agencies, as well as the pressure to strengthen commercialisation, have contributed to this trend.

The purpose and role of PRIs (develop tools for policies, monitor regulations, facilitate technology transfer, etc.) is, in fact, not always clearly defined in missions and this situation in part reflects weak guidance from the part of stakeholders – in the case of statutory PRIs – or weak stakeholder/client relations. The lack of guidance of national strategic plans regarding the role that these institutions should play in deploying new efforts has undermined the visibility and funding of PRIs. This has also left ambiguity on how they should relate to national efforts.

Although a number of PRIs have demonstrated their capacity to develop technologies useful to stakeholders, particularly statutory PRIs with industry orientation, connection with the business sector remains very uneven and unsatisfactory overall. A recent assessment has noted some improvements in performance, but also highlighted some overlaps and institutional inflexibilities (e.g. hiring of new personal – ministry and statuary PRIs are subject to Public Service Department regulations) that prevent scale-dependent research and more long-term collaboration with industry.

Some exceptions apart, research institutes seem to be less prepared to pursue commercialisation and intellectual property (IP) activity than universities. PRIs face larger administrative barriers, budget cuts on research and a less adaptive culture that until recently put little emphasis on collaboration with the private sector or on producing IP. These institutions, however, have very different profiles, and this situation calls for a careful appreciation of their outcomes and achievements.

In conjunction with stakeholders and governing agencies, a comprehensive modernisation and reorganisation of PRIs is needed – as recognised in the PRA assessment. This process will entail first assessing the potential of each public research institute to contribute to innovation and the ways in which they might do so. In a second stage – for those showing a potential for change – an in-depth revision of their mission and objectives should be undertaken followed by a new injection of resources based on performance-based funding mechanisms.

Action plans and funding should follow, with a more healthy balance between block funding and project funding and enhanced use of performance-based funding mechanisms. In the articulation of modernisation plans, legal and regulatory frameworks

need to be revisited as well as accountability frameworks – in line with performance engagements and resource utilisation.

Main recommendation

Reform and modernise the public research institutes based on an assessment of their respective mission, competences and governance. Enable those assessed favourably to develop their strengths by complementing their own revenues through a healthy mix of competitive and institutional funding, subject to regular evaluation. For the remaining institutes consider other options, including their merger, downsizing or discontinuation, if required.

Other recommendations

- *Conduct an in-depth assessment of individual PRI's technological competences and management in order to define their potential for change and the extent of the modernisation needed.*

  The NSRC's 2013 PRA assessment showed the diversity of PRIs and identified common challenges and bottlenecks – especially in terms of regulatory frameworks and governance. Building on the results of this study, a review of each PRI's technological competences (research capacity and portfolio, as well as outcomes including intellectual property portfolio) and resources (e.g. staff, qualifications and infrastructure), and the way resources are obtained and used will help redefine their respective focus and evolution, and identify the best ways to improve their results in terms of transfer of knowledge and technology, and support to the domestic industry.

- *Sharpen PRIs' mission under the leadership of directing agencies and stakeholders.*

  For many PRIs, especially those with weak autonomy or limited decision making, modernisation or reform might not occur without a strong leadership and direction of managing or governing agencies or ministries – to which they are attached or related. For some PRIs, this revision will require refocusing core competencies and areas where they perform the best or have the potential to improve. The type of activities and engagements might also change across PRIs – depending upon the directions and agendas agreed with stakeholders. The results of the assessment should help clarify the PRI's roles and engagements. For some PRIs, traditional forms of knowledge transfer, such as advisory services and technology extension (e.g. adaptation of existing technologies and their diffusion), might remain a priority while for others enhancing technology commercialisation through IP and licensing (those with growing research capacity) might become a new formal engagement.

- *Consider the different options available for PRIs' governance reform and efficiency improvement.*

  Among the options for restructuring are: 1) merging institutions with the potential for synergies; 2) corporatisation of PRIs; 3) transformation of certain ministry/division PRIs into statutory organisations; internal restructuring with no governance change or liquidation/closure. These options are not exclusive of one another; a combination of them could be considered.

- *For those PRIs with enhanced potential for improvement, augment funding through performance-based mechanisms to implement modernisation plans and expand research and technology transfer capacity.*

  One example is the use of performance contracts, which are widely applied in OECD countries. These are comprehensive contracts reflecting an "agreement" between parties (typically universities or PRIs and funding ministries/departments) regarding the activities to be delivered, resources, and timelines and result metrics. Performance-based contracts therefore contribute to a more efficient allocation of resources through steering (at least at the margin) and encourage institutions to set goals and develop their own strategies to achieve them. This instrument can be applied in conjunction with the sectorial policy of the "principal" ministry/department of the PRI, or the industry stakeholders to which the PRI are associated (statutory PRIs).

- *Define and implement performance evaluation of PRIs periodically, following best practices.*

  Although the mission and objectives of PRIs might vary, these institutions should be subject to periodical performance evaluation by their funding agencies. Evaluation helps assess the use of research outcomes and progress in the achievement of agendas. At the institutional level, international peer review may be useful as it helps benchmark with global practice.

- *Enable PRIs to better access competitive research funding.*

  Ensure that PRIs are able to compete and access resources available through competitive schemes for research and technology commercialisation. This will entail training for drafting research proposals, improving research agendas internally, as well as revisiting eligibility criteria in calls for proposals.

- *Enhance linkages between universities and PRIs through joint formation of advanced human resources (PhD programmes and training), research collaboration and sharing of equipment.*

  Increasing the interaction between the two types of core research actors will foster synergies and efficiency of public investment, and contribute to higher quality research and improve its impact.

Strengthening the human resource base and skills for innovation

Over the last decade, Malaysia has undertaken important efforts to improve the national human capital base and the level of skills in order to respond to the evolving human and economic development needs. While important steps have been made to improve the level of education and the quality and supply of competences, access to qualified personnel and lack of skills are still among the important bottlenecks firms encounter in their attempts to invest in innovation and improve productivity.

According to the World Bank Enterprise Survey, the inadequate workforce is the most important obstacle in the business environment (quoted by 33% of firms in Malaysia, as opposed to the average of 10% of firms in Southeast Asian countries). The *Global Competitiveness Report* (2015-16) also stresses human capital and training as one of the weakest pillars of national competitiveness as perceived by firms.

This situation reflects a combination of challenges. First, a shortage of skills prevails in numerous domains and this gap concerns not only the demand for university graduates but also for specialised technicians. The still relatively low share of science and engineering students in Malaysian higher education remains an important handicap to boosting innovation in industry. Migration of graduates and post-graduates accentuated the lack of qualified professionals for local industry.

Second, an important mismatch prevails between supply and demand for skills whilst the quality of higher education remains a great concern. Malaysia needs to improve the relevance and quality of skills across the board – in both tertiary education and technical and vocational education and training (TVET). In quantitative terms, the levels of education and number of graduates have improved dramatically over the last decade but quality is often questioned, as reflected in the dissatisfaction of companies and the unemployment among graduates. In terms of highly skilled human capital, those with masters and doctorate degrees are still weakly integrated in the business sector. This reflects deficiencies in terms of information and weak connections of industry and higher education and research.

Improving and expanding TVET for industry needs remains an important task on the higher education agenda. The number of students undertaking TVET courses remains far below mainstream higher education. For a long time, TVET remained poorly considered and underfunded compared to mainstream higher education. The need to raise its status to that of higher academic education was well identified in the review of the Higher Education Blueprint 2015-25. Nevertheless, a number of challenges remain, including the need for improved relationships with business, the sometimes insufficient skills of the staff and the lack of identified pathways for bright TVET students to pass to high-quality mainstream HEIs.

There has been a significant increase in the number of institutions and students in the area of TVET. However, the diversity of the number of institutions combined with the absence of a unified system of accreditation *ex ante* and evaluation *ex post* has led to problems of quality and relevance of training programmes. An insufficient level of capabilities of instructors and their limited linkages with industry have hindered the TVET system to respond adequately to rapidly evolving needs for skills.

Mainstreaming and broadening access to TVET were at the heart of the main actions undertaken during the Tenth Malaysia Plan to increase the relevance and impact of the sector. Further efforts are foreseen in the Eleventh Malaysia Plan to better address industry demands by improving system delivery and increasing the attractiveness of TVET courses as an option.

Addressing these challenges will require continued strengthening of Malaysia's skills and education system – in line with the different human development engagements defined in the Higher Education Blueprint 2015-25, the Eleventh Malaysia Plan and the Human Capital Development (HCD) Strategic Reform Initiative (SRI) contained in the Economic Transformation Programme. This will also involve activating skills supply by removing regulatory barriers to hiring and mobility and using skills effectively – making full use of skills in the workplace to strengthen productivity and better matching supply with demand.

Some of these issues are currently addressed in the HCD SRI, led by the Ministry of Human Resources. This strategy focuses on enhancing and addressing the human capital capabilities and needs of the 12 national key economic areas (NKEAs) as well as

strengthening the skills of Malaysia's workforce. A series of regulatory reforms (e.g. current update of the Industrial Relations Act 1967 and the Employment Act 1955) and support programmes are currently in the process of being implemented. Among its initiatives are upskilling and upgrading of the workforce (in the 12 NKEAs) and strengthening the human resource management of Malaysian SMEs. The former comprise implementing sector-specific manpower training programmes.

The main challenge in ensuring the performance of these plans is not to fine-tune the diagnostics or devise new actions, but to put in place adequate implementation procedures, monitor their results in a clear and transparent way, and adapt and pursue efforts accordingly. A second institutional challenge key to their success is ensuring the linkages between the different strategic programmes to ensure synergies and efficiency in the allocation of resources. The linkages are not always clear and the relationships to the innovation agenda (and national science and technology plans) are not always clearly defined.

Equally fundamental is making headway in setting up sectorial skills agendas for the NKEAs for which co-ordination across stakeholders is a key to success. As foreseen in the HCD, this requires engaging industry, educational institutions and the government to develop sustainable sector-led approaches to address skills necessities in each priority sector. A first exercise was carried out in 2012 for the oil, gas and energy NKEA. Lessons from this exercise can nourish new developments.

Main recommendation

Improve the match between the supply of skills and the needs of industry, *inter alia* by including industry in curricula development, improving the delivery of the TVET system and increasing the attractiveness of TVET courses. Focus at this stage on the implementation of the various blueprints and plans and set up a mandatory schedule to evaluate the outcomes of these initiatives.

Other recommendations

- *Establish synergies* (collaborative mechanisms such as joint launching of funding programmes and joint work in the preparation of sectorial agendas) *between the Human Capital Development Strategic Reform Initiative and the other national strategy plans related to skills development and qualification, such as the Higher Education Blueprint 2015-25 and the Eleventh Malaysia Plan.*
- *Improve the match with industry demands by involving business representatives in the development of education curricula, and better align the composition of graduate output across disciplines with evolving demand.*
- *Enhance mobility programmes and funding for the placement of highly skilled human capital – such as Masters of Science and PhDs – to support their integration in the productive sector.*
- *Implement, monitor and evaluate regularly against objectives to allow policy makers to measure progress and adjust programmes if needed.*
- *Ensure adequate inter-ministerial co-ordination of the various initiatives addressing issues in higher education and TVET.*