Chapter 5

Intellectual property opportunities and challenges

In Malaysia, there is a wide variety of actual and potential users of intellectual property (IP) whose IP needs differ based on their industry, size, export potential and other factors. This chapter summarises the characteristics and needs of four groups of users: innovators in traditional and informal sectors, "catching-up" businesses (such as SMEs and young companies), leading "frontier" businesses and public research institutions and universities.

Opportunities and challenges for using intellectual property (IP) to support innovation activities vary considerably among different actors in national innovation systems. Firms' needs for IP protection depend on their industry, size and other characteristics. Leading "frontier" businesses, including multinational companies and Malaysia's large government-linked enterprises, as well as leading universities and public research institutes, will look for IP protection abroad; in contrast, trademarks, utility models or design rights are often more useful to Malaysian small and medium-sized enterprises (SMEs). Moreover, geographical indications and traditional knowledge protection can be crucial for traditional sectors. Universities and public research institutions will use IP differently and face other challenges when it comes to the commercialisation of their IP.

In order to account for the needs and usages of diverse users, this chapter will discuss four stylised groups of innovators (OECD, 2014): i) innovators in traditional and informal sectors; ii) "catching-up" businesses; iii) leading "frontier" businesses; and iv) universities and research institutions.

5.1. Innovators in traditional and informal sectors

The informal sector and traditional industries are part of Malaysia's innovation system. Traditional knowledge and the country's biodiversity can be relevant alternative sources for innovation in regions where few firms have the technical expertise needed to engage in technology-based innovation activities. They may also serve to include groups in society that are often excluded from innovation systems. Various programmes in Malaysia have provided worthwhile support to innovators' IP in traditional and informal sectors.

5.1.1. *Traditional knowledge, genetic resources and traditional cultural expressions*

The Malaysian government supports the creation of an international legal framework to protect traditional knowledge, genetic resources and traditional cultural expressions. Important issues here relate to IP rights, and to regulations related to access and benefit sharing. The topic is an important international debate (Box 5.1). With regard to genetic resources, Malaysia is signatory of the Convention of Biological Diversity (CBD) since 1994 (CBD, 2014). Moreover, the states of Sabah and Sarawak have enacted their own laws to govern their biodiversity. The Sabah Biodiversity Enactment 2000 (SBE, 2000)

Box 5.1. **Intellectual property and traditional knowledge, genetic resources and traditional cultural expressions**

The term "traditional knowledge" tends to comprise traditional knowledge (TK), genetic resources (GRs) and traditional cultural expressions (TCEs). As noted by the World Intellectual Property Organization (WIPO):

In recent years, indigenous peoples, local communities, and governments – mainly in developing countries – have demanded IP protection for traditional forms of creativity and innovation, which, under the conventional IP system, are generally regarded as being in the public domain, and thus free for anyone to use. Indigenous peoples, local communities and many countries reject a "public domain" status of TK and TCEs and argue that this opens them up to unwanted misappropriation and misuse. (WIPO 2015a: 5)

Discussions are currently underway in the WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore towards the development of an international legal instrument or instruments to protect traditional cultural expressions and traditional knowledge, and to address the intellectual property aspects of access to and sharing of benefits from genetic resources. WIPO members have agreed to develop an international legal instrument (or instruments) that would give TK, GRs and TCEs protection. The instrument would define what is meant by TK and TCEs, who the rights holders would be, how competing claims by communities would be resolved, and what rights and exceptions ought to apply.

While the committee continues debating to find the best solution at the international level, individual countries have started to take the initiative. In India, the Traditional Knowledge Digital Library project (TKDL) is available. It is an initiative of several government agencies. The aim is to document the disclosed traditional medicinal knowledge available in the public domain. In Indonesia, a joint database on traditional knowledge is now being developed across several ministries and organisations, including the Ministries of Science and Technology; Agriculture (for genetic resources); and Education (for traditional knowledge and traditional cultural expressions), and the Institute of Sciences (OECD 2014: 63).

Source: WIPO (2015a); OECD (2014).

specifies under what conditions access to resources for exploitation is provided and how benefits are to be shared. The Sabah Biodiversity Council, the Sabah Biodiversity Centre and the Biodiversity Centre Fund are the relevant institutions overseeing the enactment's implementation.

Malaysia's National Biodiversity Strategies and Action Plans (NBSAP) aim to transform Malaysia into a centre of excellence for conservation, research

and sustainable use of tropical biodiversity by the year 2020. The NBSAP refer to a variety of policies but do not specifically focus on the commercial exploitation of the country's biodiversity. They set the long-term direction and strategic framework for the implementation of the CBD and the conservation of biodiversity in Malaysia. The NBSAP outline a vision statement, policy statements and objectives, as well as 15 strategies and 87 action plans (for example, to improve the scientific knowledge base, improve the sustainable utilisation of components of biological diversity and develop a centre of excellence in industrial research into tropical biological diversity) (Prip et al., 2010).

A first approach adopted in Malaysia has consisted of taking stock of available resources. Initiatives in this direction have included the establishment of open and closed systems:

- Among the open systems, the Bio-D Database was created as a comprehensive source of information on biodiversity (including information about relevant publications, multilateral agreements and legislation, and details about implementing agencies, national focal points, research institutes, universities and non-governmental organisations). The database is part of Malaysia's Clearing House Mechanism (MyCHM), which was set up as part of the government's commitments as signatory to the CBD. MyCHM aims to facilitate reporting and the transfer of biological diversity and conservation-related information both nationally and internationally (MyCHM, 2015).
- The government has also established closed systems, restricted to specific users, to ensure protection for uses of TK for economic purposes, such as the Traditional Knowledge Digital Library (TKDL). A pilot project called the Malaysian Traditional Knowledge Digital Library was launched in 2009, a collaboration between the state of Sabah, Department of Orang Asli Affairs (the Malaysian government agency that oversees the affairs of aboriginal people in Malaysia), National University of Malaysia, Institute for Environment and Development, and Malaysian Intellectual Property Office (MyIPO). The electronic database aims to help patent examiners in processing patent applications, ensuring that Malaysian traditional knowledge is not exploited unethically. The database only documents GRs. As of December 2013, more than 1 600 records relating primarily to species of medicinal plants had been collected.
- In addition, a collaboration between MyIPO and the Department of Heritage in the Ministry of Tourism and Culture has collected more than 200 TKE records relating to dances, songs, handicrafts, tales and ceremonies (SaBC, 2009; MyIPO, 2014: 7-8).

5.1.2. *Geographical indications, rural communities and producers of traditional products*

Another way for IP to serve rural communities and traditional producers are geographical indications (GIs), which have started to be taken up more actively over the past years, particularly in the states of Sarawak and Sabah. MyIPO has embarked on a new initiative, "Know the GI in your area", to identify and register local products for protection under the Geographical Indications Act. Sarawak Pepper was the first registered geographical indication in Malaysia, in November 2003. Pepper from Sarawak has been sold globally over the last 100 years. Other better-known examples of successful exports, fostered by GIs, include Bario rice and Perlis Harumanis mango (RSM Farook, 2007: 46-51). Most Malaysian GIs, however, are little known as yet and do not provide much return to producers of the GIs in question. Registration efforts seem at times to have focused more on quantity than on a GI's commercialisation potential, and support for the development of value-added products is lacking or has only recently started.

The main challenge consists of creating an institutional context, such as that in place for Sarawak Pepper, to create commercial products of quality and produce relevant marketing to promote them. The Malaysian Pepper Board (MPB, Box 5.2), located in Sarawak, is a good example of government support for collective action around a product protected by a GI with international recognition. MPB is the registered proprietor of the Sarawak Pepper brand name. It grants quality certificates without which producers cannot export and, what is more, it offers capacity-building courses to industry smallholders to teach them how to produce high-quality pepper. This includes providing them with information on how to produce pepper of sufficient quality to be exported. Some producers have also registered their own trademarks, such as MIKROKLEEN, SaraSpice and pepper sweets (Muling, 2013). However, the potential for promoting additional economic development based on pepper may be limited by the nature of the product, therefore requiring wider economic development efforts for the region. Pepper is different from palm oil and rubber in terms of its market size and its economic returns. The product is still in a development phase, trying to build an industry around the product that goes beyond bulk exports of the raw commodity, whereas both palm oil and rubber have already established industries of value-added products.

The application procedure for GIs established in Malaysia's Geographical Indications Act 2000 is well-established and involves fixed procedures moving from application to examination and, if necessary, amendments to registration. Legal measures in cases of third party opposition are regulated. However, the lack of co-operation between local producers has hindered further exploitation of GIs. Different from other IP rights, which provide

Box 5.2. **Malaysian Pepper Board: An institutional setting supporting traditional sectors**

The MPB is a government agency under the Ministry of Plantation Industries and Commodities. It is in charge of promoting the cultivation and industry of Malaysian pepper (MPB, 2014). The promotion and branding of pepper started in the 1970s. The geographic indication for Sarawak Pepper was the first geographic indication applied for and was obtained in 2003; its registered owner is MPB. No pepper is allowed to be exported from Sarawak unless it receives certification from MPB, and pepper production in Malaysia takes place almost entirely in Sarawak (99%). The pepper industry has reported revenues of around USD 523 million (MYR 1 billion) in the last five years (Prospect Group, 2013).

MPB guarantees the quality of the pepper being produced and exported. MPB grades the pepper and allows its export only if sufficient quality standards are reached and export standards fulfilled (e.g. the types of pesticides and other chemicals used in cultivation). MPB's grading system is ISO-certified. Maintaining quality is a large focus of MPB, which provides quality upgrading courses for the more than 67 000 smallholders producing pepper. Training courses of 3-4 days are provided at no cost to farmers. In these courses, farmers are taught how to plant, what pricing strategies to adopt, what fertilisers to use, and what kind of machinery to buy.

MPB collects a very small fee for grading the pepper produced by the farmers into the four different quality grades for pepper. As pepper is a world commodity, prices for each grade are set on international markets and may change every day. Currently, MPB only sells bulk pepper in international markets.

MPB has a research and development (R&D) division that employs about 30 people, 11 of whom are researchers engaged in research to develop new product opportunities. So far this has resulted in innovations such as pepper chocolate, pepper candies, pepper sauce and other food products, as well as non-food products such as insect repellent and perfumes. At present, when the R&D division has prepared a formula for a new product, MPB retains the original formula but teaches the industry how to produce the new product. The main role of MPB's research unit is to initiate the process and let the local industry market the product, as MPB is not in the position to produce on a large scale. Local companies are invited to learn how to make the new product, and then to produce it under their own label with their own production methods. The market for value-added products remains local, and MPB's R&D is still rather low-tech. However, MPB has plans to improve its research capabilities and has begun co-operating with University Malaysia Sarawak.

Source: MPB (2014).

individual ownership, GIs are collective IP rights, i.e. they belong to the group of regional producers of the protected good. This has the effect that producers do not take responsibility for registering GIs, leaving it to the government to take the initiative. Collective action is more important for innovators in informal and traditional sectors because many firms are small, have limited resources and lack sufficient skills. The former Secretary General of the Ministry of Domestic Trade, Co-operatives and Consumerism stressed the importance of government initiatives to encourage producers to form associations or co-operatives, so that the costs for registering the protected products can be shared and members can enjoy exclusive rights to exploit their GIs. At the same time, consumers have a guarantee of product quality (MyIPO, 2012).

5.1.3. *Promoting inclusive innovation*

The Malaysian Foundation for Innovation (YIM) was established in October 2008 under the aegis of the Ministry of Science, Technology and Innovation (MOSTI), in part to promote inclusive innovation. Indeed, YIM was assigned a key role in supporting inclusive innovation within the SME Masterplan (see Box 5.4), which aims to support innovation for the 40% of Malaysians living below the poverty threshold. YIM's objectives are to: i) develop and promote creative skills in the field of science and technology in academia, industry and society; ii) nurture and support scientific innovation at the grassroots level, particularly among youths, women and non-governmental organisations; and iii) conduct educational and awareness programmes to enhance appreciation of science and technology at schools and at the grassroots level (YIM, 2014). YIM's activities are inspired by India's Honey Bee Network and the National Innovation Foundation (Box 5.3) (NIF, 2014). It has undertaken several "innovation walks" in different regions in Malaysia aimed at identifying grassroots innovations by individual inventors, often in rural areas and from disadvantaged economic contexts.

Box 5.3. **Inclusive innovation and the role of grassroots innovation**

Inclusive innovation directly serves the welfare of lower-income and excluded groups. These kinds of innovations often modify existing technologies, products or services to better meet the needs of those groups. Within this category, grassroots innovations describe innovations that are undertaken by the excluded groups themselves. Institutions providing support to grassroots innovators can prove in many respects to be central to facilitating the activities of grassroots innovators. The Indian Honey Bee Network and the Indian National Innovation Foundation are successful representatives of such institutions.

Box 5.3. **Inclusive innovation and the role of grassroots innovation** *(cont.)*

The **Honey Bee Network** was founded in India in 1989 to support innovation processes by linking grassroots innovators from low-income groups with each other. The network has developed an extensive database documenting innovations by the poorest, including agricultural practices (e.g. natural pesticides) and machinery. This makes it possible to enhance the diffusion of knowledge to a wider group of potential users. Furthermore, the Honey Bee Network supports the protection of inventors' intellectual property and the commercialisation of marketable innovations by connecting informal innovators with formal institutions, including universities and public research institutions. Building on the philosophy of the Honey Bee Network, India's **National Innovation Foundation** was founded in 2000. As an autonomous body, it aims to provide nationwide institutional support to grassroots innovation and traditional knowledge from the informal sector. Similarly to the Honey Bee Network, the foundation offers technical and financial support for developing grassroots innovations.

Source: OECD (2015), *Innovation Policies for Inclusive Growth*, OECD Publishing, Paris.

YIM's search activities have identified 54 innovative products to date. One of them was awarded MOSTI's National Innovation Award in 2012. From these 54 products, 20 IP rights requests have been made, mainly for trademarks and design rights. YIM provides the necessary support and funding for IP registration. However, support has not yet fully allowed these inventors to make a living on the basis of their inventions owing to the nature of the inventions. A focus on more technology-intensive types of inventions, as well as on traditional medicines, could produce better results. It is in such sectors that obtaining IP rights for inventions will also be more difficult.

5.2. "Catching-up" businesses: SMEs and young companies

5.2.1. *IP use profiles of SMEs*

The group of "catching-up businesses" consists of formal businesses, including SMEs, engaged in creating incremental innovations based on technologies developed by others, including from abroad. They are often in the early stage of building their own, internal innovation capacities. SMEs account for 30.2% of gross value-added economic activity and 32.7% of employment in Malaysia (Department of Statistics Malaysia, 2012). The bulk of Malaysian SMEs (90%) are active in the services sector, followed by manufacturing (6%) and agriculture (3%). Microenterprises with fewer than 5 workers constitute the majority (74.9%) of SMEs. Most SMEs operate in the Klang Valley, Kuala

Lumpur's metropolitan area (35.7%), followed by Johor (10.3%), Perak (8.0%) and Kedah (6.8%) (National SME Development Council, 2012: 29).

The Third Industrial Master Plan 2006-20 indicates that in 2003 only 19% of all SMEs that invested in R&D had registered trademarks, and only 3% of them had applied for patents (MITI, 2006). Patents are less relevant for many SMEs because they operate in the services sector, which relies less on patent protections than does manufacturing (MASTIC, 2014). Moreover, more limited investment in R&D by many SMEs leads to much lower rates of IP adoption among the full population.

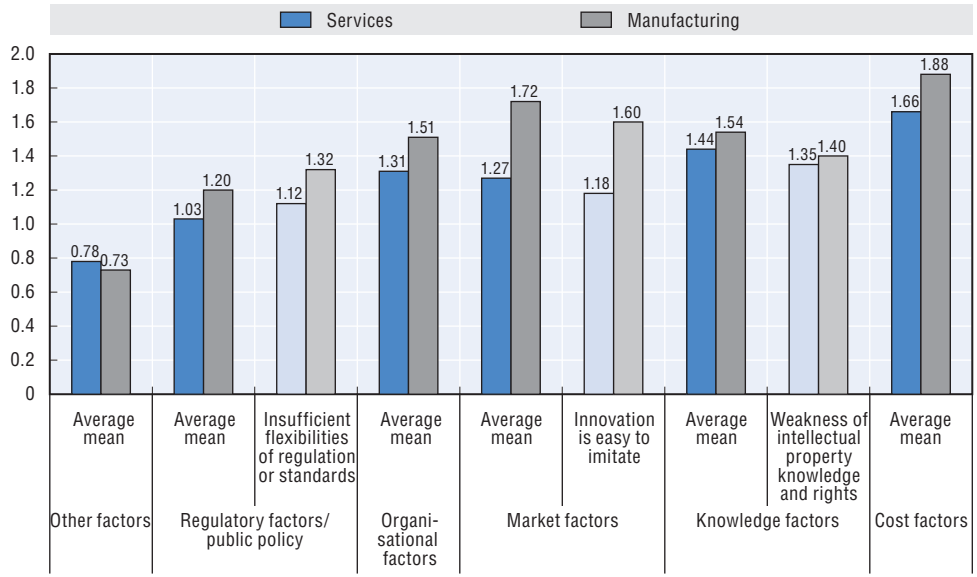
However, other types of IP, including trademarks and utility models, are often much more relevant. In a 2010 WIPO survey about their use of IP rights, Malaysian firms ranked trademarks as having the highest importance (scoring 5.1 on a scale of 1 to 7), well above patents (3.4), copyright (3.2) and industrial designs (2.4). Geographical indications were viewed as having very little importance (Hu et al., 2010). When asked about strategies other than IP rights to protect their innovations, results from the same 2010 survey showed that maintaining trade secrets came first (5.1), followed by speed to market (5.0) and offering superior services (4.9) for both product and process innovations (Hu et al., 2010).

IP-related issues such as fear of imitation and concerns over weaknesses in enforcing intellectual property rights are judged to be important but are generally are not among the factors that firms perceive to be the most important obstacles to innovation (Figure 5.1). More important are cost considerations and other market factors, such as uncertainty as to whether there will be sufficient demand for the new good or service, or the positioning of dominant players within an industry. This means that concerns about IP rights themselves impede innovation efforts but do not pose a major constraint on firms' innovation efforts.

5.2.2. Government support of SMEs' IP use

SMEs are an important target group of policies and programmes at the national and regional level promoting IP awareness and commercialisation. These include specific IP awareness campaigns implemented by MyIPO. In addition, creating an IP culture among SMEs has been a regional policy priority in Penang's electrical and electronics (E&E) cluster. E&E multinationals continue to rely substantially on other multinationals as service providers in Malaysia because local providers have invested less in R&D. There are, however, some exceptions, such as Inari Amerton, a large local electronics manufacturing services provider that offers services and support to the radio frequency, optoelectronics, fibre optics, and testing and measurement equipment sectors.

Figure 5.1. **Factors hampering innovation activities**



Note: The indicators are ranked on a scale of 0-3, where 0 indicates "not relevant" and 3 "highly important".
Regulatory factors and public policy consist of "Limitation of science and technology public policies" and "Insufficient flexibilities of regulation or standards". Organisational factors consist of "Lack of networking with research institution", "Lack of facilities", "Lack of infrastructure", "Inability to devote staff to innovation activities due to production requirement", "Managerial structure of enterprise", "Attitude of managers toward change" and "Attitude of personnel towards change".
Market factors consist of "Innovation is easy to imitate", "Uncertain demand for innovative goods and services" and "Market dominated by established enterprise". Knowledge factors consist of "Weakness of intellectual property knowledge and rights", "Difficulties in finding co-operation partners for innovation", "Lack of information on markets", "Lack of information on technology" and "Lack of qualified personnel". Cost factors consist of "Excessive perceived risk", "Lack of finance from sources outside the organisation", "Lack of funds within the organisation" and "Cost too high".
Source: MASTIC (2014: 113) based on Malaysia's National Survey of Innovation in 2012.

Malaysia's national technology commercialisation platform PlaTCOM Ventures supports SMEs in the process of obtaining and effectively developing innovations using IP. PlaTCOM provides commercialisation services for entrepreneurs, start-ups, spin-off companies and grassroots inventors, and assists in the exploitation of IP to generate income. The service also identifies gaps in clients' IP portfolios, as well as new industries and markets for clients to discover. PlaTCOM also delivers knowledge-based training modules on technology/knowledge transfer and commercialisation to foster the creation of an entrepreneurial mindset. However, PlaTCOM currently has only ten staff members and is able to work only on a very small scale. In 2014, PlaTCOM was supposed to support 16 Malaysian companies. The PlaTCOM approach is an interesting tool that can be of particular benefit for smaller businesses and can contribute to increased IP use. Deployment on a larger scale may be worth considering, e.g. adopting some of the innovative approaches used by Colombia's *Propiedad Intelectual* project (Box 5.5).

Box 5.4. **Malaysia's SME Masterplan 2012-20**

The SME Masterplan presents a cross-institutional plan for empowering the countries' SMEs. It involves 16 ministries with co-ordination by SME Corporation, an agency under MOSTI in charge of developing the countries' SMEs. It is based on the results of a study carried out by SME Corporation in 2010 to assess the economic situation and potential of Malaysian SMEs with the aim to develop the SME Masterplan for 2020. The study, which was undertaken with the World Bank, found that Malaysia's SMEs often had low productivity levels: only a few achieved high growth rates and there was a large informal sector. This was due to challenges in i) innovation and technology adoption; ii) human capital development; iii) access to financing; iv) market access; v) legal and regulatory environment; and vi) infrastructure.

The Masterplan set out to address these challenges, including issues that relate to SMEs' use of IP, mainly by connecting firms to IP-protected inventions held by universities and public research organisations. One of the six high-impact programmes, HIP2, specifically emphasises the importance of technology commercialisation platforms in matching inventors with investors and users as a means of supporting and promoting SMEs' innovation efforts. The HIP2 platform is a strategic partnership between SME Corporation and the Malaysia Innovation Agency.

Table 5.1. **Summary of initiatives under the SME Masterplan**

Six High-Impact Programmes	Four Thematic Measures	Measures for East Malaysia	Other supporting measures
HIP1: Integration of business registration and licensing to improve ease of doing business	Theme 1: Promote resource pooling and shared services	Improve connectivity and basic amenities	Complete the integrated trade clearance and facilitation system (single window)
HIP2: Technology commercialisation platform to encourage innovation	Theme 2: Create demand for SME products and services	Review restrictive laws and policies	Reform bankruptcy law to give entrepreneurs a second chance
HIP3: SME investment programme to provide early stage financing	Theme 3: Reduce information asymmetry	Ease market access	Review policy on SME taxation
HIP4: Going export programme to expedite internationalisation of SMEs	Theme 4: Build capacity and knowledge		Synchronise measures on productivity enhancement technologies with other relevant labour policies
HIP5: Catalyst programme to promote more home-grown champions			
HIP6: Inclusive innovation to empower the bottom 40%			

Source: SME Corp. (2012).

Box 5.5. ***Propiedad Intelectual Colombia***

The *Propiedad Intelectual Colombia* project, funded by the Inter-American Development Bank (USD 1.4 million) and regional Chambers of Commerce (USD 1.3 million), aims to foster the use of IP by micro, small and medium-sized Colombian firms. The project has a regional focus covering Antioquia, Bogotá, Cali, Cartagena and Barranquilla. The Inter-American Development Bank, via its Multilateral Investment Fund (FOMIN), the Chamber of Commerce of Medellin and the Superintendency of Industry and Commerce, Colombia's patent office, jointly implement the project over an initial period of four years.

The project supports the development of simplified IP application procedures and online modules for trademarks and patent applications. It has also developed various tools to inform businesses about the strategic value of IP, with the aim of overturning the widespread view of IP as a purely legal tool of little value to businesses.

The project's most ambitious service consists of providing specialised IP consulting services to around 400 companies, for which 150 national consultants have been trained. The process involves four steps. The first involves a detailed diagnostic of individual firms' use and management of IP from the perspective of innovation. The second step comprises practical courses to promote innovation, help companies identify sources of innovation financing, and train firms in finding useful information provided by publicly available IP databases. The third step involves the development of recommendations, based on an inventory of intellectual assets, to better manage a firm's intangible assets. The final step is the creation of a concrete plan detailing which IP the firm should apply for, how to conduct enforcement and what strategic priorities to set regarding IP.

Initial feedback from participating firms has been positive. Future evaluation will reveal which long-term benefits were derived from the project and, in particular, whether the training provided firms with the opportunity to manage their IP effectively beyond the project phase.

Source: OECD (2014: 127).

5.3. Leading "frontier" businesses

5.3.1. IP use among leading national frontier businesses

The top local industry players with the largest market shares and size in Malaysia are not necessarily active users of the IP system. Even in Penang's E&E industry, only one in four patents is owned by a national producer (NEAC, 2009). IP ownership still is a new "culture" for many local companies, even if they are strongly involved in R&D.

The five Malaysian companies that were listed in the United Nations Conference on Trade and Development's World Investment Report among the top non-financial transnational corporations in Southeast Asia are Petronas, Axiata, Genting, Sime Darby and Tanjong (UNCTAD, 2013). Sime Darby (a palm oil supplier) is also listed in position 1 583, with USD 41.9 million of R&D expenditure in 2012 and an R&D intensity of 3% with respect to sales in the European Union's R&D Scoreboard of 2013. Petronas (Box 5.7) and its Institute of Technology are among the top PCT (Patent Co-operation Treaty) applicants, as are two other private companies, IQ Group (a supplier of security and convenience products) and Widetech Manufacturing (a manufacturer of correction fluid products), both Malaysian technology-based firms created in the 1980s. As shown in Table 5.2, Petronas (4th) and Sime Darby (6th) are also among the leading patent applicants at the European Patent Office, as are IQ group (7th) and Widetech (29th), as well as many others, such as Harn Marketing (5th) and Qeos (25th) (see Box 5.6).[1]

Table 5.2. **Top ten Malaysian PCT applicants, 2012**

Applicant	Type	PCT filings
Mimos Berhad	Government-owned company	146
Universiti Sains Malaysia	Public university	39
Universiti Putra Malaysia	Public university	15
Petronas	Government-owned company	8
Malaysian Palm Oil Board	Government agency	7
IQ Group	Private company	4
Universiti Malaya	Public university	4
Widetech Manufacturing	Private company	4
Institute Of Technology Petronas	Government-owned company	3
Malaysian Rubber Board	Government agency	3

Source: WIPO *Statistics* (database).

Box 5.6. **The case of Qeos**

Quantum Electro Opto Systems (Qeos), number 25 in the ranking of Malaysian applicants to the European Patent Office, was founded by three researchers at the University of Illinois Urbana-Champaign in the United States to pioneer the commercial development of high-speed, low-cost and power-efficient fibre optic communications solutions. Qeos was initially supported by MOSTI's Brain Gain Malaysia Diaspora programme. Venture capital was provided by Kumpulan Modal Perdana and First Floor Capital. The company has also been supported by the Malaysian Industrial Development Authority's R&D programme and MOSTI's Technofund programme. The company is headquartered at Batu Berendam, Melaka, a free trade zone located in the southern region of peninsular Malaysia.

Source: Qeos (2014).

Box 5.7. **Petronas**

Petroleum Nasional Berhad (Petronas) is Malaysia's national petroleum corporation. It was incorporated in 1974 under the Companies Act (1965) and is wholly owned by the Malaysian Government. Ownership and control of all petroleum resources in Malaysia rests with Petronas through the Petroleum Development Act (1974). Petronas is engaged in the exploration and production of oil and gas: oil refining, marketing and distribution of petroleum products, trading, gas processing and liquefaction, gas transmission pipeline network operations, marketing of liquefied natural gas, petrochemical manufacturing and marketing, shipping, and property investment. The total number of the company's employees is close to 40 000.

IP has played a significant role in the growth and business development of Petronas. In this context, the company established a separate IP division within its legal department. One key strategy of the IP Division is to conduct IP awareness programmes within Petronas, particularly relating to the value of intangibles and the registration of Petronas trademarks and patents.

Petronas has a comprehensive strategy to promote the company's brand impact. Its brand promotional activities have made customer loyalty the most important target. The Petronas logo is registered in many countries, including the United States. Additionally, the company has more than 200 trademarks spread over 65 countries. In Malaysia, Petronas has registered 110 trademark applications in 45 classes with MyIPO. Petronas has carried out well-calculated and concerted efforts to promote its brand, using direct and indirect approaches. The most direct form of brand promotion has consisted of introducing logos on its products. In Malaysia, Petronas is the most popular brand among gas stations and its products can be found in even the most remote corners of the country. Petronas has also become a household name for cooking gas, which has found its way into many homes.

Source: WIPO (2015b).

5.3.2. The role of foreign multinationals in Malaysia

Multinational companies' affiliates established in Malaysia predominate among the top applicants from Malaysia at the US Patent and Trademark Office (USPTO) (see Table 5.4). The evidence indicates that these companies have R&D labs in Malaysia, where inventions are made, whose protection is filed in the United States. Feedback from interviews with industry and university representatives suggests that so far only a few of those inventions were developed jointly with local businesses or research institutions.

Feedback from interviews also suggests that multinationals have trust in the strength and legal certainty of the Malaysian IP system. Factors holding back further R&D investment in Malaysia included shortages in skilled personnel, as well as a shortage of SMEs with the capacity to serve as partners in R&D activities.

Table 5.3. **Top 30 Malaysian patent applicants in the European Patent Office, filing years 2000-11**

Rank	Applicant	Filings	Rank	Applicant	Filings
1	Malaysian Palm Oil Board (MPOB)	38	16	Simplex Major	4
2	Universiti Putra Malaysia (UPM)	37	17	Universiti Malaya (UM)	4
3	Mimos Berhad	29	18	Universiti Teknologi Malaysia (UTM)	4
4	Petronas	18	19	WRP Asia Pacific	4
5	**Harn Marketing**	16	20	Borneo Tsang Furnishing	3
6	**Sime Darby**	15	21	Easycup International	3
7	**IQ Group**	14	22	**Inqpharm Group**	3
8	**Shimano Components**	13	23	Koosan	3
9	**Oyl R&D Centre**	11	24	**Pure Circle**	3
10	**Biolitec Pharma Marketing**	10	25	**Quantum Electro Opto Systems (Qeon)**	3
11	Universiti Sains Malaysia (USM)	8	26	Standards and Industrial Research Institute of Malaysia	3
12	Government of Malaysia	6	27	**Texchem**	3
13	**Neuramatix**	6	28	**TMS Technologies**	3
14	**Easy Pack International**	6	29	**Widetech Manufacturing**	3
15	**Gha Brands Limited**	4	30	**Advanced Pyrotech**	2

Note: For EPO patents, Malaysian origin is determined by the country of origin of any of the applicants, and the table displays the counts of patents associated with them based on full counting, i.e. if an EPO patent has two different Malaysian applicants, it would appear twice.
Source: EPO *Worldwide Patent Statistics* (database).

Table 5.4. **Malaysia's top ten patent owners at USPTO, grant years 2009-13**

Rank	Patent owner	Patents	Company sector of activity	Malaysian private company	MNC
1	Avago Technologies ECBU and General IP (Singapore) Pte. Ltd.: Designer, developer and global supplier of analogue, digital, mixed signal and optoelectronics components and subsystems with a focus in semiconductor design and processing	209	E&E		X
2	Intel Corporation: One of the world's largest semiconductor chip makers	92	E&E		X
3	Altera Corporation: Manufacturer of programmable logic devices (PLDs), reconfigurable digital circuits	71	E&E		X
4	Infineon Technologies AG: Semiconductor manufacturer	39	E&E		X
5	Freescale Semiconductor, Inc.: Designs and produces embedded hardware and software for the automotive, networking, industrial and consumer markets	35	E&E		X
6	Purecircle SDN BHD: Provider of natural sweeteners to the global food and beverage industry	33	Food	X	
7	Malaysian Palm Oil Board: Premier government agency entrusted to serve the country's oil palm industry	29	Food		
8	Western Digital Technologies, Inc.: One of the largest computer hard disk drive manufacturers	22	E&E		X
9	Spansion LLC: Manufacturer of flash memory microcontrollers, mixed-signal and analogue products, as well as system-on-chip solutions	21	E&E		X
10	Schlumberger Technology Corporation: World's largest oilfield services company	17	Oil and gas		X

Note: For USPTO patents, the Malaysian origin is determined by the country of the first-listed inventor and the table displays first-named assignees and the counts of their associated patents.
Source: USPTO (2015).

5.3.3. *Support policies for IP use of frontier innovators*

The Multimedia Super Corridor (MSC) was established in 1996 to act as a hub for companies in the information and communications technology sector (ICT) with ICT-enabled working and living environments. The MSC Malaysia Intellectual Property Grant Scheme subsidises up to 70% of the initial costs of applying for trademarks, patents and industrial designs (Day and Muhammad, 2011). The overall support scheme has led to an increase in patents granted in the ICT industry from 2 in 1990 to 101 in 2006 (Heng Gee et al., 2009).

5.4. Public research institutes and universities

5.4.1. *Universities and research institutes as leading users of the IP system*

Public research institutions and universities increased their use of IP over the past decade: from 2005 to 2012 their patent applications increased five-fold. In the period 1988-2004, the total number of patent applications filed in Malaysia by universities was quite low (Chandran and Wong, 2011). However, in 2010 public research institutions and universities accounted for 60% of all Malaysian patent filings: most of these were filed by universities (MASTIC 2014: 133). Public research institutions and universities are also leading applicants abroad, in both PCT applications (Table 5.5) and EPO filings (Table 5.3).

Table 5.5. **Local patent and utility model applications by type of applicant, 2005-12**

	Total applications by residents	Universities (public and private)	%	Public research institutes	%
2005	522	81	16	38	7
2006	531	94	18	40	8
2007	670	165	25	109	16
2008	864	272	31	151	17
2009	1 234	547	44	204	17
2010	1 275	574	45	222	17
2011	1 136	442	39	164	14
2012	1 160	407	35	177	15

Source: MyIPO (2014).

Leading universities in terms of total patent applications include Universiti Sains Malaysia (USM), University Malaya, Universiti Putra Malaysia and Universiti Teknologi Malaysia (Box 5.8). USM was, in 2012, among the top 50 university applicants, with 39 PCT applications. USM had gone from 10 and 16 PCT applications in 2010 and 2011 respectively, to 39 in 2012 (MASTIC 2014). Two public research institutions, MIMOS and the Malaysian Palm Oil Board

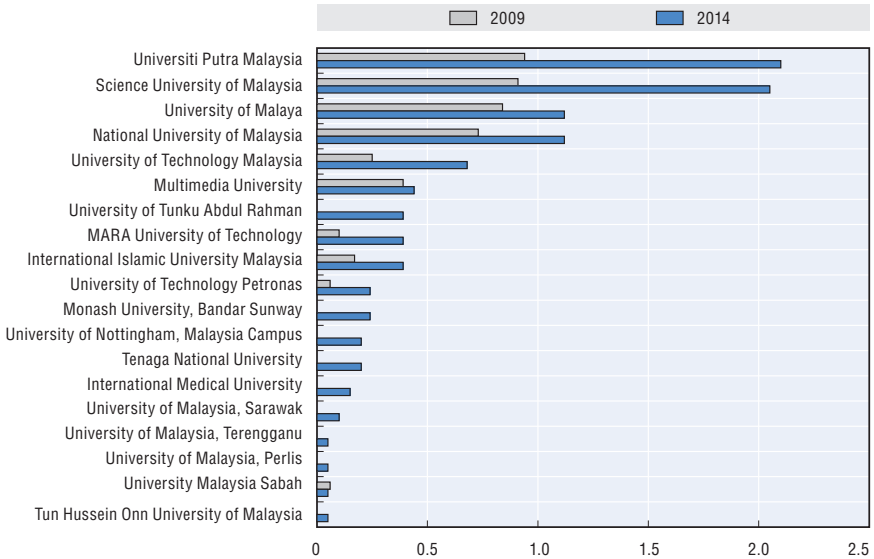
(MPOB), are among the top patent applicants in the country. In particular, MIMOS has been the top Malaysian PCT applicant in the past few years (see discussion below), filing at least 100 more PCT applications than the next Malaysian PCT applicant. These count-based publication and IP rankings are useful in providing an overview of the publication activities and the uptake of IP by Malaysian institutions. They say, however, little regarding efficiency because they do not account for publications output relative to research income, staff and government resources.

5.4.2. *The commercialisation of public research remains limited*

In spite of a much larger and increasing number of IP applications, the commercialisation rate of research from public institutions has until recently remained limited (Thiruchelvam et al., 2011). In a review of R&D commercialisation challenges for Malaysia, Chandran (2008) analysed a survey of 5 232 research projects by public research institutions and universities in the period 1991-99. Of these, 14.1% were identified as candidates for commercialisation and 5.1% were commercialised. The commercialisation rate was lower, at 3.4%, for the period 2000-05. Effectively, much of IP-protected research in Malaysia is never commercialised. However, much has happened in recent years to enhance commercialisation, including learning from past experience and an easing of infrastructure and bureaucratic hurdles to commercialisation, as well as efforts to improve industry-university linkages. Some actors have been more successful in their commercialisation efforts, including USM, MPOB, the Malaysia Rubber Board (MRB) and Universiti Putra Malaysia (Chandran, 2008; Damodaran, 2010).

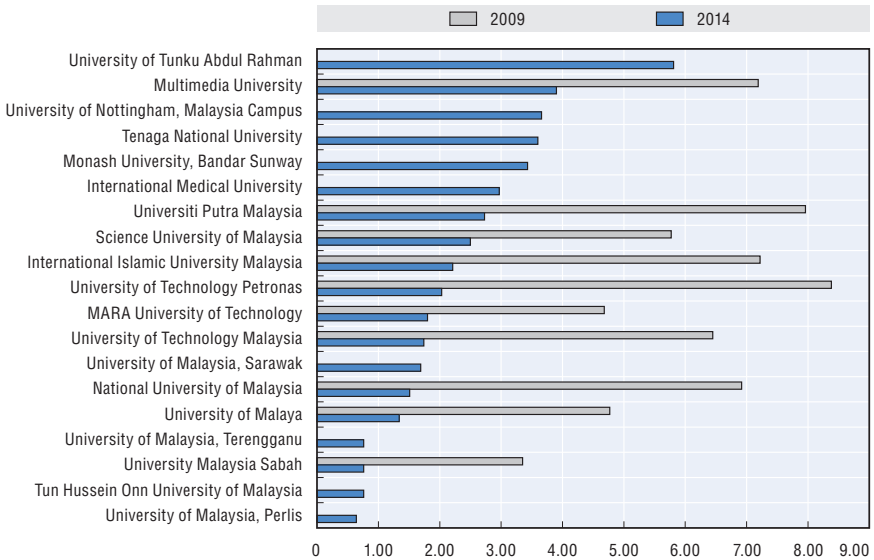
The "technological impact" of Malaysian scientific results on innovation can also be measured indirectly through patents citing publications from Malaysian universities. Figures 5.2 and 5.3 provide two relevant measures based on data from the SCImago (2014) "Institutions rankings": a) innovative knowledge, defined as the number of scientific publications cited in patents; and b) technological impact, defined as the ratio between the scientific publications of an institution that are cited in patents with respect to all of its scientific publications in technologically related scientific areas. The graphs show that even Malaysia's best performing universities (based on information from publications) have a low level of both innovative knowledge and technological impact compared to the top institutions in the world, the best of which have a score of 100 compared to the maximum of 8 reached by Malaysia's institutions. However, almost all Malaysian universities increased their level of innovative knowledge between 2009 and 2014, and the scientific production of new institutions has become visible "technologically" in those five years. This may well be the result of substantial policy efforts aimed at enhancing universities' contributions to the innovation system.

Figure 5.2. **Innovative knowledge of Malaysian institutions, 2009-14**



Note: Innovative Knowledge is a measure that depends on the number of scientific publications cited in patents. The Innovation Knowledge Indicator is size-dependent, i.e. larger institutions will rank higher because these institutions are likely to produce a larger number of publication.
Source: SCImago (2014).

Figure 5.3. **Technological impact of Malaysian institutions, 2009-14**



Note: Technological Impact is a measure based on the ratio between the number of scientific publications produced by an institution and the number that are cited in patents. The Technological Impact indicator is size-independent.
Source: SCImago (2014).

5.4.3. *Challenges to universities' commercialisation activities*

Universities have faced a variety of challenges that are relevant to IP and its commercialisation. These include:[2]

- Poorly structured technology transfer offices and information process
- Lack of demand-oriented research and poor IP management
- Bureaucracy
- Lack of relevance of university R&D to industry
- Lack of co-operation with industry in general
- Insufficient government support and incentives, including financial incentives
- Lack of information on technology and appropriate markets for inventions
- Lack of skilled personnel and absorptive capacity and human capital in SMEs that hampers university-industry knowledge flows and innovation more generally
- Lack of funding at various stages of the commercialisation process (e.g. prototype, marketing).

It is, however, worth noting that over the past years, progress has been substantial. Bureaucratic hurdles have been addressed more successfully than before. Universities have acquired greater expertise by engaging in business or drawing on foreign expertise by consulting with foreign experts or, in the case of some foreign universities operating in Malaysia such as the University of Nottingham's Malaysia Campus, drawing on the expertise of the foreign company's headquarters.

5.4.4. *Government policies and IP in public universities*

As is the case in many other countries, Malaysia has focussed on the question of how public research can contribute more substantially to innovation. As recognised in the 10th Malaysia Plan, improving the quality of education at all levels is a long-term undertaking and will likely require interventions in several areas, including changes in the ways that secondary teachers are trained and recruited, as well as comprehensive changes in curricula. In light of the dissatisfaction of employers with the relevance of formal education in Malaysia, industry representatives are to be involved in the development of education curricula, and will influence the composition of graduates across disciplines in an attempt to align graduates' skills with industry demand.

Low patent numbers and commercialisation results from public universities became a policy issue for the Malaysian Government in the mid-2000s. Realising that a substantial amount of public funding had been invested in research and development with relatively few products being commercialised, the government sought to increase the returns on its

Box 5.8. **Overview of Malaysia's universities**

The Higher Education Department within the Ministry of Education (MOE) co-ordinates and monitors the activities of public and private universities and colleges in Malaysia. Malaysia has 20 public universities, 33 private universities and 4 branch campuses of foreign universities (see Chapter 2). Public universities are categorised by MOE into three groups: 5 **research universities** (focussing on research, competitive entry, quality lecturers and a ratio of undergraduates to postgraduates of 50:50); 11 **technical/focused universities** (focussing on technical, education, management and defence research issues, competitive entry, quality lecturers and a ratio of undergraduates to postgraduates of 50:50); and 4 **comprehensive/teaching universities** (focussing on teaching, competitive entry, quality lecturers and a ratio of undergraduates to postgraduates of 70:30). Table 5.6 provides an overview showing that the largest public university of the country is University Teknologi Mara, with 34% of all tertiary students in Malaysia in 2013. Ten public universities have been either newly created or were given university status in the 1990s.

Table 5.6. **Size and type of public universities in Malaysia**

Type of university	Acronym	Year of creation	Name	Student enrolment	% Total enrolment	Top 10 PCT Malaysian applicant 2012
Research	UM	1949	Universiti Malaya	27 091	5	Yes
Research	USM	1969	Universiti Sains Malaysia	29 065	5	Yes
Research	UKM	1970	Universiti Kebangsaan Malaysia	30 041	5	No
Research	UPM	1931	Universiti Putra Malaysia	32 092	6	Yes
Research	UTM	1904	Universiti Teknologi Malaysia	33 361	6	Yes
Focussed	UUM	1984	Universiti Utara Malaysia	30 837	6	No
Comprehensive	UIAM	1983	Universiti Islam Antarabangsa Malaysia[3]	32 086	6	No
Comprehensive	UNIMAS	1992	Universiti Malaysia Sarawak	17 198	3	No
Comprehensive	UMS	1994	Universiti Malaysia Sabah	25 207	4	No
Focussed	UPSI	1922	Universiti Pendidikan Sultan Idris	27 659	5	No
Comprehensive	UiTM	1956	Universiti Teknologi Mara	189 551	34	No
Focussed	UniSZA	2005	Universiti Sultan Zainal Abidin	7 977	1	No
Focussed	UMT	1979	Universiti Malaysia Terengganu	8 715	2	No
Focussed	USIM	1998	Universiti Sains Islam Malaysia	13 022	2	No
Focussed	UTHM	1993	Universiti Tun Hussein Onn Malaysia	15 319	3	No
Focussed	UTeM	2000	Universiti Teknikal Malaysia Melaka	12 593	2	No
Focussed	UMP	2002	Universiti Malaysia Pahang	8 904	2	No
Focussed	UniMAP	2001	Universiti Malaysia Perlis	10 415	2	No
Focussed	UMK	2007	Universiti Malaysia Kelantan	6 443	1	No
Focussed	UPNM	2006	Universiti Pertahanan Nasional Malaysia	2 783	0	No
			Total enrolment	**560 359**	**100**	

Source: MOE (2015) for the list of public universities and their type; WIPO (2014) for the top ten PCT applicants; Internet search for the creation year of each university.

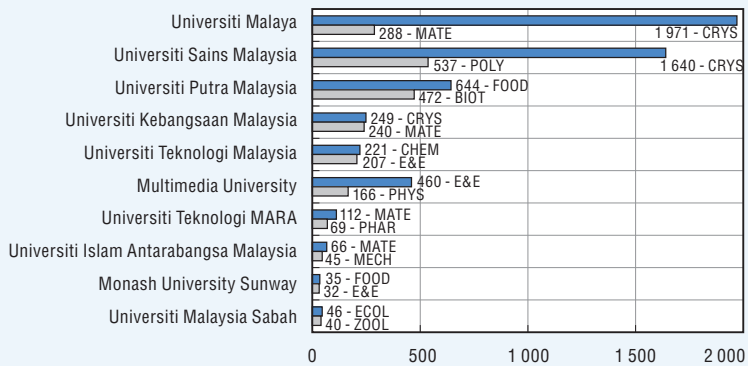
Box 5.8. **Overview of Malaysia's universities** *(cont.)*

Malaysia's leading public research universities produce most of the research output in the country. They also accounted for two-thirds of all Malaysian publications between 2001 and 2011: two of them, University Malaya (7 508) and Universiti Sains Malaysia (7 073), alone account for about 51% of all publications. When combined with the publications from the other three research universities, Universiti Putra Malaysia (4 947 publications), University Kebangsaan Malaysia (3 708) and Universiti Teknologi Malaysia (1 641), these five universities account for two-thirds of total publications. The reader should note that absolute publication numbers deliver an imperfect picture of university performance, as universities' staff sizes, research and teaching budgets and available infrastructure differ substantially.

During the last decade, private universities in Malaysia have become more important, both with regards to student numbers and with regards to their publication activities. Among private universities, the Multimedia University, set up in 1996, leads in terms of publications in the period 2001-11 with1 348 publications. Other leading private universities in terms of publications are Monash Universiti (532), University Abdul Rahman (409), Universiti Teknologi Petronas (388) and University of Nottingham Malaysia (363) (MASTIC, 2014: 89-90). Most recent data show stronger publication numbers for private universities, notably at Universiti Teknologi Petronas, but also at Monash University and Nottingham University. This indicates that these institutions, which are still quite young, have successfully positioned themselves in contributing to research outputs in Malaysia.

University research also contributes to areas relevant to industry, with a few universities catering to the needs of the E&E sector. There are also other areas of specialisation across institutions (Figure 5.4).

Figure 5.4. **Universities and their two leading research fields with number of publications, 2000-11**



Note: BIOT – Biotechnology & Applied Microbiology; CHEM – Chemical Engineering; CRYS – Crystallography; E&E – Engineering, Electrical and Electronic; ECOL – Ecology; FOOD – Food Science and Technology; MATE – Materials Science, Multidisciplinary; MECH – Engineering, Mechanical; PHAR – Pharmacology and Pharmacy; PHYS Physics, Applied; POLY – Polymer Science; ZOOL – Zoology.

Source: Mastic (2014: 93).

investment that could be translated into economic growth (MIGHT, 2009). Greater emphasis on commercialisation was one of a wider set of policies aimed at improving the performance of universities (Box 5.9), particularly in the National Higher Education Plan 2007-12. A rating system for Malaysian higher education institutes (SETARA) was introduced in 2007 to enhance quality and promote best practices in public universities (OECD, 2013). The Accelerated Programme for Excellence (APEX) was created, providing privileges and greater autonomy for excellence in research and innovation. By the end of 2014, only USM had been awarded APEX status (OECD, 2013).

In order to support wider efforts by universities to seek IP as a way to commercialise their research, in 2009 MOSTI introduced the IP Commercialisation Policy (MOSTI, 2009) for research institutions. The policy recommended that research institutions provide cash rewards of MYR 500 (USD 265) to researchers on disclosure of an invention, up to MYR 10 000 (USD 5 302) when a patent was granted, as well as a share in the revenues from commercialisation of IP generated by government-funded projects (MOSTI, 2009). However, the necessary funds to implement the measure were not added to the public funds received by the universities and few universities implemented the measures. Those that did, in the end, had to draw from their own budget. USM, for instance, only provides rewards to inventors once there is a return from an invention, but not before.

The universities show evidence of learning regarding the costs and returns from IP. Some universities are more selective than others when deciding what disclosures to protect by seeking patent protection and what disclosures to put in the public domain by publishing results in scientific journals. Feedback from universities indicates that although increasing the number of filings might have been the objective in recent years, they may become more selective mainly because of financial constraints. Getting IP rights is costly, so that universities become more careful and only patent inventions with the highest commercial potential. The same applies to the question of whether or not to file nationally or via PCT, and whether to get into national phase entries via PCT and if so, in which countries. The same is true for IP renewals. These decisions are likely to be more cost-conscious with universities' new autonomy starting in 2015.

What is more, universities have also received greater autonomy in key areas of governance, including legal, operational (governance), academic and financial matters, and in issues relating to human resources, enrolment, and income generation (see also Chapter 2). To gain autonomy, universities need to comply with certain framework conditions related to the quality of the institution, as well as to governance, as specified by the MOE. USM, Universiti Teknologi Malaysia, Universiti Malaya, Universiti Kebangsaan Malaysia and Universiti Putra Malaysia were the first universities that obtained autonomy in

Box 5.9. **Policies in support of the commercialisation of public research**

Legislative reforms, the growing importance of science for technological innovation, and changes in the way governments allocate funds to public research institutions and universities have all contributed to the rise of market-oriented activities by universities and research institutions worldwide. In particular, the demand for universities to engage in commercialisation activities has increased.

There are three main policy areas that frame IP commercialisation at academic institutions:

First, IP policies regarding ownership and commercialisation at the institutional level provide clarity in the legal framework, facilitating co-operation with private entities. University policies regarding IP and technology commercialisation include policies conveying norms about the creation, registration and exploitation of IP rights.

Second, policies towards inventor participation in the technology transfer process are crucial. These may include inventor royalty compensation, awards, recognition in curricula (e.g. credits for tenure), equity participation in spinoffs, etc. According to international best practices, royalty sharing and equity participation are proven policy mechanisms to encourage the participation of researchers in patenting and the commercialisation of technology.

Third, organisational arrangements are needed to link with the external environment, and co-ordinate and execute technology transfer activities. By facilitating the division of tasks across stakeholders, technology transfer offices (TTOs) relieve the administrative burden of IP and commercialisation from researchers, and by building reputation and networking competences, they facilitate institutions' integration into technology markets. Several studies have emphasised the role of TTOs in licensing and start-up formation. An example is the Innovation Agency (INOVA), a TTO at University of Campinas (UNICAMP) in Brazil. UNICAMP is the biggest university technology transfer provider in Brazil and Latin America, a fact based on its strong component of graduate and post-graduate researchers (one-half of students are graduate students) and on its effective management of INOVA. INOVA is a multitask agency charged with encouraging, promoting and facilitating the relationship between the university and the market. Instead of selecting UNICAMP's technologies and offering them to the market, INOVA first identifies a market demand and, in response, looks to the university for the solutions available. Another factor that contributes to INOVA's success is the professional staff involved in technology transfer. Furthermore, it manages several collaborative programmes with industry.

Source: Zuniga, P. (2011).

2012 (Kulasagaran, 2012; Abd Rahman, 2013). Greater autonomy is expected to increase their international competitiveness, but should also ease commercialisation activities by removing administrative hurdles.

Commercialisation has been eased as universities have received not only greater autonomy but also greater flexibility in their IP policy, although some obstacles remain. To reduce administrative hurdles associated with being governed by public administration rules, some universities have established their own wholly-owned subsidiaries in order to operate more flexibly with industry. However, public policies reward the number of patents held (which might lead universities to renew patents even of low value). Some of the leading universities have also started to adopt new strategies, moving away from previous efforts to create spin-offs, which involve high costs for the university, in favour of licensing, an activity that is often done by universities' subsidiaries.

The Malaysia Education Blueprint 2015-16, released by Malaysia's Prime Minister in April 2015, sets out a wider reform agenda aimed at strengthening the higher education sector's contribution to the country's 2020 goal of becoming a high-income nation. The plan specifies ten "shifts" that would be needed; Shift 7 focuses on the contributions of the education sector to Malaysia's innovation ecosystem. It emphasises a range of initiatives, including enhancing industry-university relationships with new programmes similar to the Private-Public Research Network (PPRN) that was created in 2012, as well as support for Collaborative Research in Engineering, Science and Technology (CREST), which was created in 2012, and which has helped enhance industry-university relationships. It also foresees improving the ability of universities to commercialise their research by creating an Innovation and Technology Managers Association to create synergies and learning among different institutions' technology transfer offices and staff (MOE, 2015).

5.4.5. *University funding: Implications for commercialisation activities*

Starting in 2015, all public universities are required to generate 25% of their own operating costs. The budget allocated to universities from the government has been reduced in line with the government's objective to decrease the public deficit to 3% of GDP. This obligation for universities will increase to generating 75% of their own budgets by 2025. The five Malaysian research-focussed public universities (see Box 5.8) receive between USD 26.5 million and USD 53.0 million (MYR 50-100 million) in block grants and 5-10% of that money is dedicated to technology transfer.

Commercialisation of public research can certainly be regarded as an option for generating such revenues, the new governmental requirement

representing a new incentive mechanism. However, it is also true that universities' experiences have been that commercialisation offers few rewards to most institutions. Apart from commercialisation, other revenue streams, such as student fees and consultancy services, will be needed to raise 25% (and 75% by 2025) of their operating revenue. Neither the supply side (universities providing IP for commercialisation) nor the demand side (firms seeking IP to develop innovations) seems mature enough for IP to become a sustainable source of revenue. What is more, only a few institutions have successfully developed business models around commercialisation (OECD, 2013).

Apart from licensing, there are other methods of transferring technological knowledge. Non-technological knowledge can be transferred via professional services such as consulting and contract research. For instance, Malaysia is a leader in Islamic finance and halal banking research. In sectors where patents are much less relevant, branding and reputation-building of universities' research can be important and might be supported by trademarks. Leading US universities have engaged in branding their research excellence. Also, the Malaysian example of ZAPPA demonstrates the importance of branding (Box 5.10).

Box 5.10. **ZAPPA: A best practice example for branding and commercialisation**

One of the major problems faced by rice farmers in Malaysia is that the water used during sowing and harvesting can easily become contaminated. In 1999, researchers at the Agricultural Faculty of Universiti Putra Malaysia (UPM) were tasked by the Malaysian Government with developing a new technology that would reduce water contamination, help to rid fields of weeds and increase rice paddy yield. UPM teamed with Diversatech (M) Sdn. Bhd. (Diversatech), a prominent Malaysian agricultural company. The researcher's R&D focused on developing a technology that would allow the sowing of rice paddy seeds in deeper water. In 2001 their work came to fruition with the development of Zap PadiAngim (ZAPPA), a specially-formulated seed germination enhancer. Individual farmers have greatly benefitted from ZAPPA, as they can produce more rice by using ZAPPA, thus increasing their income by up to USD 500 per hectare. ZAPPA has become a well-known product not only in Malaysia, but also in other countries in the region. As of 2012, gross sales of the product have exceeded USD 2.6 million, and UPM has received royalties in excess of USD 52 000.

Important to the success of Diversatech and UPM's innovative technology was the development of a strong brand. To that end, the two partners chose the name "ZAPPA" as a unique combination of a common English word – "zap" – which means to make something disappear, and a Malay word – "pa" –

Box 5.10. **ZAPPA: A best practice example for branding and commercialisation** *(cont.)*

which is an abbreviation for "paddy angin" (weedy rice). The combination of the two into "ZAPPA" means to make the weeds in rice paddies disappear. A catchy brand name, ZAPPA is easy to remember and describes the product's effects in a single word.

From the outset, Diversatech has been UPM's primary vehicle for technology transfer and partner for commercialisation, activities that were undertaken before any IP protection was secured. UPM researchers have also developed information brochures and posters, and launched various pilot demonstrations to show farmers the advantages of the technology and how to use it properly. Farmers were also provided with demonstration units free of charge that they could try themselves, along with the guarantee that if the rice yield were lower than normal production, Diversatech would compensate the farmers for the difference. Through these efforts, farmers and agricultural organisations and companies were convinced of the effectiveness of the technology.

Because the technology behind ZAPPA was invented at a research university, transferring the technology to the private sector was vital for its commercialisation. Although the university already had a relationship with Diversatech in place, it knew that securing IP rights was a vital step in technology transfer and commercialisation.

Source: WIPO (2015c).

5.4.6. Public research institutes and the use and commercialisation of IP

In general terms, research institutes seem to be less prepared to pursue commercialisation than are universities. They also face larger administrative barriers, have experienced larger budgetary cuts to their research activities and have a slow-to-adjust culture that until recently put little emphasis on either collaboration with the private sector or on producing IP. However, these institutions have very different profiles (Box 5.11). This section examines the approaches to the commercialisation of IP of several different types of research institutes: MIMOS, a publicly owned company; MPOB and MRB, two government agencies engaged in research related to two of the country's most important commodities (palm oil and rubber); and six research institutes under the Ministry of Health.

MIMOS Berhad

MIMOS Berhad is the leading patentee in Malaysia. In 2013 it ranked 12th among the top public research institutes in the world in terms of PCT filings

Box 5.11. **Malaysia's public research institutes**

By 2011, there were 29 public research institutes (PRIs) in Malaysia. These PRIs share the mandate to act as the interface between science, industry and society. They differ with regard to their institutional forms and the focus of their mostly applied research. Most of them have a sectoral focus on natural resources (agriculture, palm oil, rubber, cocoa, forest, etc.); industry and engineering (electronics and industrial productivity); healthcare (medical research); or other selected fields (nuclear technology, remote sensing, economics, etc.). The 2008 National Survey of R&D noted that agricultural sciences dominated the R&D expenditure of PRIs. Other areas that receive high levels of R&D funding include forestry sciences, material sciences, engineering science and biotechnology (Thiruchelvam et al., 2011: 31). While mainly reliant on public funding, some institutions have received important additional funding from the private sector. For example, Malaysia's Cancer Research Initiatives Foundation has individual and corporate donors such as Sime Darby and Petronas (OECD, 2013: 204).

Table 5.7. **Selected public research institutes in Malaysia**

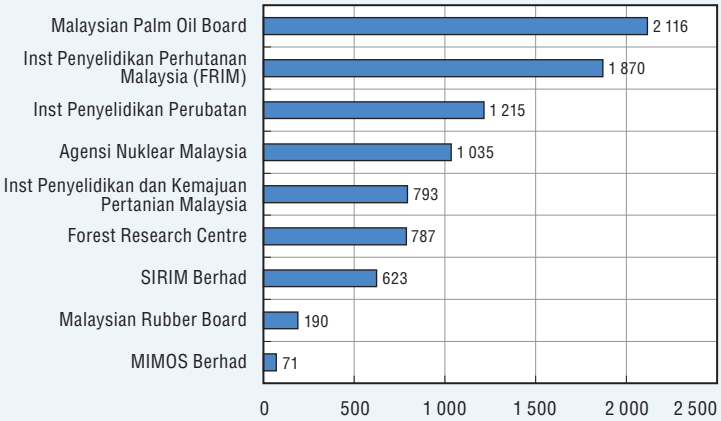
	Name	Research field	Institutional status	Ministry in charge
1	MIMOS Berhard	ICT	Corporate	MOSTI
2	Malaysian Agricultural Research and Development Institute	Agriculture	Government	MAABI
3	Malaysian Palm Oil Board	Palm Oil	Government	MPIC
4	Malaysian Rubber Board	Rubber	Government	MPIC
5	Malaysian Cocoa Board	Cocoa	Government	MPIC
6	Forest Research Institutions Malaysia	Forest	Government	MNRE
7	Standards and Industrial Research Institute of Malaysia	Standards	Corporate	MOF
8	Malaysia Productivity Corporation	Management research	Corporate	MITI
9	Institute for Medical Research	Medicine	Government	MOH
10	Institute for Health Systems Research	Medicine	Government	MOH
11	Institute for Public Health	Medicine	Government	MOH
12	Institute for Health Management	Medicine	Government	MOH
13	Clinical Research Centres	Medicine	Government	MOH
14	Institute for Health Behavioural Research	Medicine	Government	MOH
15	National Heart Institute	Medicine	Corporate	MOF
16	Agro Biotechnology Institute	Biotechnology		MOSTI

Source: Based on Thiruchelvam et al. (2011) and relevant institutional webpages.

Less emphasis has been placed on publications. Between 2001 and 2011, the MPOB published 395 ISI publications, followed by the Forest Research Institute Malaysia (357), Institute of Medical Research (321), Nuclear Agency of Malaysia (256), Malaysian Agricultural Research and Development Institute (153), SIRIM (111), Forest Research Centre (92), MRB (48) and MIMOS (45).

Box 5.11. **Malaysia's public research institutes** *(cont.)*

Figure 5.5. **Citations received by public research institutions**



Source: MASTIC (2014: 98).

with 82. In 2012, MIMOS filed 146 PCT applications and ranked 6th in the world (WIPO, 2014). In the period 2000-11, MIMOS was the third largest EPO applicant from Malaysia, with 29 filings. In the course of 2014, MIMOS has been granted four patents at EPO; another had the status "grant of patent is intended" and many others were still pending. MIMOS spends approximately USD 1.59 million (MYR 3 million) per year to file PCTs and USD 1.59 million (MYR 3 million) per year to file nationally. Some progress has also been made regarding commercialisation: at present, about 10% of MIMOS's revenues come from royalties obtained from non-exclusive licensing contracts.

MIMOS was established initially as a unit under the Prime Minister's Department to perform R&D in ICT and microelectronics and then was transformed into an incorporated company of the Ministry of Finance in 1997. Its mandate is to conduct R&D in ICT and microelectronics, support business development in the sector and be Malaysia's national ICT policy secretariat. This mandate was expanded in 2006 to improve the ecosystem for the development of the national ICT industry. MIMOS's funding is 100% public, its budget is negotiated with MOSTI based on a five-year working plan and has to be justified annually. The commercial arm of MIMOS, Frontier Novatur, is responsible for setting up research and commercialisation collaborations with industry and for marketing technologies to potential industry partners. Engagements may be in the form of technology licensing or the formation of joint ventures.

The patenting strategy of MIMOS is the result of a fundamental re-orientation that was initiated in 2006, focusing on IP and commercialisation activities exclusively. The institution's key performance indicators call for it to make 100-120 patent filings per year. These arise from the institution's three areas of R&D: applied research, advanced technology and application development. Unlike universities and other research institutes, no basic research is conducted and publications are not sought. With increased threats of budget cuts in the future, the incentive for MIMOS to gain revenue from commercialisation has increased even further.

Success has also been achieved by modifying staff incentive programmes to include tiers: staff members who submit an invention to the IP committee receive USD 53 (MYR 100); if the invention results in a patent filing, the staff member receives USD 1 590 (MYR 3 000); a patent grant (which usually happens 3-4 years after filing) earns the staff member another USD 530 (MYR 1 000). Inventors receive a share of the royalties if the product is commercialised (part of the revenues from commercialisation go to maintaining the IP, and the rest is shared between the inventors and their supporting team). All IP on the invention is owned by MIMOS Berhad.

The limited capacity of national SMEs to take advantage of inventions proposed by MIMOS challenges the further expansion of MIMOS's commercialisation activities. Most SMEs will only license IP if it offers "ready-to-market" products and will not engage in more elaborate product development. A substantial share of MIMOS's licensing contracts is provided to government at low prices given the public status of MIMOS. The government is then expected to showcase the inventions to industry groups to create additional licensing opportunities.

Malaysian Palm Oil Board

MPOB was founded in 2000 as a government agency to promote and develop the palm oil industry in Malaysia. Palm oil has become the second most-consumed oil in the world, after soybean oil. Malaysia is the world's second largest producer of palm oil, which constitutes an important source of its exports revenue. In 2011, palm oil exports reached 39 million tonnes worldwide. Malaysia's share of the world total was 46% (18 million tonnes) (MPOB, 2015a).

Current challenges include increasing the value-added in export products. Malaysia made significant progress in developing a more elaborate industry around palm oil production following the goal-setting of the Industrial Master Plans 1 and 2. However, there remains the potential to build complementary industries and produce higher value-added products. Such complementary industries would not only create more value within the

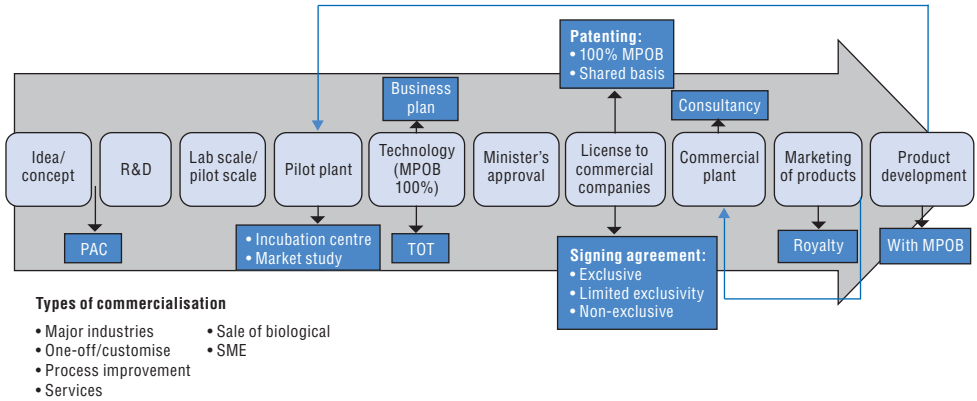
Malaysian economy, they would have other positive effects. First, such developments trigger infrastructure development in remote areas where palm oil is planted. Second, they provide employment in these same areas. Finally, they reduce the dependency on the primary commodity itself because the availability of different business models helps to reduce the negative effects of overproduction and mitigates the effects of volatile world market prices (Rasiah, 2006).

MPOB is the second largest PCT applicant among Malaysian PRIs after MIMOS, with seven PCT filings published in 2012. It is also the number one Malaysian patent applicant at EPO, with 38 patent applications for the filing years 2000-11, and the fourth largest Malaysian patent owner at EPO and USPTO with 7 and 29 patents granted in these offices respectively. MPOB filed approximately 284 patents from 1980 to the end of 2014; 150 have been granted in various countries, including the United States, Thailand, Indonesia and Brazil, where palm oil production is important.[4] They file in major offices such as China, Japan, the United States and the European Patent Office. MPOB spends approximately USD 1.1 million to USD 1.6 million (MYR 2-3 million) each year on servicing its IP filing and management, as well as on licensing activities. Similar to MIMOS, MPOB's efforts aimed at seeking and commercialising IP have intensified over the past decade.

MPOB receives industry funding from every ton of palm oil and palm kernel oil produced. Firms have to pay a tax (referred to as "cess"). MPOB aims to serve the palm oil industry as its research institution, responding to immediate common industry challenges. Its mission goes beyond aiming to transform the industry into one that offers more diversified, higher value-added, and globally more-competitive products. MBOP also receives budget allocations from the government to fund development projects and for approved research projects under the Intensification of Research in Priority Areas (IRPA) programme, the largest funding system for public R&D. While such long-term investments are a source of sustainable income flows, they are not popular within the palm oil industry because easy-to-obtain shorter-term benefits from lower value-added sales are available.

Obtaining IP titles is not the end objective at MPOB. It is to make the most effective use of IP in the industry, as shown in Figure 5.6. To this end, MPOB engages intensively with industry and global experts. The research agenda is determined at the annual Programme Advisory Committee meetings where MPOB gathers world experts who discuss the feasibility of certain types of research. The industry provides input at that stage so as to ensure that the research done effectively serves the industry. MPOB also participates frequently in exhibitions to showcase technologies. MPOB licenses its technologies (including patents) to interested parties under mutually agreed terms, with both exclusive and non-exclusive licenses. About 60 of its patents

Figure 5.6. **Commercialisation of IP at MPOB**



Source: Information provided to the OECD by MPOB.

have been commercialised (MPOB, 2015a: 31-33), with more than 563[5] technologies offered in total. Examples of commercialised technologies include red palm oil, palm-based printing ink and personal care products. To finance future R&D, MPOB asks for royalties, which are usually set as a percentage of sales or, in a few cases, as a lump sum, but can be combination of both. Yet, it is difficult for MPOB to obtain negotiated royalties because sales from licensees are hard to monitor. In some cases, at the request of industry, MPOB has also taken on the role of incubator, allowing its facilities to be used for trial manufacturing. This function includes providing technical support and help with the marketing of products, subject to payment of additional consultancy fees. In some cases, MPOB conducts research in co-operation with industry upon mutually agreed terms and conditions (MPOB, 2015b).

Success has also been the result of an internal incentive system that emphasises fostering MPOB's contributions to industry. Researchers at MPOB are required in their performance evaluation requirements to produce two research outputs per year, which may include research papers, patents, commercialisation and product development. Incentives for researchers include equal sharing of royalties between the researcher and the institution.

Malaysian Rubber Board

Malaysia is one of the world's largest producers of rubber and the primary objective of MRB is to assist in the development and modernisation of the Malaysian rubber industry in all its aspects, from cultivation of the rubber tree, the extraction and processing of its raw rubber, the manufacture of rubber products and the marketing of rubber and rubber products (MRB, 2014a). MRB has filed about 37 patent applications and 15 trademarks nationally. They

recently engaged in efforts at the international level and were among the top Malaysian PCT applicants in 2012 with three PCT filings, but it had not filed any patent applications at the EPO in the period 2000-11. Neither is it the assignee of any patent granted in the United States between 2009 and 2013.

MRB has taken efforts to commercialise IP, although with only limited success to date. MRB has engaged in some concrete negotiations with its industry. Negotiations, however, often failed in the end as the industry generally required that product development risks be incurred by MRB. MRB also provides some technology for free, to support smallholders and the general well-being of the industry, but has also signed a few exclusive licensing agreements.

The rubber industry contributed substantially to Malaysia's total exports in 2013, with exports totalling approximately USD 17.9 billion (MYR 33.7 billion). In the early 1970s, rubber accounted for 32.5% of the country's export value, but this proportion had fallen to about 4.7% in 2013 (Sukirno, 2004; MRB, 2014b: 13). Malaysia is currently the world's largest manufacturer of medical rubber gloves, the largest producer of sheath contraceptives, the second largest manufacturer of rubber thread, the third largest exporter of natural rubber and the sixth largest producer of natural rubber. However, rubber's importance in Malaysia's economy is decreasing. In 2000, the area under rubber cultivation stood at 1.43 million hectares but this had fallen to 1.06 million hectares in 2013 and now Malaysia is sixth in the world in terms of production. This is due to a variety of reasons, including the fact that other developing countries have much lower product costs for rubber, the high price volatility of rubber, as well as the limited development of higher value-added products. In 2013, exports of Malaysian rubber products totalled USD 4.18 billion (MYR 14.62 billion). Latex-based goods exports (i.e. rubber gloves, condoms, catheters, latex thread, rubber foam-like mattresses and cushions, etc.) represented 82.4% of these exports; general and industrial rubber goods represented 6.0% and 3.5% respectively. Tyres, inner tubes and footwear accounted for the rest. MRB launched the One Nation Rubber Strategy in 2014, which aims to increase the competitiveness of the national rubber industry (including by commercialising green specialty rubber and promoting rubber as renewable material for environmentally friendly development objectives) (MRB, 2015).

In attempting to commercialise the results of its research, MRB has flexibility to fix the terms and conditions of its technology licensing agreements. In addition, MRB has set up a researchers' incentive programme to foster IP disclosure, protection and commercialisation. The programme offers upfront rewards to researchers at the time of filing, additional rewards if the IP right is granted, USD 15 907 (MYR 30 000) if the invention reaches commercialisation irrespective of the revenue it makes, as well as 70% of the royalties if revenue is generated (30% goes to the institution). RRIM-Consult Corporation, established on 1 July 2002 as the commercial arm and wholly-owned

subsidiary of MRB, is tasked with undertaking these commercialisation activities (RRIM-Consult Corporation, 2014).

Commercialisation is becoming important to support the research budget. Currently, MRB obtains 60% of its revenues from government funding; 40% is internally generated. One of its targets for 2020 is to increase its own resources from royalties through the commercialisation of its R&D findings, with the objective being the generation of USD 530 223 (MYR 1 million) per year for the period 2014-16. Other sources of funds include increasing income from consultancy services related to technology commercialisation, with an expected outcome of USD 2.3 million (MYR 4.4 million) per year; increasing income from testing services by improving business management; and enhancing income generation through consultancy fees from industry support services. The last two activities are expected to generate revenue of USD 530 223 (MYR 1 million) per year from 2014 to 2016.

Challenges MRB faces in successfully supporting industry with research it can license include the following:

- Being a government agency, it does not have as much management and recruitment flexibility as private institutions (e.g. MIMOS) and must abide by general rules of public administration, which restrains its flexibilities in research compared to universities.
- Finding interested commercial partners who are ready to invest is difficult, as Malaysian companies do not want to accept the risk of developing prototypes. This is especially an issue in rubber as the Malaysian rubber industry is dominated by smallholders: according to information provided by MRB to the OECD, smallholders account for 92.5% of the total planted area and contribute 91.7% of total production.
- It is difficult for MRB to do research openly and share information because of a lack of trust among companies in the industry. Companies do not want to reveal what difficulties they face or what issues they are considering out of fear of competitors, and because they do not trust results from research institutes. Thus, research is mostly defined and decided from the research side.

Health research institutes

There are six public research institutes under the aegis of the Ministry of Health (MOH): i) Institute for Medical Research (IMR); ii) Institute for Health Systems Research (IHSR); iii) Institute for Public Health (IPH); iv) Institute for Health Management (IHM); v) Clinical Research Centres (CRC); and vi) Institute for Health Behavioural Research (IHBR). These institutes are very new to seeking IP and its commercialisation. By the end of 2014, they jointly had around 20 IP rights titles.

Some institutional reforms have been implemented to support IP and its commercialisation. A dedicated committee now decides which inventions will be taken forward for IP protection and commercialisation, based on disclosures received from researchers. However, often research institutions choose to implement solutions directly in the health system, rather than by creating spin-offs or by licensing IP to industry.

The institutes have not yet successfully commercialised their IP due to a variety of reasons including:

- There is limited capacity and expertise among researchers in establishing contacts with industry and a lack of intermediaries to support them. In the past, the Malaysia Innovation Agency provided them with support by identifying 11 of their products as having commercialisation potential.
- As government institutions, they face multiple constraints regarding human resource management, including incentive schemes for commercialisation. Researchers' performances are evaluated based on the quantity rather than the quality of their publications. Patents have only more recently been introduced, but again only quantity counts, and the difficulty of obtaining patents makes seeking them much less attractive for researchers.
- While a national IP commercialisation policy was circulated by the Ministry of Science, Technology and Innovation in 2009, it has not been put into practice yet because of a lack of funding and practical guidance from the Treasury, notably about the implementation of guidelines on revenue sharing with researchers (MOSTI, 2009).
- There is no specific budget for filing patent applications, which is very costly, particularly because of patent attorney fees.

Notes

1. Harn Marketing, Sime Darby and Shimano Components were also among the top five Malaysian patent "owners" with granted patents from the EPO for grant years 2009-13.
2. More information on challenges faced by Malaysia's research organisations with regard to financing is provided in the following: Chandran (2011); Li and Imm (2007); MOSTI (2006); OECD (forthcoming, 2013); Thiruchelvam et al. (2011).
3. Also known as International Islamic University Malaysia.
4. Information provided by MPOB to the OECD in March 2015.
5. Information provided by MIMOS to the OECD in March 2015.

References

Abd Rahman, A. (2013), "Funding reforms in Malaysian public universities transition towards competitive funding", *Australian Journal of Basic and Applied Sciences* Vol. 7/10, pp. 553-561.

CBD (2014), "Country profiles: Malaysia", Convention on Biological Diversity, *www.cbd.int/countries/profile/default.shtml?country=my#facts* (accessed on 23 February 2015).

Chandran, V.G.R. and C.Y. Wong (2011), "Patenting activities by developing countries: The case of Malaysia", *World Patent Information*, Vol. 33, pp. 51-57.

Chandran, V.G.R. (2010), "R&D commercialization challenges for developing countries: The case of Malaysia", *Tech Monitor*, Nov-Dec, pp. 25-30.

Chandran, V.G.R. et al. (2008), "The commercialization of research results among researchers in public universities and research institutions", *Asian Profile*, Vol. 36/3, pp. 235-250.

Damodaran, R. (2010), "MPOB's efforts to commercialise technology pay off", *Business Times*, 23 September 2010.

Day, N. and A. Muhammad (2011), *Malaysia: The Atlas of Islamic-World Science and Innovation*, Country Case Study No. 1, Royal Society of London for Promoting Natural Knowledge, London, *http://hdl.handle.net/10625/48146*.

EPO (2015) *EPO Worldwide Patent Statistical Database* (database), *www.epo.org/searching/subscription/raw/product-14-24.html*, using data from April 2014 (accessed on 23 February 2015).

Heng Gee, L. et al. (2009), "Reforms towards intellectual property-based economic development in Malaysia", *The Journal of World Intellectual Property*, Vol. 12/4, pp. 317-337.

Hu, A.G. et al. (2010), *The Strategic Use of Intellectual Property to Enhance Competitiveness in Select Industries in ASEAN*, WIPO Publication No. 953E, World Intellectual Property Organization, Geneva, *www.wipo.int/edocs/pubdocs/en/intproperty/953/wipo_pub_953.pdf*.

Kulasagaran, P. (2012), "Varsity autonomy", *The Star*, 5 February 2012, pp. 6-7, *www.thestar.com.my/Story/?file=%2F2012%2F2%2F5%2Feducation%2F10661055&sec=education*.

Li, L.P. and A.O.C. Imm (2007), "Performance requirements in Malaysia", in K.S. Jomo (ed.), *Malaysian Industrial Policy*, NUS Press, Singapore.

MASTIC (2014), "Malaysia science, technology and innovation (STI) indicators report 2013", *www.mastic.gov.my/en/web/guest/27*.

MIGHT (2009), "Malaysia high technology industry report", MIMOS Berhad, *www.mimos.my/* (accessed on 27 November 2014).

MITI (2006), "Third Industrial Master Plan 2006-2020", Ministry of International Trade and Industry, Putrajaya, Malaysia, *www.miti.gov.my/cms/content.jsp?id=com.tms.cms.article.Article_8e595aba-7f000010-72f772f7-733da6e4*.

MOE (2015), *www.moe.gov.my/en/ipta* (accessed on 23 February 2015).

MOSTI (2012), "Science and technology knowledge productivity in Malaysia: Bibliometric study 2012", Malaysian Science and Technology Information Centre, Putrajaya, Malaysia, *www.mastic.gov.my/documents/10156/462d0525-6585-4f96-9d29-7a974df67135*.

MOSTI (2009), "Intellectual property commercialisation policy for research and development (R&D) projects funded by the Government of Malaysia", *www.mosti.gov.my/en/policies-roadmaps/ip-commercialization-policy/* (accessed on 23 February 2015).

MPB (2014), Malaysian Pepper Board, *www.mpb.gov.my* (accessed on 27 November 2014).

MPOB (2015a), "Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities", *www.mpob.gov.my/images/stories/pdf/cb_complete.pdf* (accessed on 23 February 2015).

MPOB (2015b), Malaysia's Palm Oil Industry, *www.mpob.gov.my/images/stories/pdf/cb_complete.pdf* (accessed on 27 February 2015).

MRB (2015), *www.lgm.gov.my/news/news2014Apr1NRS.htm* (accessed on 24 February 2015).

MRB (2014a), *www.lgm.gov.my/general/Aboutus.aspx* (accessed on 23 February 2015).

MRB (2014b), "Natural rubber statistics 2014", *www.lgm.gov.my/nrstat/nrstats.pdf* (accessed on 23 February 2015).

Muling, L.S. (2013), "Geographical indications: What is new in the Asia-Pacific Region? A Malaysia Perspective", Presentation given at the World Intellectual Property Organization, October 2013, *www.wipo.int/edocs/mdocs/geoind/en/wipo_geo_bkk_13/wipo_geo_bkk_13.pdf*.

MyCHM (2015), *www.chm.frim.gov.my/About-Us.aspx* (accessed on 25 February 2015).

MyIPO (2014), "Interview with Minister of Domestic Trade, Co-operatives and Consumerism YB Dato' Sri Hasan Bin Malek", *MyIP Bulletin*, April 2014, pp. 5-8.

MyIPO (2012), *MyIP Bulletin*, October 2012.

National SME Development Council (2012), "The SME Masterplan 2012-2020: Catalysing Growth and Income", National SME Development Council.

NEAC (2009), "New Economic Model for Malaysia Part 1",National Economic Advisory Council, *www.pmo.gov.my/dokumenattached/NEM_Report_I.pdf*.

NIF (2014), National Innovation Foundation-India, *www.nif.org.in/* (accessed on 27 November 2014).

OECD (2015), *Innovation Policies for Inclusive Growth*, OECD Publishing, Paris.

OECD (2014), *National Intellectual Property Systems, Innovation and Economic Development: With perspectives on Colombia and Indonesia*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264204485-en*.

OECD (2013), *Innovation in Southeast Asia*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264128712-en*.

Qeos (2014), *www.qeosystems.com/* (accessed on 27 November 2014).

Prip, C. et al. (2010), *Biodiversity Planning: An Assessment of National Biodiversity Strategies and Action Plans*, United Nations University Institute of Advanced Studies, Yokohama, Japan, *http://archive.ias.unu.edu/resource_centre/UNU-IAS_Biodiversity_Planning_NBSAPs_Assessment_final_web_Oct_2010.pdf*.

Prospect Group (2013), "Interview with Grunsin Ayom from the MPB" (video), *www.theprospectgroup.com/malaysian-pepper-board-mpb-director-general-grunsin-ayom-2020-growth-targets-pepper-industry-81984/*.

Rasiah, R. (2006), "Explaining Malaysia's export expansion in palm oil and related products", in: Chandra, V.G.R. (ed.), *Technology, Adaptation, and Exports: How Some*

Developing Countries Got It Right, The World Bank, Washington, DC, *http://siteresources.worldbank.org/INTEXPCOMNET/Resources/Chandra_2006.pdf*.

Reuters (2013), "Insight: Nation-states enter contentious patent-buying business", *www.reuters.com/article/2013/03/20/us-patents-nations-insight-idUSBRE92J07B20130320* (accessed on 27 November 2014).

RRIM-Consult Corporation (2014), *http://rrimcorp.lgm.gov.my/Aboutus.aspx* (accessed on 23 February 2015).

RSM Farook (2013), "Harumanis Mango Flowering Stem Prediction using Machine Learning Techniques", *Research Notes in Information Science*, Vol.13.

SaBc (2009), "Biodiversity information management & TK in Sabah", *Biocultural Diversity and Conservation Learning Platform Briefing Notes*, Vol. 4, *www.bbec.sabah.gov.my/phase2/downloads/TEK_study_2011/04%20Biodiversity%20Information%20Management%20and%20TK%20in%20Sabah.pdf*.

SCImago (2014), "Institution Rankings", *www.scimagoir.com*, (accessed on 17 November 2014).

SME Corp. (2012), "SME Masterplan 2012-2020", *www.smecorp.gov.my/vn2/node/190*.

Sukirno, S. (2004), "Growth and transformation of the Malaysia economy", *www.ekonomikerakyatan.ugm.ac.id/My%20Web/sembul20_1.htm*.

Thiruchelvam, K. et al. (2011), "Financing innovation: The experience of Malaysia", Towards Effective Policies for Innovation Financing in Asia Project, working paper report for the International Development Research Centre, Canada.

UNCTAD (2013), "World Investment Report 2014: Annex Tables", United Nations Conference on Trade and Development, *http://unctad.org/en/pages/DIAE/World%20Investment%20Report/Annex-Tables.aspx*.

USPTO (2015), "Patenting by geographic region (state and country): Breakout by organization: Malaysia, *www.uspto.gov/web/offices/ac/ido/oeip/taf/stcasg/myx_stcorg.htm*.

WIPO (2015a), *Intellectual Property and Genetic Resources, Traditional Knowledge and Traditional Cultural Expressions*, WIPO Publication No. 933E, World Intellectual Property Organization, Geneva, *www.wipo.int/edocs/pubdocs/en/tk/933/wipo_pub_933.pdf*.

WIPO (2015b), "Creation of a Brand Name: Petronas", *Case Studies on Intellectual Property* (IP Advantage), World Intellectual Property Organization, *www.wipo.int/ipadvantage/en/details.jsp?id=2630*.

WIPO (2015c), "University R&D to Feed a Nation", *Case Studies on Intellectual Property* (IP Advantage), World Intellectual Property Organization, *www.wipo.int/ipadvantage/en/details.jsp?id=2917*.

WIPO (2014), *Patent Cooperation Treaty Yearly Review: The International Patent System*, Economics & Statistics Series, WIPO Publication No. 901E/2014, World Intellectual Property Organization, Geneva, *www.wipo.int/edocs/pubdocs/en/patents/901/wipo_pub_901_2014.pdf*.

YIM (2014), Malaysian Foundation for Innovation, *www.yim.my/index.cfm?&menuid=37&lang=EN* (accessed on 23 February 2015).

Zuniga, P. (2011), "The state of patenting at research institutions in developing countries: Policy approaches and practices", *WIPO Economics Working Papers*, Working paper no. 4, *www.wipo.int/export/sites/www/econ_stat/en/economics/pdf/wp4.pdf*.