The Challenges of Corporatization Policy for Government Research and Technology Organizations for Wealth Creation

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Abstract

Malaysia's economic transformation towards the status of a high income nation has led to the widespread demand for an accelerated corporatization policy; one where public sector agencies are transformed into business entities to facilitate the creation of knowledge and wealth. This shift was encouraged by successful corporatization models abroad, including those adopted by the Fraunhofer-Gesellschaft in Germany; the Korea Institute of Science and Technology (KIST) in Korea; and the National Institute of Standards and Technology (NIST) in the United States. These institutions have since encouraged a similar corporatization process in emerging and third world nations. However, corporatization comes along with a unique set of institutional challenges. This study aims to investigate the corporatization processes undertaken by various government research and technology organizations (GR&TOs) in Malaysia, and then to evaluate their overall progress. The outcome of this study indicates that a myriad of challenges can be inverted into growth opportunities through the application of appropriate strategic planning.

Keywords: Corporatization policy, Government Linked Research and Technology Organizations, Governance, Technology Commercialization and Innovation

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Introduction

As part of the national innovation thrust to attain the status of a developed nation by the year 2020, the Government of Malaysia (GoM) has aggressively emphasized the importance of wealth creation and economic growth. One critical enabler identified towards this end has been the transformation of select public research institutes into business or corporate entities. Government research organizations were traditionally tasked to develop new knowledge and technology through research and development (R&D) programmes, and in turn transfer commercial potentials to industries that lacked innovation and marketing capabilities. A Key Performance Indicator (KPI) for these agencies entailed an increase in the return of investments (ROI) through technology development, commercialization, innovation and the provision of technical services. In a nutshell, these knowledge- and technology-based organizations are entrusted with market-oriented R&D, and ultimately, product demand and commercialization.

Such corporatization initiatives have been successfully executed by renowned institutes such as Fraunhofer-Gesellschaft in Germany; the Korea Institute of Science and Technology (KIST) in Korea; and the National Institute of Standards and Technology (NIST) in the United States. The Malaysian government has likewise selected a number of public research institutes and statutory bodies to transform into corporate entities from the mid-90s onwards. These include MIMOS Berhad, SIRIM Berhad, the Malaysia Rubber Board (MRB) and the Malaysia Palm Oil Board (MPOB), among others.

According to Baker (2005), corporatization and commercialization are two processes that have similarities, but which must be treated independently. Both processes can occur within the

context of public ownership, without services being transferred to a private company. Corporatization, however, focuses on hiving off government agency-generated services to a business unit or separate company in order to accommodate full service provisions (Smith, 2004). Corporatization, thus relieves the Government of financial and administrative responsibilities, along with the expectation process promotes competition, efficiency and increased productivity. Ultimately, it targets economic growth through the commercialization of research, innovation and technical services, and helps streamline public sector institutions into smaller, nimbler and more dynamic entities. Corporatized entities are managed on a more commercial basis through their Board of Directors, under whom a management team is responsible for day-to-day policies, operations and administration.

All these new entities are wholly-owned by the GoM, where assets and equities are not divested. The GoM allocates an annual budget for these newly corporatized entities in order to cover their capital development and operational needs, on the basis on potential market demand. Therefore, it is crucial for these newly-corporatized entities to develop appropriate governance and management systems, and to establish strong linkages with industries and consumers to meet demand and supply needs in both local and international markets. Corporatization consequently poses a highly challenging mandate for GR&TOs. It is therefore crucial to investigate the challenges faced by GR&TOs in the corporatization process, and then inquire whether obstacles are able to be inverted into opportunities. By examining the corporatization policies and processes in the country, the survey findings in this study can potentially seed crucial insights on the development of optimal mechanisms to achieve the stated goals.

Since GR&TOs in developed countries play a leading role in corporatization, a brief overview of their raison d'être, expectations and roles are illustrated in Section 2, followed by a

brief overview of GR&TOs in Malaysia in Section 3. Section 4 presents the survey findings and results, and analyses the manner in which challenges can be regarded as opportunities for development and growth. Finally, Section 5 concludes.

Roles of GR&TOs in Developed Countries

Rapid changes in the international economic environment and contemporary technologies make GR&TOs ever more relevant in the context of future growth. They play an important role in technology development and innovation, and in national economic growth. (Mazzoleni and Nelson, 2007). R&D performed by GR&TOs typically have a greater impact on national economic performance compared to those carried out by businesses. In order to cope with new knowledge and technology, governments commonly have established research organizations, institutes and universities based on the growing industrial needs. Table 1 summarizes the reasons for the establishment; roles and missions; and expectations of GR&TOs in sample developed countries.

Table 1

Reasons for Establishment, Expectations and Roles of GR&TOs

Country	Year of formation/ Institution	Reasons for establishment and expectations	Roles/missions of the GR&TO
Germany	1949 (66 years) Fraunhofer-Gesellschaft	To undertake applied research and drive economic development; serve the industry, service sectors and public administration; promote innovation; strengthen the national technology base; improve the acceptance of new technologies; and train future generations of scientists and engineers.	To conduct the following for industry, government and society: R&D, mainly contract research, support and advice on research-related matters; provide training; conduct inspection; and promote technology certification.
Netherland	1932 (83 years)	To transform the nation from an agricultural economy to an	To provide contract research and specialist consultancies;

	TNO (Netherlands Organisation for Applied Scientific Research)	industrial one; and support companies and the government with innovative and practicable knowledge.	provide grants and licences for patents and specialist software; test and certify products and services; issue independent assessments of quality; and set up new companies to promote market innovations.
Taiwan	1973 (42 years) ITRI (Industrial Technology Research Institute)	To develop greater value-added technologies in order to achieve sustainable development.	To expedite the development of new industrial technologies; provide assistance in order to upgrade industrial technologies and techniques; and transform Taiwan's research capability from "follower" to "pioneer" levels in order to provide greater advantages and opportunities for domestic industries.
France	1939 (76 years) CNRS – National Centre for Scientific Research	To address challenges faced by industries in order to achieve sustainable economic growth; and strengthen the scientific and engineering base through a combination of multiple technologies.	To evaluate research progress; transfer new knowledge beneficial to society, culture and economy; encourage the use of technology applications and promote research-oriented results; develop scientific information and support research training; and participate in national and international scientific dialogues to develop national policies.
Finland	1942 (73 years) VTT (Technical Research Centre of Finland)	To conduct technical research; and test materials and structures upon request from the authorities, companies and other organizations.	To provide research services to companies, society and customers to enhance international competitiveness; promote the realization of innovative solutions and new businesses; combine multidisciplinary expertise with "know-how" partners; exploit global networking opportunities; and access basic research outcomes from top global universities.
Korea	1966 (49 years) KIST (Korea Institute of Science and Technology)	To move the economy from being imitation-oriented to one that is innovation-oriented; and create internal capabilities for new technologies and products.	To take the lead in building a science and technology-based society; conduct research and develop creative new technologies; disseminate results and research accomplishments to society; serve as a platform for national R&D; develop funding-based innovative R&D models; lead fusion research under the national educational system; and explore frontier and emerging technologies.

United States of America	1901 (114 years) NIST (National Institute of Standards and Technology)	To promote industrial competitiveness by advancing science measurement, standards and technology in order to enhance economic security and improve the overall quality of life.	To conduct research that advances the nation's technology infrastructure; promote overall excellence among US manufacturers, service companies, educational institutions, healthcare providers, and non-profit organizations; offer technical and business assistance to smaller manufacturers; manage the Technology Innovation Program, which provides cost-shared awards to industries, universities, and various consortiums; and manage the Advanced Technology Program and the Annual National Quality Award.

It is clear that these GR&TOs were formed to solve internal economic and social obstacles; generate new knowledge and technologies for wealth creation; and enhance national competitiveness. Since GR&TOs play such a paramount role in this regard, it is imperative for governments to provide grants to R&D projects on a *quid pro quo* basis in which GR&TOs contribute back to national innovation.

GR&TOs in Malaysia

Acknowledging the importance of research, technology and innovation for economic and social growth, various ministries in Malaysia have consistently developed appropriate policies and master plans; provided funds for infrastructure and facilities; issued guidelines for the protection of Intellectual Property (IP); and provided incentives to small and medium enterprises (SMEs). The Ministry of Science, Technology and Innovation (MOSTI) manages and implements the national science, technology, research and innovation undertakings. In 1975, the Government established the National Council for Scientific Research and Development

(NCSRD) to synchronize, coordinate and monitor the implementation of R&D and Science, Technology and Innovation (ST&I) among various ministries and stakeholders.

Various ministries are involved in promoting ST&I and R&D throughout the country. The Ministry of International Trade and Industry (MITI) plans, formulates and implements policies on industrial and technological development, as well as international trade and investment promotion. The Ministry of Domestic Trade and Consumer Affairs handles the application and approval of patents, trademarks and industrial design; while the Ministry of Higher Education (MoHE) operates various Science and Technology (S&T) programmes to support industrial needs. The Ministry of Finance (MoF) augments ST&I and R&D programmes through fiscal incentives.

Since the mid-1990s, the GoM has, either established new research and technology organizations, or has transformed select public research institutes to business entities. GR&TOs are defined as research and technology organizations that have commercial aims; where the government has direct control of the equity, the ability to appoint board members and senior management, and major decisions. The board members of most GR&TOs comprise a Chairman and representatives from the government and industry. The Chief Executive Officer (CEO) or Director General (DG) is appointed by the relevant Cabinet Minister. The Board leads by providing general directions to the organization. The CEO or DG reports directly to the Board. Research activities in GR&TOs focus more on applied research to cater to immediate industrial and market needs. Senior management members report directly to the CEO, and are tasked with responsibility and accountability for financial and business effectiveness, as well as profitability.

The implementation of corporatization policies is inevitably transformed and modified based on culture and institutional setting. This transformation is particularly important in an era

where top-down dictates of "government" have evolved into processes of "governance" (Hill and Hupe, 2002). With new key performance indicators set by shareholders, the majority of newly-appointed Chief Executives and Director Generals have introduced and applied new management systems in order to expedite the transformation process. The majority of GR&TOs have successfully introduced and implemented various management systems dealing with annual and long-term strategic business plans; budgets and financial management; key performance indicators and balanced scorecards; human resources management, including career development and performance appraisals; procurement systems; project management; and customer relationship management. At the same time, some of them have made significant contributions to the dynamism of the national economy, enabling some of the country's products and services to be recognized for their quality and innovativeness, particularly for ICT, Oil and Gas, and Rubber and Palm Oil products.

As research time span decreases, faster market entries for R&D products and services are demanded (OECD, 1998). Due to financial constraints and the rising costs of research, there is ever greater pressure on GR&TOs to generate revenue, increase innovation and economic performances, and simultaneously fulfil customer requirements.

As competition increases, the market may become less attractive for investments, primarily due to the lower profit margins and greater uncertainties. GR&TOs need to be more careful in defining and controlling research, technology and innovation programmes. Well-developed strategies focus on the appropriate technologies and resource requirements to achieve particular types of innovation; manage the overall complexities of innovation; manage demands to achieve benchmarked levels of performance; and accept the prevalence of success (or failure) in adaptation (West 1992).

After a decade after the implementation of the corporatization process, it is timely to conduct a survey to access the roles and challenges faced by GR&TOs in Malaysia. This survey was conducted using as participants 37 Malaysian GR&TOs, from mid-2010, to early-2011, in order to determine the roles and barriers of GR&TOs in delivering their new mandates. Among a total of 150 questionnaires distributed, 126 were collected. Among the collected questionnaires, about 84% were deemed suitable for further analysis. The respondents comprised CEOs of government research organisations, vice presidents of R&D, heads of technology transfers, and heads of technology units. The subsequent section presents the findings and results.

Results and Discussion

GR&TOs are an integral part of the national education and S&T system, and focus on fundamental, experimental and applied research. Based on the survey findings, GR&TOs in Malaysia performed a variety of innovation-related roles, which are as follows:

- developers of new technologies and long-term R&D and strategic technologies to increase technological innovation and revenue;
- providers of technical solutions and promoters of S&T;
- providers of national S&T infrastructure, facilities and programmes;
- trainers and recruiters of researchers and a highly-skilled workforce;
- coordinators and collaborators in cooperative R&T&C with local companies in order to nurture new industries;
- promoters and facilitators of technology transfer and diffusion;
- organisers and catalysts for state- and community-based innovation;
- intermediaries or brokers of technology and scientific equipment;
- developers of incubation programmes for SMEs and start-up companies;
- trainers for technical and technology programmes;
- advisors to policy makers and the GoM;
- consultants for new technology and process development;
- facilitators for technical standards development and conformity;
- testers of existing products and new product development;
- calibrators for technical compliance and regulators for enforcement;

- managers of IP and knowledge content; and
- publishers of S&T journals.

The role of GR&TOs is thus relatively challenging, since the GoM expects them to be innovative, while at the same time balance between profit and non-profit contributions. They need to generate profit to be sustainable, and yet support non-profit activities, as part of the government's obligation to society.

In addition, the business sector and citizens currently demand greater transparency and involvement in the development of research priorities. Consequently, the GoM is being led to develop more outcome-oriented approaches to the governance of the national science system. Despite some successes, as well as great investments into research and technology management and management systems, a large number of weaknesses that afflict GR&TO business performance remain, particularly in generating new sources of income. While the majority of GR&TOs have successfully generated numerous novel research findings, only a few new technologies have been commercialized. According to interviews with senior management members, survey feedback from heads of R&T divisions, and management business reports, there are many barriers and impediments faced by GR&TOs in delivering their corporatization agenda. Notable barriers encountered during the implementation of research, technology and commercialization (R&T&C), and technological innovation in each GR&TO are summarized in Figure 1 and Table 2. All inputs gathered were coded and analysed using the content analysis approach.

Based on the interviews, a total of 68 variables were identified as barriers to corporatization policies. Based on the rankings and frequency of responses from the survey, seven major barriers were identified and presented in Figure 1. All respondents admitted that the

shortages or inadequacies in readily available human capital, particularly those related to technological innovation and market assessment capabilities, were major barriers to day-to-day operations. These deficits significantly impact new and emerging technologies. Other identified barriers include deficits in effective communications; financing and collaboration; management of ideas; intellectual property; policy implementation and creativity; innovation culture; research and design; and technology commercialization.

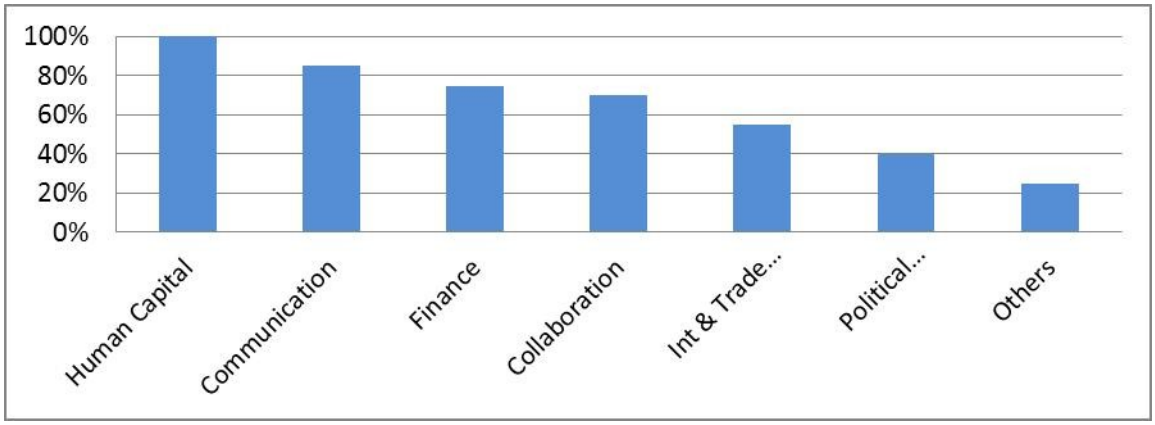

Figure 1. Barriers in Delivering Corporatization Policies by GR&TOs.

Table 2

Challenges Faced in Implementing Government R&T&C and Innovation

No.	Themes	Barriers to R&T&C and Technological Innovation
1	Number of qualified staff	(a) Insufficient number of researchers, engineers and lecturers in new technology; (b) Insufficient number of researchers to carry out approved projects; (c) Insufficient staff in marketing and commercialization; (d) Insufficient number of qualified lecturers with PhD qualifications; (e) Slow recruitment process due to overly-centralized decision-making culture; (f) Inappropriate placement of researchers; and (g) Underutilization of government-allocated R&D funds.
2	Ideas and creativity management	(a) Lack of creativity; (b) Lack of knowledge and competency in innovation management; (c) R&D, research design, strategic business, IP management and utilization, commercialization,

		negotiation, market assessment, technical writing and project management; (d) Lack of skills in bringing research to development; (e) Lack of talent to act as "brokers" to match technology with market needs; and (f) Lack of IT skills to cope with rapid changes in technology.
3	Insufficient funds	(a) Insufficient funds to implement R&D projects; (b) Insufficient funds for overall maintenance; (c) Insufficient capital investments in ICT businesses; (d) Insufficient funds to invest in major projects and facilities; and (e) Insufficient funds to proceed with spin-off programmes.
4	Collaboration	(a) Lack of collaboration with local companies and industries, as well as universities and academic institutions; (b) Lack of collaboration with international research universities; (c) Insufficient number of successful entrepreneurs; (d) Lack of cooperation and support from international universities; (e) Slow progress in technology transfers; and (f) Lack of demand by industries.
5	Communication	(a) Poor policy sharing; (b) NIP and ICT policies not cascading into all levels for implementation; (c) Lack of writing skills to publish articles in local and international journals; and (d) Large digital gap between urban and rural areas.
6	Commercialization	(a) Slow transfer of technology to industries; (b) Lack of commitment from incubators and suppliers; (c) Lack of skills in moving from technology to innovation; (d) Lack of demand from entrepreneurs; (e) Poor project management of incubators; (f) Insufficient number of successful entrepreneurs; (g) Manufacturing plants need to adopt to the GoM's requirements; and (h) Local companies, mainly SMEs, not ready to invest in ISO requirements.
7	Internationalization	(a) New research outputs not meeting trade or ISO requirements; (b) No technological standards for certain IT products; (c) No Malaysian standards accepted at an international level; (d) Local companies not ready to invest in ISO requirements; and (e) Insufficient number of quality technologies produced.
8	Policy implementation	(a) Not aware of NIP; (b) Poor policy sharing; (c) ICT policy not cascaded to all levels for implementation; (d) NIP and implementation plans not cascaded down and shared; (e) Lack of support by other ministries; (f) Frequent change of technology focus due to political interference; (g) Political interference in various aspects of operation; (h) Funds shunted to other unplanned projects; and (i) Dependency on foreign technology.
9	Culture	(a) Resistance to change in the public sector; (b) Lack of innovation and research culture; (c) Researchers keen to join management or administration; (d) Culture of 'too much to do' and too many "don't

		dos"; (e) Poor change management; (f) Risk-averse culture; (g) Lack of incentives to take on risks; (h) Malaysian perception that imported products are better than local counterparts; (i) Red tape and long procurement processes delay implementation; and (j) Digital gap between urban and rural areas.
10	Others	(a) Competition from other countries; (b) Imported raw materials may increase R&D costs; and (c) Political Interference.

Additionally, the heads of R&T divisions briefly explained some of the challenges that team members faced during the implementation stage, which were categorized into two main categories: government-caused and institutional-caused barriers; these are described as follows:

Government-caused barriers

- Lack of support in terms of limited R&D budget allocations, and difficulties in getting budget approvals.
- Too much red tape involved in securing research grants.
- Many current research projects involve multiple ministries (e.g., MOSTI and MOH for scientific products requiring clinical trials). However, each research grant is dedicated to a particular ministry only (e.g., MOSTI produces the product, while MOH is responsible for clinical trials). Grants from a ministry can only be used by the institutions under that particular ministry.
- Lack of recognition by the GoM of local researchers, technologies and products. The enthusiasm for "foreign technology acquisition" at high costs, compared to channelling funds into local technology development and establishment, is quite demoralizing.
- Lack of benefits for successful researchers

Barriers caused by institutions

- Insufficient qualified researchers in new technologies
- Lack of technology commercialization skills by the majority of project leaders in the R&C division.
- Lack of support, and very slow decision making, due to multiple layers of approvals required. Ideas have to be presented in many different meetings, but with no clear, finalized decision formulated (the obvious reason being management avoiding accountability).
- Excessive much red tape (e.g., in the recruitment, purchasing and approval processes). Most decisions are made by the CEO and Vice President, while lower management lack a

role in the decision-making process. Most of the time, decisions are delayed because "committees" do not have sufficient quorums to proceed.

- Tardy inter-departmental support within organizations due to Key Performance Indicator requirements. After R&T units become business units, each department is busy trying to generate its own individual income rather than collaborating with, or assisting, other departments in the implementation of R&D and technology commercialisation.
- Having an IP policy, but not implementing it, and in turn deterring successful researchers from producing successful R&D outputs for commercialisation. Without any visible direct incentives, the majority of researchers are only interested in producing "theoretical research" rather than commercially viable new technologies.
- Insufficient linkages to industry and stakeholders in ensuring the successful implementation of technology commercialisation plans.

There are thus several barriers and challenges faced by GR&TOs in implementing R&T&C and corporatisation policies. These barriers, unless addressed, remain impediments to GR&TO mandates to increase research outputs and wealth creation for the organisation in particular, and the country in general.

The challenges faced may also be perceived as opportunities for the future growth of GR&TOs in Malaysia. To overcome these challenges, GR&TOs need to establish and adopt an effective collaboration model. As collaboration is of benefit to GR&TOs in terms of revenue, licensing, equity, sponsored research, grants, technological development and the sharing of resources and facilities; GR&TOs need to establish systematic collaborations and synergies with relevant stakeholders, including government agencies, local and multinational organisations, industries, suppliers, universities, the research community, and above all, the society as a whole.

To successfully implement any innovation plan, there is a need to identify and grant appropriate levels of authority to key groups of individuals who are committed to the cause and implementation processes of the National Innovation Policy. This group of individuals would be identified as Innovation Champions and experts in their given disciplines.

It is recommended that each sector within a GR&TO be headed by a technology 'champion', who has complete knowledge of the sector, its thrusts, and its goals; and also has the ability to utilize these three elements to energize the sector with direction, leadership, guidance and management. Above all, the champion must be result-oriented. Technology champions must ensure that team members are readily available to disseminate important information. Malaysia does not have an adequate culture of communication to reach target audiences. To overcome this barrier, champions in each GR&TO must motivate their staff to be more communicative, yet innovative at the same time. Moreover, they should hire local communication experts to better communicate and distribute knowledge to all stakeholders and the public.

It is also crucial to encourage individuals to be more creative and bold in tackling additional risks. Positive failures, with full evidence of good practices and implementation, should be promoted. In the long-term, this will help encourage creativity and innovativeness among individuals and entrepreneurs alike. GR&TOs must focus on radical rather than incremental innovation.

To facilitate SME start-ups, several key issues must be emphasized. Foremost, the GoM must centrally coordinate institutional frameworks to create favourable environments for SME start-ups, particularly in the area of pre-commercialization funding and grants.

The lack of inter- and intra-GR&TOs communications on research and development has resulted in the constant overlap of equipment procurement and research activities. GR&TOs are also top-heavy in their management structure, clouding the future direction of research and development from a bottom-up perspective. In the end, grants can be channelled towards more productive avenues. Once a National Innovation Database is created, it would be easy to track expenditure, progress of research, experts, scientists and technologists involved in various

research and development initiatives. Such information can be utilized by GR&TOs instead of researching existing technical information in a compartmentalized manner.

GR&TOs should also conduct benchmarking processes and/or determine best practices for formulating, executing and implementing technology development and commercialization programmes based on successful GR&TO templates from developed countries.

It is also advisable for Malaysian GR&TOs to undertake regular global scanning of emerging best practises and/or novel projects executions administered by established counterparts abroad. This information can be aggregated through open source methods (i.e., from journals, news articles, institutional websites, conference proceedings, and press releases from various academies of sciences, among others). A more streamlined intra- and inter-GR&TO communications structure should include dedicated global scanning activities that may entail basic foresight activities, along with horizon scanning.

Ideally, global scanning must focus more on "what is working at the moment" models over hypothetical futuristic governance processes (i.e., future of civil services). Identified best practises abroad must also be evaluated for their suitability in local adaptation and implementation. Wholesale emulation of foreign, particularly Western, institutional practises, may not be suited for Malaysia, especially in the light of the widening chasm between the growth trajectories of an increasingly volatile West, and those of relatively stable APEC, BRICS and Eurasian Economic Union (EEU) blocs of nations. It may be timely for local GR&TOs to adopt a more "Look East" policy, as the enthusiasm for "foreign technology acquisition" at very high costs, as revealed by this study, is seemingly matched by the enthusiasm for foreign consultants at equally high costs. Between 2009 and October, 2013, the GoM spent a total of RM 7.2 billion

on foreign private consultants, entailing an increase of 13.5%, on average, each year (Ministry of Finance).

Foreign consultants may be prone to advocate wholesale transplantation of best practises ill-suited for local institutional needs, and thereby inadvertently constrict native competitive capabilities. Inevitably, foreign consultants may nudge out available local talent, and in turn contribute to the "shortage or inadequacy of available human capital, particularly concerning technological innovation and market assessment capability", as identified in this study.

Furthermore, foreign consultants hired by one particular ministry are likely to be unaware and unconnected to similar research or talents available at other ministries or research institutions, thereby entrenching a silo-culture. This may result in expensive tie-ups with foreign institutions, at the expense of promising local innovation initiatives. The creation of a National Innovation Database should therefore be accelerated to unearth and maintain local talent. Obstacles faced by GR&TOs in this instance can potentially be inverted into opportunities in the near future.

Currently, the effort put in to unearth local talent is insufficient. An adaptation of the Open Innovation system currently being developed by South Korea's KISTEP would aid tap local ideas and talent, and simultaneously plug a brain-drain haemorrhage. Enhanced inter- and intra-communications among local GR&TOs via a National Innovation Database is an ideal platform for local talent identification and absorption.

Finally, the corporatization of GR&TOs should not lead to the "privatization of science" for short-term commercial gains, or narrow industrial interests, which sacrifice long-term human capital development and national strategic needs in the process. Overemphasis on private sector-style KPIs and short-term commercial gains may contribute to inter-departmental rivalries, as

well as the vitiation of a long-term strategic innovation focus that is vital to the holistic development of the nation. There is thus a need to balance commercialization imperatives with long-term strategic needs.

The above strategic outline may assist in overcoming various challenges, increase operational efficiency, and expand space for national development and growth through research, technology and innovation.

Conclusion

To comprehensively understand the role of GR&TOs in delivering corporatization policies, it is worthy to note that various initiatives remain to be more focused on R&D activities, and less focused on commercialization and innovation, as expected by shareholders. Most GR&TOs in Malaysia support the Ministry or Agency that funds a particular R&D. This approach may, or may not, optimize the corporatization agenda in terms of wealth creation, knowledge and human capital development.

It was also noted that all GR&TOs act independently, and remain guarded in their research findings. This does not help the dissemination of information, nor does it help the flow of ideation.

It is reasonable to conclude that Malaysia remains a remarkable economic growth example that reflects the strong macroeconomic management and political stability of the nation. To maintain momentum, the country needs to accelerate its competitiveness in all scientific fields and move up the technology chain by producing higher value-added, technology-intensive products. This is the primary role of all GR&TOs in the country. Once all GR&TOs are required to follow the Government's corporatization policy agenda, a new class of GR&TOs may emerge that is predicted to catapult the status of the nation to one that is developed.

References

Bakker, K. (2005). Neoliberalizing nature? Market environmentalism in water supply in England and Wales. *Annals of the association of American Geographers*, *95*(3), 542-565.

Barret, S., & Fudge, C. (1981). Policy and action: Essays on the implementation of public policy. *London: Methuen*.

Chesbrough, H. W. (1999). The organizational impact of technological change: a comparative theory of national institutional factors. *Industrial and Corporate Change*, *8*(3), 447-485.

Chesbrough, H., & Socolof, S. (2003). Sustaining venture creation from industrial laboratories. *Research-Technology Management*, *46*(4), 16-19.

Dosi, G. (1988). The nature of the innovative process. *Technical change and economic theory*, *2*, 590-607.

Fagerberg, J., Mowery, D. C., & Nelson, R. R. (2006). *The Oxford handbook of innovation*. Oxford Handbooks Online.

Freeman, C. (1987). Lessons From Japan. *Technology Policy and Economic Performance, London: Frances Printer*.

Hill, M., & Hupe, P. (2008). *Implementing public policy: An introduction to the study of operational governance*. Sage.

Mazzoleni, R., & Nelson, R. R. (2007). Public research institutions and economic catch-up. *Research policy*, *36*(10), 1512-1528.

Ministry of Finance (2013). Quoted in the Malay Mail: Putrajaya spent RM7.2b, or RM4m day, on private consultants, Parliament told (Nov 13, 2008).

Ministry Of Science Technology & Innovation 2010 Annual Report.

National Survey of Research and Development Report (2012). Malaysian Science and Technology Centre (MASTIC), Ministry Of Science Technology & Innovation (MOSTI).

Nelson, R. R. (Ed.). (1993). *National innovation systems: a comparative analysis*. Oxford university press.

OECD (1998). Science and Technology Policy: Review and Outlook, OECD, Paris.

Patel, P., & Pavitt, K. (1994). The nature and economic importance of national innovation systems. *STI review*, *14*.Nelson, R. R. (Ed.). (1993). *National innovation systems: a comparative analysis*. Oxford university press.

Porter, M. E. (1985). Competitive strategy: Creating and sustaining superior performance. *The free, New York.*

Porter, M. (1990). 77ie competitive advantage of nations.

Pressman, J. L., & Wildavsky, A. (1984). Implementation: 3rd edition. *Berkeley: University of California Press*.

SIRIM Berhad 2010 and 2011 Annual Report.

Schumpeter, J. A. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle* (Vol. 55). Transaction publishers.

The Policy Research Working paper (World Bank, 2006).

Thurow, L. C. (1996). The future of capitalism; how today's economic forces shape tomorrow's world.

Van Meter, D. S., & Van Horn, C. E. (1975). The policy implementation process a conceptual framework. *Administration & Society*, *6*(4), 445-488.

West, M. A., & Anderson, N. (1992). Innovation, cultural values, and the management of change in British hospitals. *Work & Stress*, *6*(3), 293-310.