RESEARCH AND DEVELOPMENT ACTIVITIES TOWARD CAPACITY BUILDING: MALAYSIA EXPERIENCE

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This paper discusses the Malaysia position in world ranking on publication of papers in international science and technology journals. Malaysia was ranked number fifty-five (55) among 178 countries. Several factors had been identified to relate shortcoming of research publication in Malaysia in comparison with developed countries such as the country research and development (R&D) expenditure, number of researchers on ratio of 1,000 labour force and R&D expenditure as percentage of Gross Domestic Product. The R&D expenditure at institutional level comprising Institutes of Higher Learning, Government Research Institutes, and private sector were also been highlighted. This paper further discussed the low involvement of academia as project leader in research activities citing example of Kolej Universiti Teknologi Tun Hussein Onn as case. As a conclusion this paper recommended several factors to be explored further as to what are driving factors that influence academia to conduct and upgrade their research performance.

Research activities assume an important role to the university. Without research activities, university could not sustain it growth. Research should be a central focus to the university to be renowned and thus it depends very much on its expertise in research and development. In other words, research activities in the university could not be separated and it would be driving force for the development of a nation (Utusan Malaysia, 2005). Furthermore, Malaysia is committed to be a develop nations in the year 2020 as noted by Mahathir Mohamad (1991). He noted that one of the main challenges to achieve truly develop nation, Malaysia must create a scientific and progressive society, a society that is innovative and forward-looking, one that is not only a consumer of technology but also a contributor to the scientific and technological civilisation of the future.

The emphasis on science and technology is not rhetorical. It has been emphasised in almost every Malaysian Plan which emphasised the need to strengthen science and technology and significantly increased research and development with the utilisation Malaysia technology. Nevertheless, a survey of 5,232 projects implemented by the public research institutions and universities during the Sixth and Seventh Plans revealed that 14.1 percent of these projects were identified as potential candidates for commercialization while only 5.1 percent was commercialized (Malaysia, 2001).

Numbers of Malaysian Papers in International Science and Technology Journal as Indicators of R&D Activities

Malaysian Science, Technology and Information Centre (MASTIC) had conducted a study on the Malaysian authors and co-authors that contributed their articles in international science and technology journals. The study found that a total of 10, 538 had been produced. This number of papers is equivalent to 0.08% of the total papers which is 13,278,111 for the period 1981 to 2002. Malaysia ranked 55 among 178 countries, behind South Korea (ranked 25), Taiwan (26), China (14) and India (11). United States of America (USA) is leading in contribution of science and technology papers amounted 37.64%, United Kingdoms in the second place (9.06%), followed by Japan (8.13%), Germany (8.02%), France (5.78%), Canada (4.87%), Italy (3.33%) and Australia (2.58%) (MASTIC, 2003).

In this study, it was found that a total of 13, 475 papers had been published by scientists or Malaysian researchers in an international journal from 1995 to 2002 which covers 39 fields which was recorded from renowned international database (MASTIC, 2003). The scientists or researchers papers in international journals according to Malaysia Plan are tabulated as in Table 1:-

Table 1: Science and Technology Papers by Malaysia Plan For Period before 1966-2002

Malaysia Plan	Number of Papers
Before 1966	11
1(1966-1970)	14
2(1971-1975)	59
3(1976-1980)	204
4(1981-1985)	1634
5(1986-1990)	1888
6(1991-1995)	3183
7(1996-2000)	4466
8(2001-2002)*	2016

Source: Science and Technology Knowledge Productivity in Malaysia Bibliometric Study 2003, MASTIC
*For period of two years only

The contribution of Malaysian scientists or researchers represent their institutions. University Malaya was ranked first in term of frequencies paper published with a total of 4,216 times, followed by Universiti Sains Malaysia (2,790), Universiti Putra Malaysia (2,489), Universiti Kebangsaan Malaysia (1,692) and Universiti Teknologi Malaysia (511).

Table 2 illustrate top ten institutions that contribute papers in publication of science and technology for period 1955 to 2002.

Table 2: Top Ten Public Institute of Higher Learning and Research Institute That Contribute Papers in Publication of Science and Technology for Period 1955-2002

Institution	Number of Papers
Universiti Malaya (UM)	4,216
Universiti Sains Malaysia (USM)	2,790
Universiti Putra Malaysia (UPM)	2, 480
Universiti Kebangsaan Malaysia (UKM)	1,692
Universiti Teknologi Malaysia (UTM)	511
Institute of Medical Research (IMR)	492
Malaysian Agriculture Research and Development Instititute (MARDI)	347
Palm Oil Research Institute of Malaysia (PORIM)	304
Department of Mineral and Geosciences	286
Forest Research Institute of Malaysia (FRIM)	228

Source: Science and Technology Knowledge Productivity in Malaysia Bibliometric Study 2003, MASTIC

The study also shown that there was collaboration among local institutes and overseas in contributing joint research papers. Researchers from University Malaya and Universiti Sains Malaysia contributed the highest joint research papers with 263 papers, followed by Universiti Sains Malaysia and Nanjing University (224). The details of collaboration in joint research paper in science and technology publication between public Institution of Higher Learning and local and overseas institutions is as Table 3 below:-

Table 3: Top Ten Public Institutions of Higher Learning Collaborating Joint Research Papers in Science and Technology Publication For Period 1955-2002

Institutions	Number of Papers
Universiti Malaya and Universiti Sains Malaysia	263
Universiti Sains Malaysia and Nanjing University	224
Universiti Kebangsaan Malaysia and Universiti Putra Malaysia	162
Universiti Kebangsaan Malaysia and Universiti Malaya	156
Universiti Malaya and Universiti Putra Malaysia	154
Universiti Sains Malaysia and University Madras	137
Universiti Kebangsaan Malaysia and Universiti Sains Malaysia	129
Universiti Sains Malaysia and Prince Songkla University	121
Universiti Malaya and National University of Singapore	107
Universiti Malaya and Institute of Medical Research	101

Source: Science and Technology Knowledge Productivity in Malaysia Bibliometric Study 2003, MASTIC

Malaysia Research and Development Expenditure

The Government had allocated big amount of research and development expenditure from 1992 to 2002. This expenditure reflects the increment from RM550.7 million in 1992 to RM2, 500.6 million in 2002. Table 4 have shown research and development expenditure and its percentage from Malaysia Gross Domestic Products. Even though there was an increase from year to year, this amount was considered low compared to expenditure from developed countries such as United States of America (USA) and Japan. USA spent over RM1.0 trillion for research and development, Japan (RM456.1 billion), China (RM59.1 billion), Korea (RM52.6 million) and Italy (43.8 million) (MASTIC, 2004).

Table 4: Research and Development Expenditure and as a Percentage Of Malaysia Gross Domestic Product for Period 1992-2002

Item	1992	1994	1996	1998	2000	2002
Total Research and Development (RM million)	550.7	611.2	549.1	1,127.0	1,671.5	2,500.8
Research and Development Expenditure as Percentage of Gross Domestic Product	0.37	0.34	0.22	0.39	0.5	0.69

Source: MOSTI Facts and Figures, 2004

Malaysia research and development in year 2002 as percentage of Gross Domestic Product stood at 0.69%. This percentage was relatively low compared to Singapore (2.15%), Taiwan (2.30%), Republic of Korea (2.53%), USA (2.53%) and Japan (3.07%). Malaysia had formulated Second Science and Technology Policy which targeted research and development expenditure at least 1.5% from Gross Domestic Product by year 2010 (MOSTE, 2003).

Number of Malaysian Researchers

In term of the number of Malaysian researchers for every 10,000 labour forces, the ratio was 18:10,000 in 2002. This ratio is relatively low compared to USA which is 89.6:10,000, Australia 99:10,000, Norway 111.0:10,000, Japan 112.8:10,000 and Denmark 120.0:10,000 (MASTIC, 2004). Malaysian researcher for every 1,000 labour force is also relatively low which is 0.72:1,000 compared to Finland at the ratio of 15.45:1,000, Japan 10.05:1,000 and Taiwan 9.50:1,000 (MASTIC, 2004). Number of patent and innovation utility which have been applied and granted (patent which is filed in Malaysia) by residents was comparatively low to non-residents. The application applied for patent and utility by residents for period between 1990 to 2002 amounted 2,565, out of which the application granted was 388. Meanwhile application for patent and innovation utility for non-residents was 56,121 and the

application granted 14,609 for the same period. The number of application for patent and utility by residents was twenty two (22) times higher compared to application by residents.

Research and Development by Institutions

The expenditure for research and development at the national level for 2002 stood at RM2,500.6 million. From this amount, RM1,375.2 million (55%) was for operational expenditure while RM1,124.4 (45%) for capital expenditure. At the institution level, operational expenditure for Institute of Higher Learning (IHL) in 2002 was 15.3% (RM209.8 million), Government Research Institutes (GRI) 16.9% (RM232.7 million) and private sector 67.8% (RM932.7 million). Capital expenditure for IHL was 13.4% (RM150.7 million), GRI 24.4% (RM274.4 million) and private sector 62.2% (RM703 million) for the same period. The operational expenditure components consist of labour and operating cost while capital expenditure includes land and building cost. Within capital expenditure, cost of machinery and equipment form higher cost compared to land and building cost. The detail of research and development by type cost from 1992 to 2002 is as in Table 5.

MASTIC had identified the incremental of capital cost as one of the factors that inhibit research and development activities for three institutions above (MASTIC, 2004). The MASTIC report also identified lack of machinery and equipment facilities that limit the implementation of research and development activities. National Council for Scientific Research and Development (MPKSN) in its yearly report suggested that the research infrastructure needs to be further strengthened particularly at institutional level. Conducive research environment and state-of-the-art facilities were factors that can encourage researchers to conduct quality research in line with the aspiration of the nation (MPKSN, 2003).

Table 5: Research and Development (RM million)
By Type of Cost from 1992- 2002

Type of Activity by Sector	1992	1994	1996	1998	2000	2002
National						
Operational Expenditure	338.2	356.3	329.3	696.3	807.2	1,375.2
Capital Expenditure	212.5	254.9	219.9	430.8	864.3	1,125.4
Grand Total	**550.7**	**611.2**	**549.2**	**1,127.0**	**1,671.4**	**2,500.6**

Government Research Institutes						
Operational Expenditure	**181.6**	**133.6**	**87.7**	**170.0**	**292.5**	**232.7**
• Labour	111.6	85.6	62.9	73.9	110.6	174.6
• Operating cost	70.0	48.0	24.8	96.1	181.9	58.1
Capital Expenditure	**72.1**	**31.2**	**21.0**	**77.3**	**124.9**	**274.4**
• Land and Building	33.3	5.2	9.3	39.6	11.7	27.2
• Machinery and Equipment	38.7	26.0	11.7	37.7	113.2	247.2
Total	**253.7**	**164.9**	**108.7**	**247.3**	**417.5**	**507.1**
Institutes of Higher Learning						
Operational Expenditure	**31.1**	**27.5**	**34.3**	**102.3**	**144.0**	**209.8**
• Labour	17.5	19.1	9.3	39.6	11.7	27.2
• Operating cost	13.7	8.4				
Capital Expenditure	**19.5**	**123.4**	**6.1**	**31.3**	**142.0**	**150.7**
• Land and Building	1.7	0.2	1.1	22.2	61.3	20.5
• Machinery and Equipment	17.8	123.2	5.0	9.1	80.8	130.1
Total	**50.7**	**150.9**	**40.3**	**133.6**	**286.1**	**360.4**
Private Sector						
Operational Expenditure	**125.4**	**192.5**	**207.3**	**424.0**	**370.6**	**932.7**
• Labour	67.8	105.9	93.9	163.8	175.9	248.9
• Operating cost	57.6	86.6	95.8	260.2	194.7	683.8
Capital Expenditure	**120.9**	**100.1**	**192.9**	**322.1**	**597.3**	**700.3**
• Land and Building	77.2	19.0	-	106.4	170.1	120.5
• Machinery and Equipment	43.8	81.1	210.6	215.7	427.2	579.8
Total	**246.3**	**292.2**	**400.1**	**746.1**	**967.9**	**1,633.1**

Source: National Survey of Research and Development 2004 Report, MASTIC and MOSTI Fact and Figure, 2004

Purpose of Intensified Research Priority Area (IRPA) Program

The Eight Malaysia Plan a five year plan from 2001 to 2005 has emphasised that in allocating grants for research and development projects, the MPKSN adheres several principles. These are:

- To fund projects which are of high national priority and commercialisable;
- To fund projects which address the need of Malaysian industry;
- To encourage collaborative efforts among research institutions; and
- To enhance research and development linkages between public and private sectors.

The main bulk of IRPA funding should be allocated to fund activities that will lead to commercialisation. However, in the interest of generating more capabilities and expertise within the country, some funding allocation should also be given to research activities

directed toward knowledge advancement even though they are presently not seen as commercialisable. Under the IRPA Programme, research projects are divided to three categories

- Experimental Applied Research

  Projects under this category should be towards generating institution capacity and knowledge advancement. It should have the elements of commercialisation potential. The projects could also involve more than one institution.

- Prioritised Research

  Research projects under this category should emphasise on immediate need of the country. It should be multi-institutional, multi-disciplinary with industry linkages and commercialisation potential.
- Strategic Research

  Project under this category should focus for future competitive socio-economic environment or new breakthrough in scientific field. It should be multi-institutional, multi-disciplinary with industry linkages and commercialisation potential.

MPKSN in its annual report, stressed on the important of adaptation and research culture among local researchers in determining the successful adoption of the concept of multidisciplinary and collaborative research and development activities that could lead to the creation of commercially viable research output. The need to collaborate and work together among researchers in various institutions requires a high level of confidence and understanding. This can be achieved through assimilation and adoption of a strong research and development culture (MPKSN, 2003).

Research Projects at the Kolej University Teknologi Tun Hussien Onn (KUiTHHO) from 2002-2006

Kolej Universiti Teknologi Tun Husssein Onn (KUiTHHO) was established in 2002 as one of the university. With total number of teaching staff of 143, the numbers of lecturer/project leader involved in research and developments in 2002 were 58 persons. A total of 81 fundamental projects were approved in 2002 with support grants from the Ministry of Higher Learning. The difference in the number of projects approved and the number of lecturers involvement as a project leader because few lecturers/project leaders holds more than one research grants and this represent 40.6% involvement as a project leader. Meanwhile, lecturer holding more than one research grants amounted 16.1%. However as the numbers of lecturers increased to 362 (year 2003), 489 (2004), 518 (2005) and 525 (2006), the percentage of new lecturers involved in research as project leader did not exceeding 7.0% from the total number of lecturers in KUiTTHO from 2003 to 2006. It was also found that the number of project leader who hold more than one grants not more that 5.0%. The number of KUiTTHO lecturer/project leader who received grant under the Ministry of

Higher Learning for conducting research and development from 2002 to 2006 is tabulated in Table 6.

Table 6: Number of KUiTTHO Lecturer/ Project Leader Who Receive Grant for Conducting Research and Development (R&D) Under Ministry of Higher Learning from 2002-2006

Approved Project	Number Of Project	Project Cost	Lecturer/ Project Leader	Total Lecturer in KUiTTHO	Involvement of Lecturer/ Project Leader	Involvement of Lecturer/ Project Leader More than One Grant
2002[1]	81	RM1,442,164.6	58	143	40.6%	16.1%
2003[1]	34	RM1,135,465.11	18	362	5.0%	4.4%
2004[2]	17	RM632,900.00	15	489	3.1%	0.4%
2005[2]	57	RM1,318,725.00[3]	35	518	6.8%	4.2%
2006	38	RM402,000.00	26	525	5.0%	2.3%

Source: Research Management Centre and Innovation, KUiTTHO

[1]Project status finished

[2] Project status still active.

[3]Total amounted RM318,850 grant provide by Ministry of Higher Learning and RM999,875 from KUiTTHO's fund

The involvement of lecturers who receive grants for Intensified Research Priority Area (IRPA) project are still not overwhelming which account less than 1% of the total number of academic staff in KUiTTHO. The number of lecturer/project leader who receive IRPA grant projects under the Ministry of Science, Technology and Innovation from 2002 to 2004 is shown in Table 7.

Table 7: Number of KUiTTHO Lecturer/ Project Leader Who Receive IRPA Grant Projects from Ministry of Science, Technology and Innovation from 2002-2006

Approved Project	Project Completion	Number of Projects	Project Cost	Lecturer/ Project Leader	Total Lecturer in KUiTTHO	Involvement of Lecturer/ Project Leader
Ogos 2002	Dis 2004	1	RM154,000	1	143	0.7%

Okt 2003	April 2006	1	RM135,600	1	362	0.3%
April 2004	Mac 2006	4	RM497150	4	489	0.8%

Source: Research Management Centre and Innovation, KUiTTHO

Other than grants from Ministry of Higher Learning and IRPA grant funded by Ministry of Science, Technology and Innovation, few KUiTTHO's lecturers received grants from institutions such as Construction Industry Development Board (CIDB), National Property Research Centre (NAPREC) and Department of Irrigation and Drainage (DID). However, the number of lecturers/ project leader who received grant for conducting research and development activities under these institutions from 2002-2006 was small as shown in Table 8.

In discussing statistics in Table 6 to 8 above, problems that exist at KUiTTHO are low involvement of lectures in research activities as project leader for the period between 2002 to 2006 which less than 7%. This calculation is based on single count of yearly grant approval by Ministry of Higher Learning. In overall, the number of lecturers who received more than one grants also low which did not exceed 5% for the same period of time. The low involvement of lecturers as a project leader who received IRPA grant from Ministry of Science, Technology and Innovation and other institutional grants are so obvious which accounted less than 1%.

Table 8: Number of KUiTTHO Lecturer/ Project Leader Who Receive Grant for Conducting Research and Development (R&D) Under Various Institution from 2002-2006

Approved Project	Number Of Project	Project Cost	Type of Grant	Lecturer/ Project Leader	Total Lecturer in KUiTTHO	Involvement of Lecturer/ Project Leader
2002	2	RM200,000	CIDB[1]	2	143	1.2%
2003	1	RM213,860	CIDB[1]	1	362	0.3%
2004	1	RM1,378,400	NAPREC[2]	1	489	0.2%

2005	1	RM18,000	DID[3]	1	518	0.2%
2006	2	RM338,444	NARPEC[2]	2	525	0.4%

Source: Research Management Centre and Innovation, KUiTTHO
[1]Construction Industry Development Board (CIDB)
[2]National Property Research Centre (NAPREC)
[3] Department of Irrigation and Drainage (DID)

Conclusion

This paper had discussed the low involvement of lecturers as project leader by taking KUiTTHO as an example. What are the driving factors that could influence academia to conduct research activities at the Institute of Higher Learning? Is it the adequate funding influence academia to get improve in research? Is it the motivational factors (intrinsic or extrinsic) aspires academia to do more research? Could it be leadership in university is contributing factor for the academia in increasing their research activities? How about upgrading of academia skill, will it increase their research performance? These are several questions that need to be addressed and explore further.

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