

# Fostering Commercialization of Agricultural Technology in Malaysia

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## ABSTRACT

*R&D activities should be promoted and supported to foster invention-innovation outputs. Malaysia has indicated significant continuous growth of R&D activities [Government Expenditure on R&D in Proportion to the Countries Gross Domestic Products (GERD/GDP)]. The relative increasing R&D investments in Malaysia has strengthened the country's major sector productivity and export inclusive agricultural based technology. Along the way is Malaysian Agricultural Research and Development Institute (MARDI) as the country's main public agricultural R&D agency. Investing in R&D alone without a proper strategic and operational plan may be a fiasco to the nation. Thus, to ensure the relevance of the mainstream of national invention and innovation arena, MARDI has proactively strengthened her in-house strategic technology management. This paper aims to share the national R&D activities, MARDI's technology management and further, to highlight the main elements contributing to stimulating vibrant technology transfer ecosystem and fostering technology commercialization.*

**Keywords:** Agricultural Technology, Government Investment, Invention, Innovation, R&D Output, Intellectual Property Management, Technology Commercialization

## INTRODUCTION

In order to foster invention-innovation output in Malaysia, R&D activities should be inspired. The strengths of R&D activities in Malaysia can be viewed from the continued growth in private sector's support for R&D. MASTIC survey 2012 has reported that R&D activities in Malaysia was driven by Private sector (Business entity), followed by Institution of Higher Learning (IHL) and lastly by Government Research Institute (GRI). Graph below indicates said proportion from 2000 – 2012.

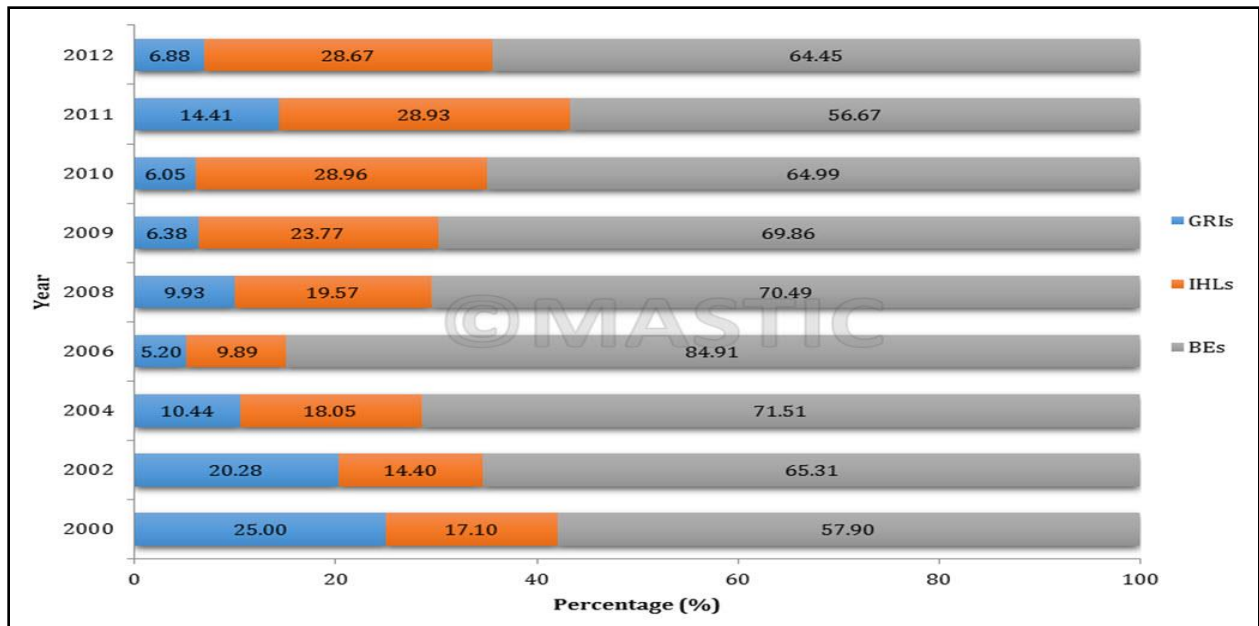


Fig. 1. R&D Expenses by Sectors for the year 2000 – 2012. Source: MASTIC (2012)

As shown in Fig. 2 below, from year 2000 onwards, Malaysia has indicated significant continuous growth of Malaysian intensity for R&D activities. In 2012, GERD/GDP was 1.13%, 43% increment compared to year 2008 (0.79%). And Malaysian GERD has reached RM 10,612.8 million increment of 74.8% compared to in 2006 (RM 6,070.8 millions).

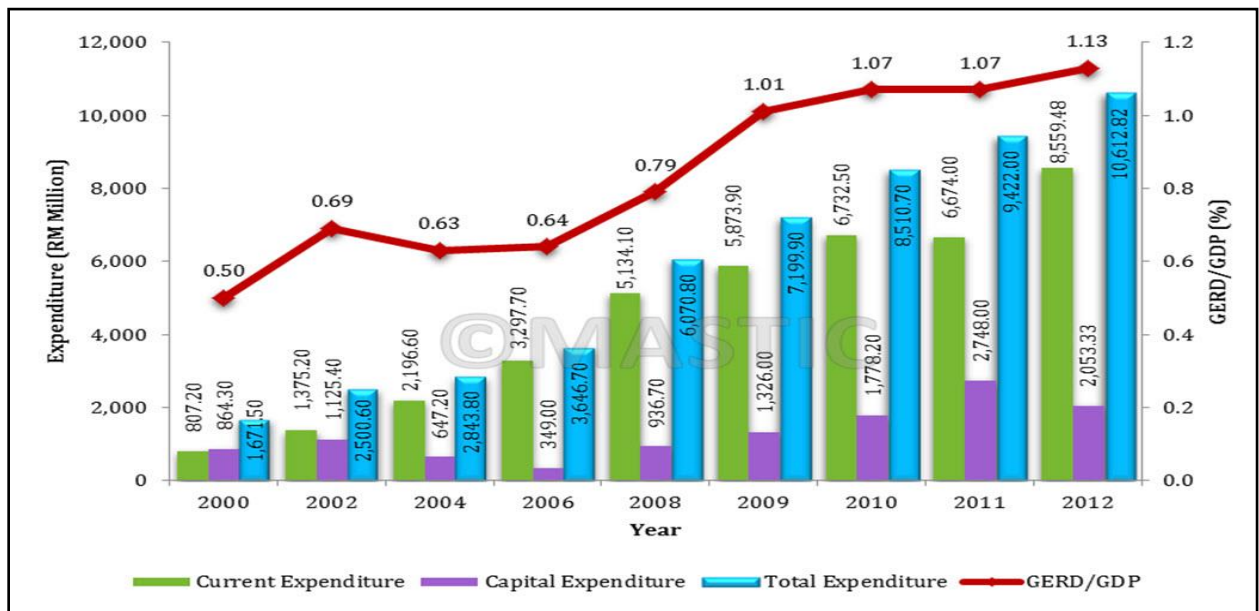


Fig. 2. Government Expenditure on R&D (GERD) over Gross Domestic Product (GDP)\_GERD/GDP from Year 2000 – 2012. Source: MASTIC (2012)

Meanwhile, as shown in Fig. 3, the agricultural sector continues to be among the major contributor to Malaysian's GDP growth comparable to Medical and Health Science and Biotechnology sectors. Due to that, the Malaysian government has allocated considerably high proportion of investments in the agriculture sector compared to many other developing countries. Sharif *et al.* (2015) documented that in the year 2010, agricultural R&D investments was USD 174 million. Government spending on agricultural R&D has doubled since the 1980s.

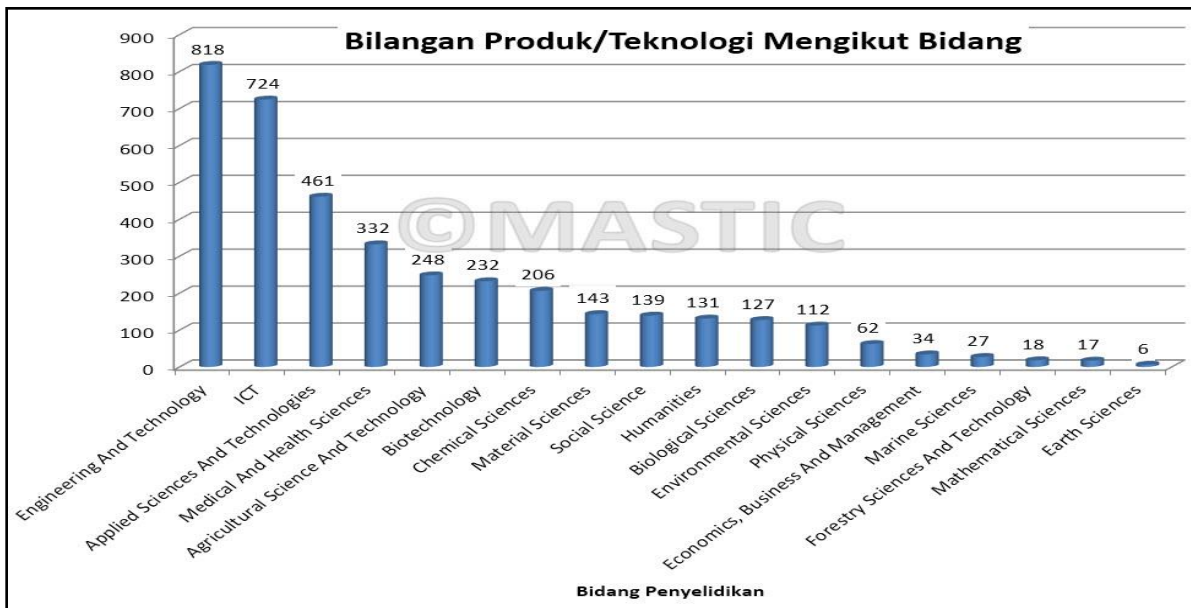


Fig. 3. Numbers of Products/ Technologies Generated by Sectors. Source: MASTIC (2012)

## OVERVIEW OF INTELLECTUAL PROPERTY RIGHT (IPR) PROTECTION IN MALAYSIA

In July 2007, the Malaysian government in July 2007 has officially announced and launched the much talked about National Intellectual Property Policy (MyIPO, 2007). The main undertaking of this policy is to develop intellectual property as a new engine growth for the enhancement of social and economic prosperity.

The core objectives of National Intellectual Property Policy (NIIP) are:

a) Highest Standard of IP Protection System

In order to achieve this, the administration of the Intellectual property Corporation of Malaysia (MyIPO) will be improved and strengthened to meet the yearly increase in registration applications and also to ensure that the needs of applicants are met. The NIPP also upholds that Government Agencies that enforces infringements of IP rights under the Trade Description Act 1972, Optical Disc Act 2000, Trade Marks Act 1976, Patents Act 1983, Copyright Act 1987, Industrial Design Act 1996, Layout Designs of

Integrated Circuits Act 2000 and lastly, Geographical Indications Act 2000, must be strong and resilient to deter repetition infringements.

b) Promotion of Commercial Exploitation of IP

The goal is to nurture an IP industry that is able to sustain Malaysia's economic growth in the new era. It is done by attracting local and foreign enterprises to position the entire, if not substantial part of their IP value chain in Malaysia.

c) Development of IP Management Capabilities

The strategy in achieving this is to develop a panel of specialists to be placed at all levels of IP chain activities at both the public and private sectors.

d) Development of Infrastructure for IP transaction

In order to have an efficient and successful IP industry, it is important to have a highly developed financial support from the banking industry and financial institutions inclusive by providing incentives, grants, finance management for the IP industry.

e) Promoting Foreign Investments and Technology Transfer

Malaysia is giving assurance to have very high standard of IP protection system that guarantees protection of IP rights to encourage more foreign investments and technology transfer ecosystem flourish in this country.

f) Human Resource and Public Awareness

The policy also intends to promote human resource development and public awareness in various areas such as rights acquisition, enforcement, dispute settlement, management, valuation and licensing as well as general awareness. Overall, these developments will help spur the nation's growth economically and socially. As a consequence, this will help Malaysia reach her vision of being a developed nation by 2020.

Herewith are some statistics relates to patent applications in Malaysia as of May 2016.

Table 1. Application and Granted Patents and Utility Innovations From 1986 – 2016

YEAR	APPLICATION			GRANTED		
	Malaysia	Foreign	Total	Malaysia	Foreign	Total
1986	29	233	262	-	-	-
1987	71	3,195	3,266	-	-	-
1988	73	1,547	1,620	-	6	6
1989	84	1,803	1,887	11	121	132
1990	92	2,213	2,305	20	498	518
1991	106	2,321	2,427	29	1,021	1,050
1992	151	2,260	2,411	10	1,124	1,134
1993	198	2,684	2,882	14	1,270	1,284
1994	223	3,364	3,587	21	1,608	1,629
1995	185	3,992	4,177	29	1,724	1,753
1996	221	5,354	5,575	79	1,722	1,801
1997	179	6,278	6,457	52	741	793
1998	193	5,770	5,963	21	545	566
1999	218	5,624	5,842	39	683	722
2000	206	6,021	6,227	24	381	405
2001	271	5,663	5,934	18	1,452	1,470
2002	322	4,615	4,937	32	1,460	1,492
2003	376	4,686	5,062	31	1,547	1,578
2004	522	4,920	5,442	24	2,323	2,347
2005	522	5,764	6,286	37	2,471	2,508
2006	531	4,269	4,800	187	6,562	6,749
2007	670	1,702	2,372	338	6,645	6,983
2008	864	4,539	5,403	198	2,044	2,242
2009	1,234	4,503	5,737	270	3,198	3,468
2010	1,275	5,189	6,464	204	1,973	2,177
2011	1,136	5,423	6,559	335	2,057	2,392
2012	1,160	5,867	7,027	308	2,193	2,501
2013	1,269	6,081	7,350	305	2,386	2,691
2014	1,439	6,321	7,760	381	2,381	2,762
2015	1,375	6,532	7,907	360	2,548	2,908
MAY 2016	483	2,533	3,016	114	1,196	1,310
<b>TOTAL</b>	<b>15,678</b>	<b>131,266</b>	<b>146,944</b>	<b>3,491</b>	<b>53,880</b>	<b>57,371</b>

Table 1 indicates consistent increment in the numbers of foreign patent application in Malaysia from year 1986 – 2016. At the same time, indicates the domination of foreign patent applications in Malaysia. However the ratio of Malaysia vs Foreign applications is significantly closer over the years. As for year 2000, the ratio is 1:29, year 2005 the ratio is 1:11, year 2014 the ratio is 1:4. However year 2015 the ratio was slightly increase to 1:4.7

Table 2. Patent Granted Base on Field of Technology (PCT Classification)

YEAR	SECTION								TOTAL
	A	B	C	D	E	F	G	H	
1993	215	169	503	15	37	52	155	138	1,284
1994	260	267	505	12	71	79	192	243	1,629
1995	336	268	542	27	48	61	194	277	1,753
1996	285	323	483	31	76	103	178	322	1,801
1997	151	138	196	13	32	45	82	132	789
1998	104	98	141	4	18	31	64	106	566
1999	132	112	191	9	21	49	68	139	721
2000	61	59	110	8	19	42	36	70	405
2001	155	233	288	18	44	102	231	399	1,470
2002	206	236	334	19	42	104	228	323	1,492
2003	224	242	396	28	38	119	190	341	1,578
2004	325	377	625	25	50	132	321	492	2,347
2005	333	452	600	30	82	164	316	531	2,508
2006	948	1,155	1,275	101	197	448	1,042	1,583	6,749
2007	1,179	1,213	1,748	109	221	407	883	1,223	6,983
2008	423	421	451	33	98	159	293	364	2,242
2009	656	633	837	53	119	185	488	497	3,468
2010	364	390	599	22	75	125	274	328	2,177
2011	404	402	693	28	90	126	283	366	2,392
2012	445	424	722	25	72	101	328	384	2,501
2013	523	393	840	36	98	108	315	378	2,691
2014	538	430	729	27	154	150	331	403	2,762
2015	542	494	642	25	161	198	352	494	2,908
MAY 2016	239	186	437	15	62	71	97	203	1,310
<b>TOTAL</b>	<b>9,048</b>	<b>9,115</b>	<b>13,887</b>	<b>713</b>	<b>1,925</b>	<b>3,161</b>	<b>6,941</b>	<b>9,736</b>	<b>54,526</b>

Section A :	Human Necessities
Section B :	Performing Operations; Transporting
Section C :	Chemistry ; Metallurgy
Section D :	Textiles ; Paper
Section E :	Fixed Constructions
Section F :	Mechanical Engineering; Lighting; Heating; Weapons; Blasting
Section G :	Physics
Section H :	Electricity

## ELEMENTS TO FOSTER TECHNOLOGY TRANSFER

To foster technology transfer, there are several elements that need to be strengthened, synergized and complement each other to emit the best outputs or successes which in this case is the technology transfer itself. Among the main elements are:

### **Related Policies**

One of the main components contributing to the success of technology transfer in an organization is to have clear policy and guideline emerging from ideation to commercialization. The related policies or manuals or guidelines generally to cover aspect of R&D cum invention-innovation activities, source of funding, ownership of the generated technologies/ IPs, inventorship, Intellectual properties management and protection, negotiation, mode of commercialization, aspect of agreement and many more. However, to render comprehensive policies, one must grasp the philosophy behind those relating to the said policies. Below is a summary of some of them:

### ***Philosophy 1: Research categories by factors***

Either we are aware or not, research has been segregated into a few categories. And each categories result into different research strategies eventually resulting into different research output or outcomes.

Research is generally divided into four main categories which are basic/ elementary research, applied research, product refinement/ end product research and future research. Each category has almost definite pattern on few key points which needs to be taken into consideration prior to implementing corporate strategic plan and corporate operational plans of an organization.

The key points to be considered are research terms, funding amount, Intellectual property (IP) generated, expected output and commercialization potential. These key points are being summarized in the table below.

Table 3. Research categories by factors

<b>Type of research</b>	<b>Basic/Elementary</b>	<b>Applied</b>	<b>Product Refinement</b>	<b>Future</b>
Research term	Long/Middle	Middle/Short	Short	Long
Fund allocation	Definite	Moderate	Small	Infinite
Expected output	No	Moderate	Definite	Low
Potential IP generation	Low	Intermediate/High	Intermediate	Low
Commercialization potential	No	Intermediate/High	High	Low

By fully awakening and understanding said rule of thumb, an organization may construct the R&D policy to further portray the intentional output or outcomes.

***Philosophy 2: Setting Appropriate Corporate Key Performance Index (KPI) relates to R&D – Commercialization***

Another point to ponder prior to establishing comprehensive policies is to understand the interface throughout the ideation stage to commercialization and setting up the right KPI(s). KPI is the yardstick to measure an organization's success and/or failure on particular activity in which it is engaged to, and for this case "transfer of technology". Bear in mind that the KPIs to be set shall follow the "**SMART** rule", whereby the KPIs must be Specific, Measurable, Achievable, Realistic and Time related.

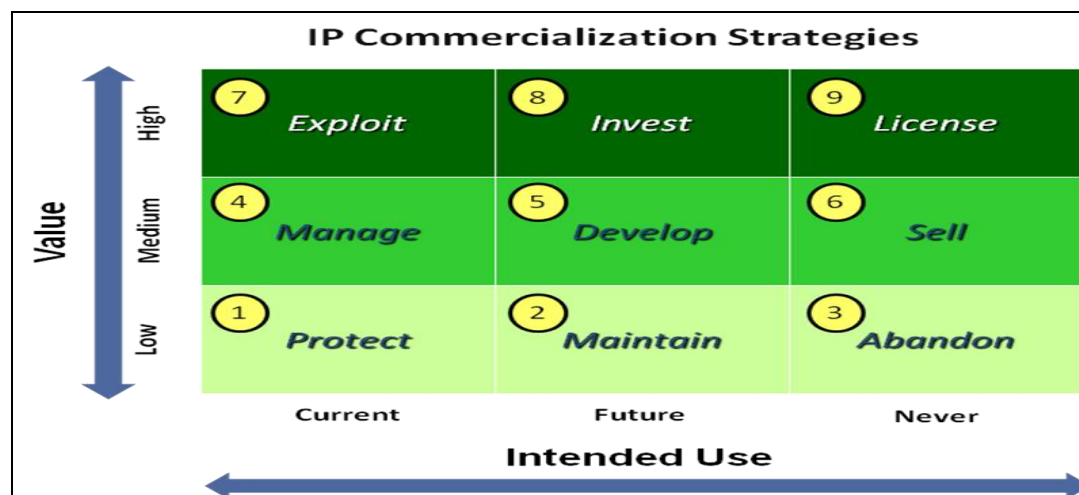
For instance, in setting up KPI for technology transfer, elements to be considered are number of publications produced, number of IPs generated, number of technologies commercialized, number of technologies used as public goods, monetary gains by commercialization activities, number of Spin-off Companies created, number of jobs created and so on. As for the sake of discussion, let's consider setting up KPIs for IPs. There are few ways to measure an organization's IP, among them are number of technology disclosures, number of IP filing, number of IP granted and/or number of IP commercialized. Please bear in mind that, along the way, the number substantially decreases due to the fact that the requirements become more stringent/ difficult. For example, not all technology generated/ declared apply IP, and not all IP filed are granted, further commercialized technologies are not solely dependent on how strong its IP, but relatively contributing factors to that. Thus in setting up the said KPI, the organization should understand the gist output or result its anticipating thus it may plan the activities, resources and strategies towards achieving the said KPI(s).

***Philosophy 3: IP Commercialization Strategy***

An organization shall assess the feasibility of each commercialization initiatives by identifying commercialization strategies based on R&D focus or orientation and IP values. Table below summarizes the rule of thumb of IP commercialization strategies which is to be served as a guideline for the organization's IP commercialization decision making.



Table 4. Summary of IP Commercialization Strategy



By having full understanding and enlightenment by said philosophies, an organization may publish comprehensive policies and/or guidelines and/or SOP manual that relates to R&D activities, IP management and even commercialization strategies. These should include proper R&D planning on staffing, budgetary, resources and so on. In terms of percentage allocation/ directions, it is subjected to policy decision on the focus of research categories.

### The Mechanism

In order to foster technology commercialization in an organization, having comprehensive policies alone is useless. Yes, said organization may have strong R&D manpower and advanced R&D facilities however with the absence of respective so called ‘mechanism’ to properly manage such activities, the output tend to be pointless or not commercialized. The mechanism or portfolio may be named “Commercialization Innovation Center”, “Technology Management Center”, “Research Innovation Office”, “Technology Transfer Office” and so on and it doesn’t matter. The most important elements there are the competencies of the staff and the ‘Term of References (TOR)’ of said portfolio which is inclusive of the responsibilities, functions, strategies and operations wise of said portfolio.

The said portfolio shall have competent staff and adequate manpower in combination of several set of knowledge, expertise and skills. The staff shall be a mixture of people from various soft-skills and background of technologists (from various field of agricultural technologies), IP Specialists, Marketers, Business Analysts, Technoprenour Personnel and Legal Advisors whereby eventually said team to be set as strong commercial negotiation team.

The essence of having the portfolio is to provide the competent manpower, the physical location, the clear policies, guidelines and process flow with the aid of the suitable or best functions or TOR. Thus, strong manpower alone is insufficient. To ensure the success of commercializing technologies, said portfolio must be supplemented with the right operational strategies which would translate into best operational strategies and approaches. Whereby said strategies or approaches are derived initially from the policies and guidelines. To ensure the

success, the TOR or the function of the mechanism, shall include the function and capabilities to provide vital information to the researchers regarding the earliest of the ideation and project proposal stage which is inclusive of the information of industries demand/needs, market feasibility and visibility, project viability inclusive novelty review, proof of concept (POC) review and financial viability.

In other words, to summarize the portfolio function or TOR, it must play the role as “business intelligent”, “technical intelligent” and “to provide guided or oriented R&D” management. Point to ponder here is there must be a synergistic among the R&D – Commercialization policies and guidelines, operational strategies and competent staffing and sufficient manpower. These synergetic bonding may transform the overall activities into efficient and high output (success of commercialization). And these elements will be the main elements to determine the success or failure of technology transfer of an organization.

### **Tips and Tricks Along Technology Management Phase**

Another crucial element to ponder for nurturing technology commercialization is the art of technology management itself. For the sake of discussion, here we have categorized the Technology Management Phase into three stages, Technology Generation Phase, IP Management Phase and Commercialization Management Phase. This paper will document and layout tips and tricks involve in each phase based on the knowledge and experiences gained and compiled by the main writer.

#### ***Technology Generation Phase***

Technology Generation Phase is from ideation stage, writing up the project proposal and along the way, the project implementation to project completion. In this phase, confidential information management is vital. Few tips and points to ponder by technology generators are management of confidential information. Among the techniques to manage confidentiality of information are: first and foremost is keeping secrecy, which means there shouldn't be any publication, paper or oral presentation that relates to the gist of the technology. Publication here may refer to any scientific media or even social media.

Second to segregate the *know-how* within the team members, here, the project leader shall within his/ her means control the dissemination of information even among the team members. In other words, nobody shall know everything towards the invention (especially if involve formulation) except the project leader.

Third, it is crucial and essential to maintain proper records and log books. This is evident in any case of dispute resolution. In view of technology development, one shall appoint separate vendors or fabricators as to ensure no single vendor or fabricator will get the whole concept idea of the said technology or product. Furthermore, apply Non Disclosure Agreement (NDA) to third parties i.e. vendors, fabricators prior to engagement of services. Seek management endorsement the soonest, once the invention is made available. This to ensure that said invention to be managed properly on its intellectual property protection and its commercialization.

Another important point to ponder here is the importance to “name the inventors” and their percentage of contribution towards the generation of said invention or technology during the technology declaration for top management endorsement. This is essential to ensure that the rightful persons benefit or enjoy the benefit sharing if said technology is commercialized in the future.

### ***Technology Completion Phase***

Upon technology generation, the technology generator shall seek management endorsement the soonest. This to ensure that the said invention is to be managed properly of its intellectual property protection and its commercialization. During this phase, an organization shall have relevant portfolio and capacity to envisage the potential of the generated technology in view of its IPR and commercialization thus may adapt suitable strategy for protection and commercialization. For example, if the said technology relates to a pesticide formulation, patent definitely is not the best IPR protection mode. The best IPR mode is trade secret. Further strategy for commercialization is either outright sale (if the entity doesn't have any further interest on said technology development) or contract manufacturing (OEM) and distributorship approach. Licensing approach is close to impossible due to the fact that there is no way to maintain the *know-how* or trade secret by the entity during the commercialization which eventually leads to either failure on licensing period or not to be continued.

Another important point is pertaining strong insights of Patent Act 1983 (MyIPO, 2006) and the overall patent system. This is important for invention or technology that relates to patent or utility innovation protection. Here, subject or matters pertaining to grace period of technology disclosure, date of filing for local and/or international application, root of international protection either via *Paris Convention* or PCT, concept of patent protection itself, related office procedural and fees and so on. All these matters are important to strategize on when, where and what to file and protect. For better understanding, please refer to PCT Application Procedure (<http://www.myipo.gov.my/pct-carta>) below:

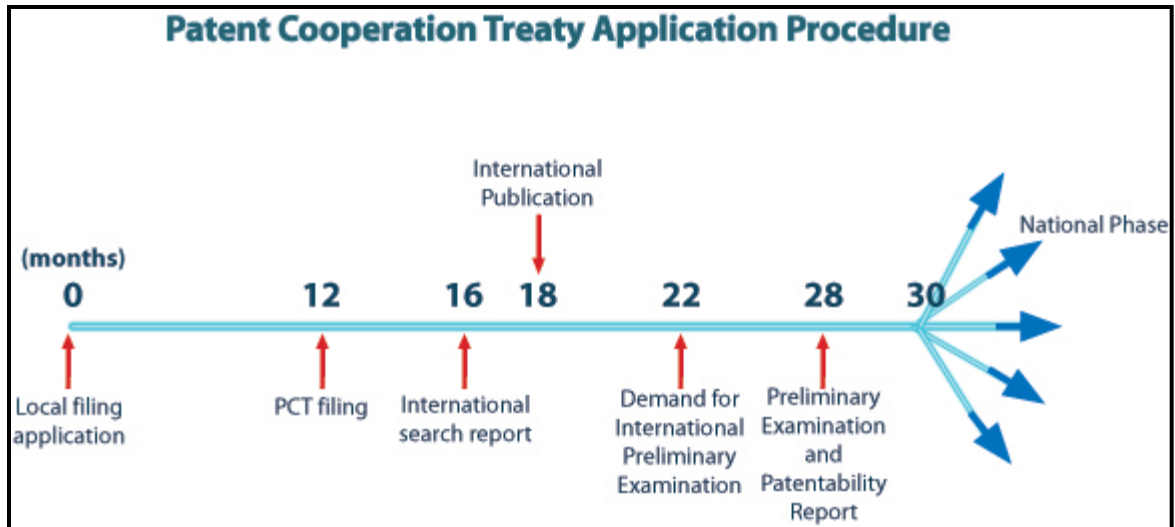


Fig. 4. PCT Application Procedure. Source: MyIPO

By understanding the Malaysian Patent System, *Paris Convention* and PCT application procedure, one can decide either, to keep as trade secret first until there is potential commercializer or technology takers, or directly make protection either to local only or to local and other respected countries or through PCT. This strategy is important and best suits well when IPR protection budgetary is limited.

### ***Technology Commercialization Phase***

For the sake of discussion, Technology Commercialization Phase itself is divided into three components namely Prior Commercialization Stage, Discussion and Negotiation Stage and Commercial Agreement Sealed Stage.

It is important to value and package the said invention or technology prior to Commercialization Stage. This exercise will be able to estimate the real value of market potential, feasibility, and recommendations of the best mode of commercialization. Furthermore, it will help during the Discussion and Negotiation Stage whereby Technology Value and Royalty (if any) may be known beforehand thus to be the basis of commercialization discussions and negotiations.

During the stage of Discussion and Negotiation, another point to ponder is the importance of application for NDA and confidentiality information management. It is best not to disclose everything about the gist of the technology until the commercialization agreement is signed (of course it depends on the type of technology transferred and mode of commercialization). Furthermore, there is no such dogma about having specific time interval for negotiation period. However, sensible period should be taken into consideration. Be wise to focus on IPR protected invention or technology for discussion and negotiation or else the technology potentially faced negotiation turndown, infringement and waste of time. It is also important to perform due

diligence of the potential commercializer prior to having serious discussions on technology commercialization.

Upon signing the commercial agreement or Commercial Agreement Sealed Stage, a few elements to look upon first and foremost are technical support during the early stage of commercialization. potential to refine the invention, potential to extend the IPR protection, responding and taking action toward potential infringer, clear benefit sharing and schedule for collection of said benefit sharing.

### **Commercialization Strategies**

According to Joshua and Scott, 2003, effective commercialization strategies seem to differ due to many factors, i.e. industrial sectors, nature of the company, technology, and governance policy, national or state policy and so on. For example, in the early 1980s computer industry, Sun Microsystems' commercialization strategy involved direct entry into the workstation market. Sun's entry was mostly discounted by established firms such as Digital, IBM, and Apollo Systems. However due to wise move on technological, organizational, and market-positioning choices, Sun emerged as a leading computer hardware firm by building a novel value chain for high-end computer purchasers (Baldwin and Clark, 1997). On the other hand, many technology entrepreneurs success are inspired by integrating their innovations into a close cooperation with strong industry players. For example in the interconnection technology segment, the profits earned by companies such as American Internet Corporation and Growth Networks are the result of an alliance strategy (and ultimately an acquisition) by the industry market leader, Cisco Systems. In the case of the 20-month-old closely-held Growth Networks, the US\$ 355 million acquisition in 1999 secured a return for Growth Networks' stakeholders valued at over *US\$ 5 million per employee (New York Times, 2000)*.

There are vast commercialization strategies and approaches. The list will be long winding and it can be a topic of a paper by itself. Nevertheless, commercialization strategies are among the most important elements to be desirously looked upon in order to ensure the success or failure of technology commercialization. This is regardless of any cluster either agriculture, transportation, ICT and so on. Therefore it is quite essential to highlight and at least briefly discuss the said element.

As being described above, it is imperative to comprehend a few philosophies related to invention, innovation and commercialization and adaption said philosophies into governance policies and further translate into proper strategies. Said organization commercialization policies and strategies should be in line and complement each other to assure synergistic action could be taken towards fostering commercialization. For example we refer to table 1: Research categories by factors and table 2: Summary of IP commercialization strategies and their correlation. For instance, in case of product refinement research cluster, the said product or technology to be generated upon is of high interest to the technology generator's organization, furthermore, the value is anticipated to be high. Therefore the best approach by the organization is to invest toward the technology or product development project. This could be done by persuasively convincing the second party (the company that demands the said technology) to embark into a collaborative research rather than a contract research. There are a few advantages gained by the

organization (the technology generator's organization) by having said approach such as its project development fund may be reduced (shares), higher chance of technology take off or take over (by the technology demanded organization) and the potential to enjoy the benefit sharing (being commercialized or continue utilized due to the reason that the IP is at least co-owned by both organizations).

As another example, as it is a known marketing concept of Product Push Market and Demand Pull Market. However, one needs to fully understand the philosophy behind both concepts. A research organization needs to take into consideration one of these two concept on generating technology/ invention thus applying the correct strategies to ensure the success of technology commercialization. For instance, in a scenario whereby a research organization look towards fast investment return with low initial financial commitment, she shall embark into a policy of developing demand pull invention or technology as her main R&D policy. And when we scrutinize and analyze further, it's referring more towards product refinement project cluster. Thus to ensure the success of this approach, said organization shall build strong industry networking with relevant key players and developing technology – company portfolio databases is essential. The key personnel here should realize that project development stage here are driven by the input from the industries and what their needs are. To leverage on that, the said organization shall have strong downstream scientist and engineers to ensure the success of technology generations. On the other side, for Product Push Market or approach, different focus shall be adhered to by the organization. The research organization shall anticipate and allocate certain amount of funds for conducting massive promotion and marketing penetration activities. Yet these are to be assigned far before enjoying the fruits of technology commercialization.

Among the famous commercialization strategy or approach are Licensing vs. Distributorship n OEM vs Outright sale. Furthermore, for licensing, there is an exclusive license approach, non-exclusive license approach and territorial licenses. One has to understand these concepts prior to engaging with and offering to the potential commercializer. Few other commercialization strategies that can be adapted are butter trade strategy or tie in concept. Butter trade approach is more toward a win-win situation of two separate organizations by leveraging self IP to each other to enable both parties to move on in commercializing each specific technology where initially, the said specific technologies are deterred due to the dependability of other party's IP. Whereby tie-in concept or approach more likely to force a party to either buy or license a technology or IP to enable him/her to move on due to the fact of initial unauthorized utilization of said IP or technology.

## **CONCLUSION**

In conclusion, there is no single strategy or approach or best mode to foster technology commercialization. However by understanding in depth certain elements as those highlighted and discussed above, this may contribute towards furnishing relevant policies for a research organization, drawing significant strategy inclusive from ideation toward commercialization stage and further, driving synergetic operation and decision on managing R&D&C. All of these can truly foster technology commercialization.

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