

Current Achievements and Challenges in Commercializing Technology

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ABSTRACT

Currently the world's agriculture industry has changed quickly to become a commercialized entity caused by rapid growth of the world economy, market liberalization, rapid urbanization process and the increase in food demands. There are many ways to commercialize technologies to ensure that it can produce the expected output in a business environment. To date, MARDI's Technology Commercialization Office managed to collect profits through licensing payouts, royalties, management fees and consultation services involving commercial companies or alliances. The business challenges in introducing new technology can be recognized, to conduct a good practice to effectively transfer (commercialize) new invention to the target group and approaching new methods of commercialization and to re-brand Technology Commercialization Office (TC).

Keywords: Agriculture industry, Commercialization, Market liberalization, Licensing payouts, Royalty, Management fees, Company or Alliances, Businesses' challenges, Technology Commercialization Office (TC)

INTRODUCTION

Agriculture today is not only about farming- it's a business, but recently the world's agriculture industry has changed quickly to become a commercialized entity. This inevitable phenomenon is due to a number of factors such as the rapid growth of the world economy, market liberalization, rapid urbanization and rapid increase in demand for food. Today's global economy, business competitiveness is not only dependent on production efficiency, but also product quality, safety, pricing as well as biodiversity preservation. It is well acknowledged that to achieve these standards, it requires the uptake of modern technologies. In line with the economic growth, there are staggered outbound movements in relation to the food-crop output to a production system that is more oriented to market diversity or commercialized production system. The research institutions view the commercialization process as in need of a paradigm change in terms of setting up of the agriculture research priorities and methodologies in transferring new technologies to the target groups. Now, new technologies are transferred and commercialized

through licensing, outright sale, negotiations, contract manufacturing through Original Equipment Manufacture (OEM), and leasing mechanisms.

The most important aspects of new technology commercialization is to ensure that it can produce the expected output in a business environment. Ensuring this, all new technologies have to be evaluated, upscaled, thoroughly tested and packaged before they are offered for sale. As to date, MARDI's Technology Commercialization Office managed to commercialize 94 technologies that contribute income of around RM 8.0 million in the form of licensing payouts, royalties, management fees and consultation services. These technology commercialization activities involve 84 commercial companies or alliances that play a crucial role in bringing the technologies to the market and competing with in line or existing products. It is estimated that from this commercialization activity, it can generate RM 341.07 million yearly with the value of involved technologies are RM 50.217 million (*MARDI's Commercialization Report until July 2016*) with more than 90% of the technology are commercialized through licensing. This reflects that technology commercialization is a very big agenda for MARDI in particular and for the country in general in ensuring the country's economy can be generated and blooming in line with the government urges to elevate technology commercialization through the Malaysia Commercialization Year (MCY) Program 2016.

National commercialization statistics show that only 5-7% of the technologies are successfully commercialized from the total number of technologies produced. While at the international level only 5-8% of technologies are successfully commercialized (MOSTI 2012). On the other hand, MARDI successfully commercialized 14% of technologies generated throughout RMK-10 which is one fold higher than the country's average. This process goes through a very difficult process and challenges. It is known that the future challenge in agriculture technology commercialization lies in the aspects of good business and best conduct in transferring new invention in community economy. The business' challenge in introducing new technology to the market in the agriculture industry has changed whereby it is not enough to only produce new invention and hope to sell it through an aggressive marketing campaign. Businesses' challenges that have been recognized in new agriculture technology commercialization are the values it creates, customer's acceptance, access to capital market and intellectual property protections. Among other future challenges are, to conduct a good practice to effectively transfer (commercialize) new inventions to the target group. New methods involving profit sharing agreement, joint-venture and to create a spin-off company. In ensuring the commercialization agenda is executed while facing the challenges in commercialization activities, Business Unit (BU) has been re-branded to Technology Commercialization Office (TCO) to execute MARDI's technology commercialization in an effective and efficient way. Thus the challenge ahead for a public research institution like MARDI is to continue producing and transferring technologies that are required by the agriculture sector so as to be able to further improve the competitiveness of the agriculture business in Malaysia. The major transformation for MARDI to undergo in order to fulfil this mission is to emphasize more on the generation of "demand-pull" technology and transferring of technology through marketing and sales.

TECHNOLOGY GENERATION

Technological development is guided by two forces, namely “demand-pull” and “supply-push”. The first is “demand-pull”, where the needs of the marketplace, create the demand for a technology. The second force is “supply-push”. Here the impetus for development comes from scientist itself who generate new and valuable technology which can then be introduced into the marketplace. Nevertheless, both forces can produce useful technologies provided the technology generation process (system) is well in place and effectively managed.

The MARDI’s technology generation process is closely modeled on the Stage-Gate Model developed by Robert G. Cooper in 1986. The Stage-Gate Model sees technology innovation as a clearly defined process. According to Cooper (1986), the model’s objective is to increase the quality of product/technology innovation by focusing on the process rather than the product. By dividing the technology generation process into sequential phases, overview can be maintained and when necessary, corrected. The result is that inventions get into the market as quickly as possible by eliminating unnecessary activities. Managing issues at the early stage maximize the chances that an invention becomes a commercial success.

The MARDI’s technology generation model in the broad sense involved two (2) distinct organizational entities, namely the research and technology transfer wings. The research wing or centers carry out the task of generating new technologies or inventions whereas the technology transfer wing mainly deals with technology transfer activities which includes sales and services of packaged technology. In MARDI’s technology generation model, the innovation process is sub-divided into six (6) stages where work is performed by various multidisciplinary teams (Table 1). The gates in this case are actually the evaluation and monitoring exercises within the stages to evaluate and monitor the progress of the inventions/innovation process.

Table 1. The MARDI's sequential model for technology generation and commercialization

Stage	Activity	Gate	Outcome
Idea Creation	Research ideas of value	Head of Research Program at Research Centers	Research Project Title
Project Proposal	Literature review and complete research project proposal write-up	Technical Expert Committee in the Research Centers	Project Proposal approval for funding
Basic Research & Technology Development	Research Activities	Science-Fund Technical Evaluation Committee Assessment Committee (Research Center)	Proof of concept (POC) / Invention / Novelty / Prototype
Technology Verification & Evaluation	Technology screening and evaluation	TC's Technology Evaluation Committee (IP & Business Analysis) Technology's Evaluation & Enhancement Committee (JPPT)	Recommendation of potential technology / Viability and feasibility
Technology Disclosure / Endorsement	Research findings presentation	MARDI's Corporate Management Committee (JPKM)	Endorsement for IP registration & commercialization evaluation
Technology Packaging and Marketing	Business model and plan development. Business matching and negotiation	Targeted clientele such as GLC, PLC, SMEs', limited and private limited companies.	Pre-commercialization / Licensing, J/V, or OEM, spin-offs companies, profit sharing etc.

TECHNOLOGY ENHANCEMENT AND COMMERCIALIZATION

The most critical aspect about marketing and selling of new technology is getting or ensuring it to produce the expected output (performance) in a business environment. This task has been empowered to the Technology Commercialization Office (TC). TC main functions are to develop MARDI's research findings into value propositions and ultimately to market or commercialize these findings. It is important to note that R&D findings will remain intangible, as long as they are not commercialized. Therefore, TC efforts are mainly directed towards commercialization of MARDI's research findings.

In order to carry out TC task effectively, TC categorized the Technology Commercialization Office (TC) activities in four (4) main thrust areas namely;

- i) Business Analysis (BA);
- ii) Intellectual Properties Management (IP);
- iii) Promotion and Marketing of packaged technology; and

iv) Commercialization of packaged technology.

Basically, the first thrust allows the identification of proven technologies either for pre-commercialization or commercialization purposes in the case for incomplete and complete technology, respectively. New technologies declared by the research centres are evaluated for completeness through the Plan Innovation Model (PIM) matrix. In that aspect, TC looks at the technical production or process method, physical and non-physical needs, emotions and economic values, competitive advantage and marketing strategies. When all these conditions are met, then only the financial evaluation will be carried out. The projected cash flow analyses, partial and full budgeting techniques, are some of the methodologies that TC used to evaluate the financial benefits of the new technology. Complete technologies with good economic and financial potentials are then packaged up for sale to interested parties. Along with these, all available information on the market will be compiled and analyzed. Other than that, a suitable value is determined for the technology so that it can be sold to the commercial partners.

The second thrust concentrates on the task of screening and evaluation of Intellectual Properties. Their task is to filter and recognize the technology novelty and patentability, protecting and maintain MARDI's intellectual properties and to exploit the intellectual properties either for commercial or others. Intellectual property protection is very crucial to make sure the generated technology is well protected before it goes through commercialization phase. There are seven (7) types of intellectual property protection that can be applied under certain circumstances such as:

- i. Pattern – the exclusive rights that are given by the government for a new invention either it is a product or a process (up to twenty (20) years from the year it is being filed). It is given when it complies to these characteristics that are novelty, inclusiveness of inventing steps and can be used in any industries.
- ii. Utility renewable – exclusive rights are given to a small inventions that does not need the inventing steps like what is needed to get a pattern (ten (10) years from the year it is being filed and can be extended to five plus five (5+5) years).
- iii. Trademark – marks that are used/suggested to be used to show the relationship between a product or service with the owner/registered user (Section 3-Trademark Act 1976).
- iv. Industrial design – industrial design is the design's characteristics, schematic, pattern or design that is used on a product through any process or industrial means, a character on a finished product, an attractive feature and valued by eyes (Section 3 – Industrial Design Act 1996).
- v. Geographical indicator – indicators that recognized any products of its origin from a country or region, where qualities are determined in its county or place in a country's state, or the reputation of the product's characteristics that basically it is originated from its' geographical states.

- vi. Integrated circuit layout design – a 3-dimensional structure of elements of an integrated circuit and part or all of the relationship of that particular integrated circuit or its' 3 dimension layout that is prepared for that integrated circuit so that it can be produced.
- vii. Copyright – exclusive rights that are given by the law for a period of time to the masterpiece creator to control their masterpiece usage based on the Copyright Act 1987.

The second thrust also concentrates on the task of technology up-scaling, technology incubator system and franchise development. Incomplete technology that needs to be up-scaled are either processed for pre-commercialization funding or further tested in MARDI's technology incubator system. Technologies that successfully “graduated” from this program are then packaged up for sale.

The third thrust deals with marketing and sale of packaged technologies through consulting, leasing and licensing. They also play a role in executing promotional activities and MARDI's technology marketing to strategic partners. It is done through organizing AgroInvest Seminar and AgroInvest Focus, biz-talk, business forum, business matching, exhibition participation and others. Choosing the right commercial partners is crucial to make sure that every commercialized technology can stand and compete in the market with other products. In that matter, an early due diligence with the company or commercial partners must be done right and with accuracy.

Next is the fourth thrust or commercial plays an important role in commercialization activities that includes negotiation process, determining the suitable commercialization mode, bind the agreement documents (MoA), project monitoring process and to develop alliances with industry partners effectively. It is a crucial and critical role in making sure that the final process in commercialization is done efficiently and succeed. In addition, MARDI has nominated five (5) technologies with different commercialization mode for the Malaysia Commercialization Year (MCY) 2016 where these technologies must be fully commercialized from selecting the commercial partners, signing the agreement to the launching before the end of year 2016.

The main thrusts play a very important role in their respective fields to ensure that packaged and commercialized technology is mature, viable and feasible in terms of economy and finance. Without proper actions, maybe certain aspects or elements that should be highlighted by the technology involved will be ignored and results negative impact on real commercial stage with certain commercial partners. Besides the cores indicated, an element that is very important and can not be ignored is the view from a legal perspective, especially, in the early stages of screening and assessment technology and also in the commercial negotiation phase of the project. To enable commercialization activities to be beneficial to commercial partners, the target groups as well as research institutions special agreement should be sealed so that responsibility and obligations are fully implemented by the parties involved. If omitted from a legal perspective, a lot of negative implications can be derived from research institutions in the future.

Every year the government has allocated a big amount of funds for R&D purposes which is increasing every year (Shown in Figure 1). This statistic shows that, the government is serious on

this matter to make sure that the outcome can be applied and solve the problem of the country and be a catalyst for economic growth.

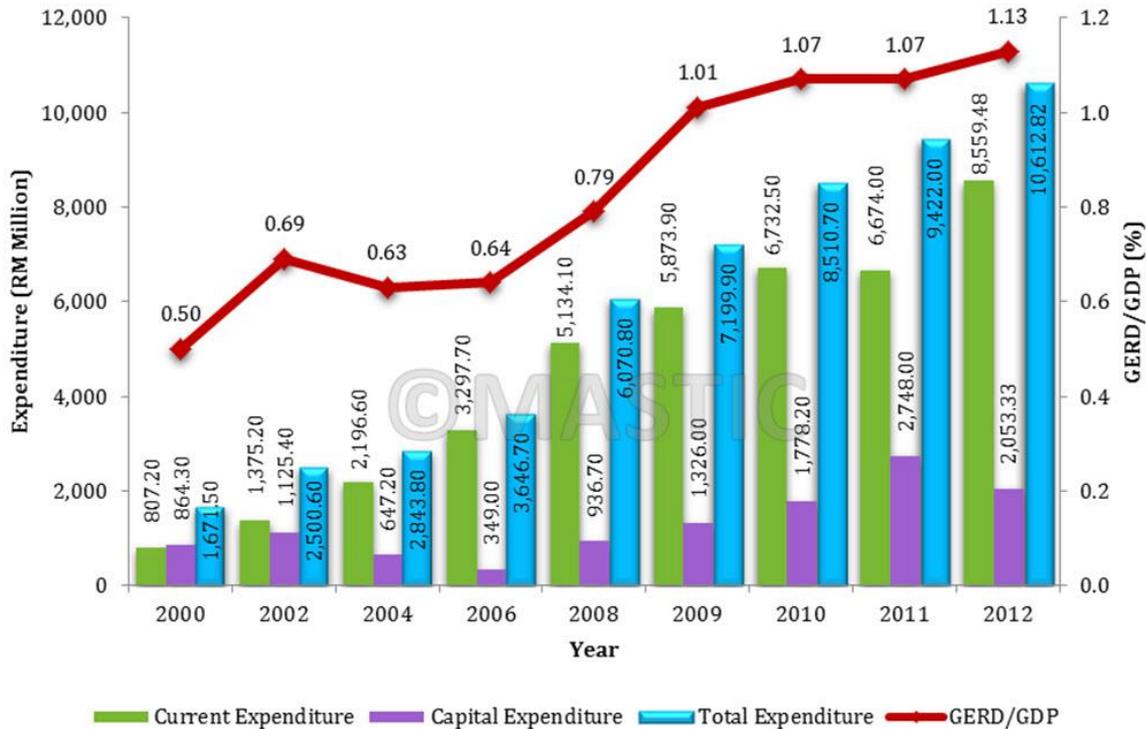


Fig. 1. Expenditure for R&D Activities

FUTURE CHALLENGES IN THE COMMERCIALIZATION OF TECHNOLOGY

New challenges in commercialization are to conduct a good practice to effectively transfer (commercialize) new inventions to the target groups and approaching new methods of commercialization and to re-brand the Technology Commercialization Office (TC).

In implementing MARDI’s technology commercialization activities, there are many challenges that arise and need to be overcome because each commercialized technology has its own features and the approach are varied and unique. This situation requires particular experience and expertise to ensure that each technology can be commercialized effectively to its commercial partners. It has been acknowledged that the future challenges in the commercialization of agriculture technology lie in the business aspect and the best practices (methods) in transferring the new invention into the nation’s economy.

The first challenge is how the business pushes the new agricultural technology to the market since industry are changing – it is no longer adequate to produce new inventions and hope to sell

it through an aggressive marketing campaign. Some of the identified business challenges in the commercialization of new agriculture technology are value creation, customer/consumer acceptance, capital market access and intellectual property protection (Boehlje, 2004). According to Boehlje (2004), the most basic business challenge in introducing any new technology is that of creating value for the customer. In other words, can the customer make profits by adopting this new technology? Getting the customer/consumer acceptance has been one of the key determinants of successful commercialization of new technology in agriculture. It is increasingly recognized that successful implementation of new technology requires systematic attention to be paid to issues of consumer acceptance and trust. New technologies will fail if the communities that use and depend upon them do not fully accept them. There is ample evidence of this in relation to the launch of various technologies. For example, the irradiation of food products (fresh fruits) and the introduction of genetically modified food products sold in supermarkets have been largely restricted by public concerns and outcries about the underlying technologies involved. While many members of the scientific community, commercial interests and legislators have regarded the risks associated with such technological applications as acceptable and have permitted their sale yet the public has not trusted these groups and the products have either failed or struggled in the marketplace. Social demand – as it affects the agricultural sector – does not only reflect consumer preferences in terms of food, but also environmental and health concerns, including the commitment by society as a whole to the wise use of natural resources (water, soil) and biodiversity preservation.

The next challenge is to conduct best practices for technology commercialization and transfer. As we know, technological innovation typically requires large capital outlays, and consequently access to capital/financial markets is critical to the success of discovery and commercialization of new technology (Boehlje, 2004). Usually new technological innovation will involve mechanization and new specialized production equipment that require large capital investments. Even at the pre-commercialization stage, the capital requirement is also substantial. For example the enhanced virgin coconut oil technology that MARDI developed requires about RM 4.0 million in pre-commercialization funding to set-up a pilot plant in Johor Bahru. Besides that, it also covered how the new technology is protected from analogues or copycats through intellectual property right (IPR). The process of acquiring IPR is very tedious and costly. On the other hand protecting intellectual property is increasingly fraught with controversy and difficulty. Intellectual property law is not uniform throughout the world, and in many countries the protections that might apply to new technology in the USA or Europe do not apply in South America or China (Boehlje, 2004).

Other future challenges is to execute the best method of effectively transferring (commercializing) the new invention to the targeted group. Currently, MARDI executes consultancy and licensing approaches as a vehicle for transferring new technology to its customer. Both methods have been proven to be very successful and furthermore quite easy to implement and manage. From a financial viewpoint, both consultancy and licensing only give rather limited financial gain in the short term period. It has been acknowledged that the quality of

the invention, market value, and appropriate mechanisms in these approaches considered as the important factors in shaping the commercialization choice (Dechenaux *et al.*, 2008; Lowe and Ziedonis, 2006, Shane 2000). New methods include production of a product through Original Equipment Manufacturer (OEM), distributing rights, creating profit sharing agreements, joint-ventures and spin-offs companies are considered to be of better choices today because they give more returns financially. According to Bray and Lee (2000), returns from spin-offs companies are 10 times more than the average annual income from traditional license, and is significantly higher than the amount usually received as a technology licensing fee.

Re-brand Technology Commercialization Office (TC) is the most interesting and challenged effort. Branding is the art of aligning what people think about your company with what people actually do think about your company. And vice versa (*Jay Baer- Convince & Convert. Author with Amber Naslund of The Now Revolution*). Commercial Unit has been founded in 1996 to execute technology commercialization activity through joint ventures (JV) and technology licensing. To further enhance the activity, the Business Unit is founded after MARDI's New Act, enacted by the Parliament to intensify the commercialization activity through methods such as licensing, consultancy and outright sale. On the February 5, 2016, the Business Unit has expanded its function as the Technology Commercialization Office (TC). The function and role of TC are widening with the use of the new approach of technology commercialization that are Original Equipment Manufacturer (OEM), appointment of distributor and agent, spin-off company formation and others. These re-branding is important in making sure that the commercialization process can be executed effectively and in the right manner in addition to gaining a higher return to MARDI.

CONCLUSION

The rapid growth of the world economy through market liberalization has slowly transformed the agriculture sector into a more commercialized entity. Commercialization of the agriculture industry has been undoubtedly been supported strongly by the advent of new agricultural technology discoveries. The ways these new technologies are transferred to the customer are also changing in tandem with the commercialization of the agriculture industry - from simple "give-away" to value trading, MARDI is slowly getting into the process of commercializing its technological findings through consultancy and licensing efforts. In order to remain competitive and relevant in the near future, MARDI has to embark into creating more value proposition for its new technological findings and generating more revenues by creating spin-offs and joint-venture companies through these new technological findings.

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