Mechanization R&D – technology generation for sustainable agriculture in Malaysia

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Introduction

Research and development (R&D) is part of the overall process of innovation where an idea is transformed into tangible output that has utility. Most of the developed and advanced countries in the world today owed much of their technological success and economic growth to their relentless efforts in R&D; it does not only generate new technology and product but also help to create wealth and knowledge and stroke the economy of a nation. The same is also true of the world's successful corporations that internalized R&D as part of the business it supports.

Mechanization R&D in national agricultural development

The long term agricultural development in Malaysia is guided, among others, by the National Agricultural Policy (NAP). The current policy, the NAP III, laid the foundation and strategies for a sustainable development of Malaysian agricultural and agro-based industries to meet global competition. It was in this document that specific reference to mechanization technology as an enabler to modernize the local agriculture and agro-based industry to overcome the critical labor shortage and low productivity on a

sustainable basis was highlighted. The policy also identifies the areas of focus and underlined major technological gaps for the industry to be bridged through domestic R&D undertakings, technology prospecting and acquisition, adoption and adaptation.

The recent food and energy crisis and the need to maintain clean environment has changed the face of global competition in world food production, Malaysia is no exception. This is one of the many challenges confronting the industry that call for more vigorous R&D undertakings and supports especially from the government research institutions (GRI's) to generate cost effective and sustainable mechanization technologies. Expectations for R&D in agricultural and food mechanization in the country are higher than at any other time in history.

The amount of R&D investment by any nation or corporation is generally measured as the percentage of R&D expenditure to the gross domestic product (GDP), known as R&D intensity. Malaysian R&D investment in 2002, was about RM2.5 billion or at an R&D intensity of about 0.69% (Anon, 2003), higher than Thailand (0.2%) and the Philippines (0.11%), but in pale comparison with the more developing countries like Korea (2.53%) and Singapore. Many domestic government research institutions (GRI) and institutions of higher learning have benefited from the fund.

In the Malaysian S&T Policy, the targeted intensity by 2010 is about 1.5% (Anon, 2003). The disparity is too big to close if we were to catch up with the developed and even the more developing world, however the gap indicates that prospect for innovation and R&D in the country in the years ahead remains high.

Goal and Challenges of Mechanization R&D

The role of mechanization technology as it was initially introduced many decades ago; to overcome the issues of unavailability, drudgery and low productivity of farm and factory labor, are still the goal and major motivation for most of today's mechanization R&D initiatives.

Over decades, mechanization has made significant contribution to the production of food to most part of the world. It has in fact helped liberates millions of people from the hardship of farm and factory labor for the pursuit of more meaningful endeavors. There

are many outstanding examples to testify the above statement. The development of combine harvester has remarkably changed the landscape of the agricultural production over decades in terms of man hour, cost and time saving per ha. Considered the epitome and a benchmark of a successful R&D endeavor in agricultural mechanization over decades, yet research for more efficient and better functionality and quality harvested produce is still being pursued till this day.

One of the major R&D challenges confronting the industry is the R&D process itself. The institutions must adopt a process that can sustain R&D over time while at the same time meeting the market demand for the technology. Stable and continuous funding is major factor and prerequisite of an effective conduct of R&D. In the whole of 8th 5-year Malaysia Plan, a total of RM19.5 million was spent under the peer reviewed R&D grant provided by the Ministry of Science, Technology and Innovation (MOSTI) on agricultural and food mechanization (Anon, 2008). Although funding is critical, the immediate concerns in the Malaysian GRI's may not be for the lack of it, but more on the rate of technology adoption and commercialization. Technology that is not market oriented and lacks flexibility will forever remains on the shelf.

While R&D has improved the knowledge and technological status, it has also created a myriad of new concerns for GRI's over issues of personal privacy and intellectual property right (IPR). Strategic management of IPR together in a well-conceived infrastructure for commercialization has long term ramification to R&D. The impact of commercialization can be monitored over time by looking at indicators such as the number of RI's engaged in patenting and licensing, the number of companies formed based on the licensing, the value of economic activity generated/year, job created, the number of products in the markets and others.

It is also of vital important to address R&D workforce and educational concerns if long term R&D program is to be sustained. Inability to develop a strong and growing cadre of research scientists and engineers would stifle innovative capacity. The single-investigator research project is basically no longer a good proposition in many research undertakings. Networking and outsourcing of competencies where researchers collaborate across institutional boundaries must now be the rule and not the exception. The creation of well-funded laboratories would also be benefited with this collaboration; where sharing is not just the limited to knowledge but also includes equipment and instrument; coined as collaboratory (Finholt, 2001). There are however, a number of profound policy

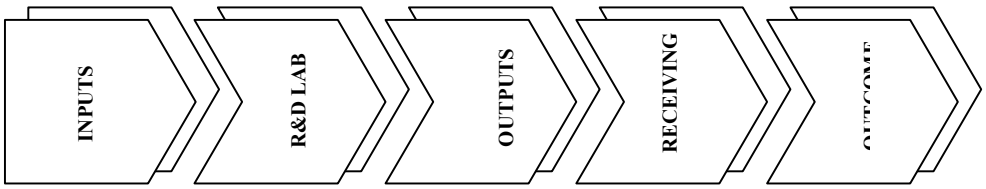
consequences here, particularly, for example, in the area of evaluation and monitoring, publication, sharing of IPR and commercialization. High impact R&D achieved through high caliber and innovative work force is the only guarantee for continuous funding.

R&D Value Chain

The whole value chain of mechanization R&D process flow can assume the form of an industrial R&D process (Figure 1) as described by Norling (2001). As inputs flow into R&D laboratory and moves through the value chain, it transforms ideas into outputs. This is the phase that traditional R&D, which follows with an extension process to the end-user, usually ends.

However, under the current competitive environment, expectation of an R&D calls for commercial considerations along the value chain, as the end game is not measured just as outputs, but on the business potential of the outputs to return the R&D investment. The commercial potential of the outputs should drive them further into outcomes creating new businesses, and new and improved products, processes, operations and services; the phase where very few outputs ever made it through. Failure to do so may be caused by several shortcomings in the manner R&D is conceived, conducted and managed along the value chain including the mode of commercialization.

In designing agricultural and food machinery system, it is of utmost important to consider the characteristics of the users even more important than the technical process requirement as investment in a machine is a critical decision by user; the farmers and processors, who have very limited resources.



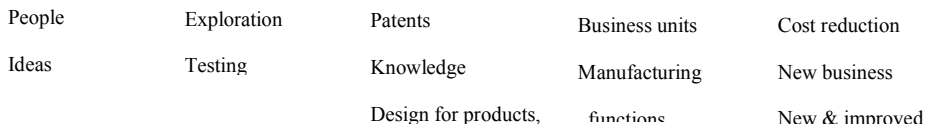


Figure 1. Industrial R&D value chain

The Scope of Mechanization R&D

Agricultural and food mechanization covers wide ranging areas of operations and disciplines and a variety of specialty areas. It no longer serves the traditional area of mechanization that used to be associated with, such as farm power and machinery, soil and water engineering, natural resource, agricultural process engineering, food process, forest engineering, aquaculture engineering, farm structures to name but a few.

During the last five years, GRI's such as the Malaysian Agricultural Research and Development Institute (MARDI) have developed, adapted and commercialized a number of farm and food mechanization technologies. The farm mechanization technologies involved the crop establishment and maintenance operations for crops such as paddy, pineapple, root crops and others.

As new information and technology emerge, new specialty areas in agricultural and food mechanization R&D are also created to fulfill new demand such as the need for higher product quality, timeliness, safety, reliability, ease of operation and low production costs. As for an instance, the advent of ICT, global positioning system (GPS) and geographical information system (GIS) coupled with satellite and other mobile electronic technologies created an opportunity for developing a comprehensive system of agricultural management tool in what is today known as precision farming. The research in precision farming at MARDI is now in the third phase of its study where several technologies are now being tested and verified at commercial scale in the major granary areas in Malaysia; among them are the variable rate technologies namely in seeding,

fertilizer and chemical applications and remote sensing. One of the main drivers of precision farming has been on the aspect of sustainability.

Such a new specialty area as precision farming and others like autonomous vehicle, controlled environment, biosensors, mechatronic, GIS, imagery, ICT, automation, photonic, nanotechnology, traceability etc, and some may overlap with one or more areas, add new dimension to R&D in agricultural mechanization including addressing the sustainability issue in production agriculture.

Conclusion

The disparity in our R&D expenditure is too big to close if we were to catch up with the developed or even the more developing countries, however the gap indicates that prospect for innovation in many areas of R&D in the country in the years ahead remains high. On the other hand, the compelling issue of agriculture sustainability could well be the new impetus to motivate future mechanization R&D. As has been noted, the bigger challenges in our mechanization R&D undertakings are the issues of adoption and commercialization and how the industry or the nation benefits from the investment. But the final analysis is the social value of these activities which can be best reflected by their contribution to the standard of living and the quality of life of the community.

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