Rushdi Abdul RAHIM, Natrah Mohd EMRAN
myForesight® – Malaysia's National Foresight Institute,
Malaysian Industry – Government Group for High Technology, Cyberjaya,
Malaysia

STREAMLINING MALAYSIA'S NATIONAL R&D AREAS

Key words

Prioritised R&D areas, Malaysia's National Science & Research Council (NSRC), foresight methodology, foresight in Malaysia, myForesight® Malaysia's National Foresight Institute.

Abstract

This article provides a brief on the processes and methodologies undertaken in conducting the R&D areas prioritisation in Malaysia. The listed prioritised areas will provide the basis for resource allocation of the country for the next 10 years and beyond. The R&D prioritisation initiative involved intense iterative periods of open reflection, networking, consultation and discussion, leading to the joint refining of future visions, long term goals and the common ownership of the focus areas. There are also dedicated groups that are responsible in monitoring output of each discussion to ensure the coordination, cohesiveness and inclusiveness of the necessaries. Endorsement of the recommendation will be the foundation and guidelines for further work especially in steering future R&D activities in Malaysia.

Introduction

Research and Development (R&D) has long been an essential activity in any developing or developed nation. R&D activities are not only generators of new knowledge especially in Science and Technology (S&T), they are also an essential factor in economic growth.

However, due to the limits in R&D funding, neither government nor industry can afford to invest in every possible field of research. Therefore, there was an urgent need to have a collective alignment of R&D priorities through an effective network of all government research institutes and facilities, as well as energising a dynamic link with all S&T related entities. This is to ensure that a real time monitoring of the impact on sectoral R&D funding can take place to maximise R&D productivity through effective implementation of the government's plan towards a higher income economy.

The Malaysia's National Science & Research Council (NSRC) was established and mandated to ensure that the country's investment in S&T is making the greatest possible contribution to a high-value economy through an increase in productivity, environmental quality, stimulation in R&D and enhancement of the skills of the Malaysian workforce. Thus, the R&D Prioritisation exercise was initiated in 2011 to streamline the national scientific research areas focusing on the local strength and niche. The prioritised areas will provide guidance, especially in R&D funding to achieve an efficient distribution and utilisation of public funds through intensified R&D funding (GERD). Figure 1, depicts the R&D Governance in Malaysia.

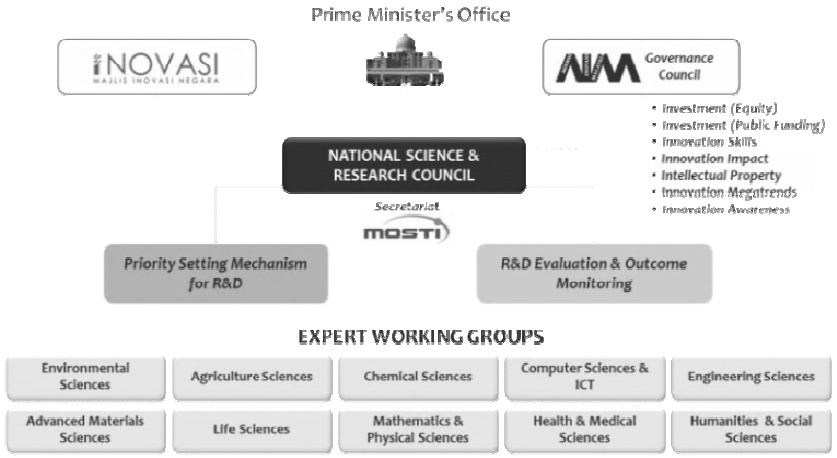

Fig. 1. R&D Governance in Malaysia

1. The fundamentals

1.1. Prerequisites of the initiative

The prioritisation exercise started in early 2011 in response to the 2nd NSRC meeting. A set of prerequisites was outlined by NSRC in undertaking the R&D prioritisation exercise. The prioritisation must satisfy the following:

- The prioritisation process must utilise a well-known or recognised framework and model.
- The selection process of the R&D priority areas must be transparent and without prejudice.
- There must be a diversified engagement of stakeholders, representing trans-disciplinary expertise and interest.
- Consideration must be given to the long term impact and strategies in each of the areas.
- Consideration must be given to the availability or the scarcity of existing resources and competencies.

1.2. Leveraging on current national initiatives

Realising that there are existing works on the identification of focus areas, the subcommittee decided on the exercise to leverage on the existing body of works which covered in both economic and S&T areas (Table 1).

Table 1. Reference to existing national documents and plans

S&T Focus Areas	Economic Focus Areas
i. Mega Science Study ii. National Technology Foresight	i. Industrial Master Plan III (IMP3) ii. National Key Economic Areas (NKEA)

Mega Science Study: The Academy of Sciences Malaysia (ASM) undertook a Mega Science Framework Study for Sustained National Development in 5 pre-identified sectors which include Water, Energy, Health, Agriculture and Biodiversity.

National Technology Foresight: Malaysian Industry Government Group for High Technology (MIGHT) undertook the National Technology Foresight programme focusing on systematically identifying and assessing potential sectors in S&T that is important to Malaysia for the next 10 years [1].

Industrial Master Plan III (IMP3): The IMP3 was developed by the Ministry of International Trade & Industry (MITI) with the objective to achieve long-term global competitiveness through the transformation and innovation of the manufacturing and services sectors.

National Key Economic Areas (NKEA): Twelve (12) NKEAs were identified representing economic sectors that will drive the highest possible income through the collective contribution of high impact projects, policy support and incentives from the government under the Economic Transformation Programme (ETP).

The outcome; Table 2 enlisted area highlighted in previous national documents and grouped in eighteen (18) common sectors:

Table 2. Focus Areas Comparison Matrix

List of areas sector	IMP 3	National Foresight	Mega Science	NKEAs
Advanced Manufacturing	☑ Machinery & Equipment	☑		
Agriculture & Food Security	☑ Halal & Food processing	☑ Food Security	☑ Agriculture	☑ Agriculture
Biotechnology		☑ *	☑ Biodiversity	
Domestic & National Security		☑ ICT Based		
E & E	☑	☑ Electronics *		☑
Education	☑ Education Services			☑
Energy	☑ Petrochemicals	☑ Future Energy	☑ Energy	☑ Oil, Gas & Energy
ICT		☑ *		☑ Comms. Content & Infrastructure
Material Science	☑ Textile & Apparel, Metals	☑ *		
Medical & Healthcare	☑ Devices & pharmaceuticals	☑	☑ Health	☑
Nanotechnology		☑ *		
Plantation crops	☑ Wood, rubber, oil palm	☑		☑ Palm Oil
Services	☑ Non-Government			☑ Business & Financial
Tourism	☑			☑
Transportation	☑ Equipment & Logistics	☑		☑ Greater KL
Waste Management		☑		
Water Security		☑	☑ Water	
Wholesale & Retail	☑ Distributive trade			☑

1.3. Benchmarking the best practice

In identifying the Malaysia R&D priority areas, the NSRC is aware of the concerns and arguments on how the areas are selected. Concerns were highlighted that in naming the R&D focus areas will give the connotation that other areas are of less importance.

Therefore, the objective was to identify a sufficient wide area focus with the necessary long-term goals, without going into those areas in depth, hence not sacrificing innovations that might arise in those focus areas.

The benchmarking exercise was conducted to look at how other countries are allocating their resources on R&D and scanning the areas of focus in strategizing the development of S&T in selected countries.

The following are amongst the criteria of the benchmarking:

1. Focus areas – Scanning through the focus areas by other countries: This exercise is crucial in enlightening and keeping pace with the cutting-edge and potential areas before prioritisation is executed.

2. GERD – Gross Domestic Expenditure on Research and Development (GERD) is defined as total intramural expenditure on research and development performed on the national territory during a given period. Adequate R&D funding that is commensurate with economic growth and national income is necessary for ensuring sustainable development, especially in S&T.

Through this exercise, Malaysia capabilities and capacity were compared with other countries in looking at how other governments are driving the development of S&T in their respective countries.

The NSRC was also made aware of the European Commission's ERA (European Research Area) which was created to optimise transnational cooperation and coordination of research programmes across Europe. The subcommittee took note of the listing of the R&D priority areas, taking into account on the common research agendas, grand challenges and infrastructures.

Further reference was made to Composite Science and Technology Innovation Index (COSTII): an innovation index developed to determine scientific and technology innovativeness of a nation. It is used by South Korea to determine its science and technology innovation capability in comparison to the Organisation for Economic Co-operation and Development (OECD) countries.

Five composite indicators and thirty-one detailed indicators were used to compare science and technology innovation capabilities between countries. Each indicator was standardised by a rescaling method and a scoreboard was produced to compare the participating countries. Index values of Malaysia and 30 other OECD countries and their rankings were compared to identify the relative positions of each country's S&T innovation capability in order to discover strong and weak points.

However, for this initiative, the focus is only on the activities' indicators, specifically in R&D intensity as per the following table. Taking stock of the result and with our aspiration to become a developed country by 2020, it is clearly seen that Malaysia still lags behind many developed countries and falls below the OECD average.

Table 3. COSTII Activities Index

Item		Indicators
Activities	Investment in R&D	1. Total amount of R&D investment (million USD, PPP) 2. Ratio of total R&D investment per GDP 3. R&D investment per researcher 4. Ration of industrial R&D investment vis-à-vis GDP
	Entrepreneurial Activities	1. Total Entrepreneurial Activity (TEA) (Age group of 18-64) 2. Ration of investment of venture capital vis-à-vis GDP

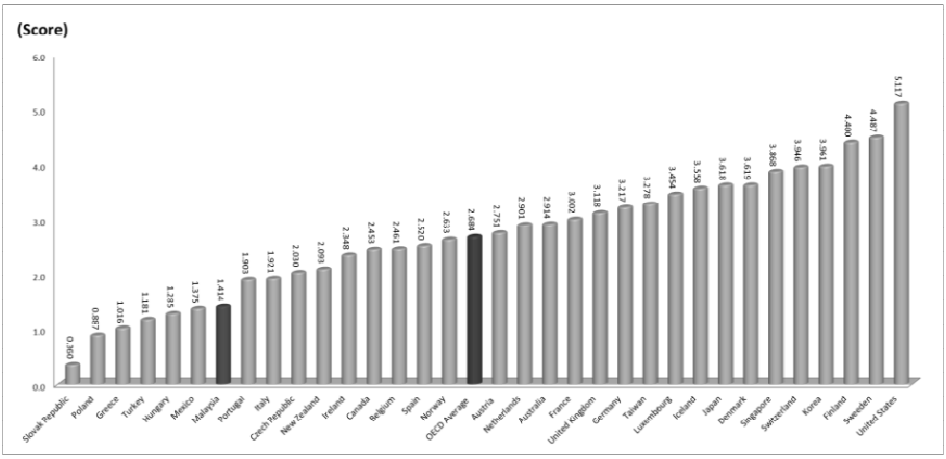

Fig. 2. COSTII Activities Index

The activities composite indicator represents how actively the knowledge creation and utilisation is performed.

Activities are composed of two items and six detailed indicators. Two items are comprised of R&D investment and entrepreneurial activity (Table 3).

As shown in Figure 2; the result of the evaluation of activities ranges from 0 to 7. Malaysia scores 1.414 points and ranks the 27th in the activities dimension, significantly lower than OECD average (2.684 points).

From this exercise, the following was concluded:

- Malaysia still lags behind other developed nations it aspires to be competitive with in terms of R&D spending;
- R&D focus areas of each country differ from each other and are presented in general to provide sufficient scope for focus.

2. Methodology & techniques

The main objective of this initiative is to systematically identify and prioritise R&D areas that will provide the basis for resource allocations of the country for the next 10 years and beyond.

Therefore, the selection and combination of the methods and processes made in undertaking this exercise is in consideration with the resources and timeframe of which the output was required.

Throughout the R&D Prioritisation initiative, a series of discussion sessions were held engaged with groups of experts and relevant stakeholders executing the selected methodologies.

2.1. Debates and deliberations

A series of workshops and meetings were held actively with participation from the Expert Working Groups (EWGs) members, representatives from ministries, and policy makers. They were expected to provide a vision of future possibilities and needs for their topic areas, implicitly or explicitly.

The findings were then consolidated and further reiterated by the EWGs. Upon completion, it was presented to the sub-committee for further comments, refinements and changes if needed.

Following the workshop, a series of meetings chaired by the heads of respective EWGs were organised. Each group then further consolidated, streamlined and enhanced the findings through consultation within the experts groups and the sub-committee, before being presented to the subcommittee.

2.2. Engagement with the experts

The main task of expert panels is to synthesise a variety of inputs, including workshop results, research reports and the outputs of discussions, etc. As for the initiative, a series of meetings, discussions, and conferences were organised in order to streamline their insights.

A combination of methods was employed to select and motivate the panels, assigning tasks during workshop sessions to activate them in the development and sharing of knowledge.

Brainstorming & Impact Uncertainty as well as Cross Impact Analysis are among methods used in the panels' work. Leadership and conflict management skills are required to maintain motivation and morale and to resolve disagreements that may arise during the expert panel sessions.

2.3. Selection of prioritised areas

Upon consultation with the EWGs, there were criteria sets in the selection of R&D areas, based on its attractiveness and feasibility. The attractiveness of criteria is based on its socio-economic benefits, whereas feasibility takes into account Malaysia's ability to undertake research in those areas.

Table 4 categorises the criteria used as guidelines in selecting the R&D areas.

The main objective of this exercise is to reduce the *initial* list of technologies considered to a list of *critical* technologies that are the most relevant against the set of applied criteria. However, since prioritisation may discard a substantial number of technologies that had been considered so far, there can suddenly be "the winners" and "the losers."

Figure 3 below shows the prioritisation plot and its level of emphasis. Points in the upper right-hand corner are strong candidates for "critical R&D areas," while the points in the lower left-hand corner correspond to less

attractive R&D areas with low feasibility in the considered environment. Special attention should be given to the point in the upper left-hand corner – a technology of very high attractiveness but very low feasibility. If such an area is highly attractive and important, then the group of experts considers it as a good candidate for prioritisation and recommends supportive measures that would increase the feasibility.

Table 4. Set of Criteria for Prioritisation

Attractiveness	Feasibility
1. Alignment to national priorities 2. Economic & industrial impact 3. Knowledge generation 4. Social & societal impact 5. National competitiveness 6. Novelty	1. Application potential & diffusion 2. Cost effectiveness 3. Material & infrastructure 4. People & competencies 5. Technology readiness & maturity 6. Time horizon of impact

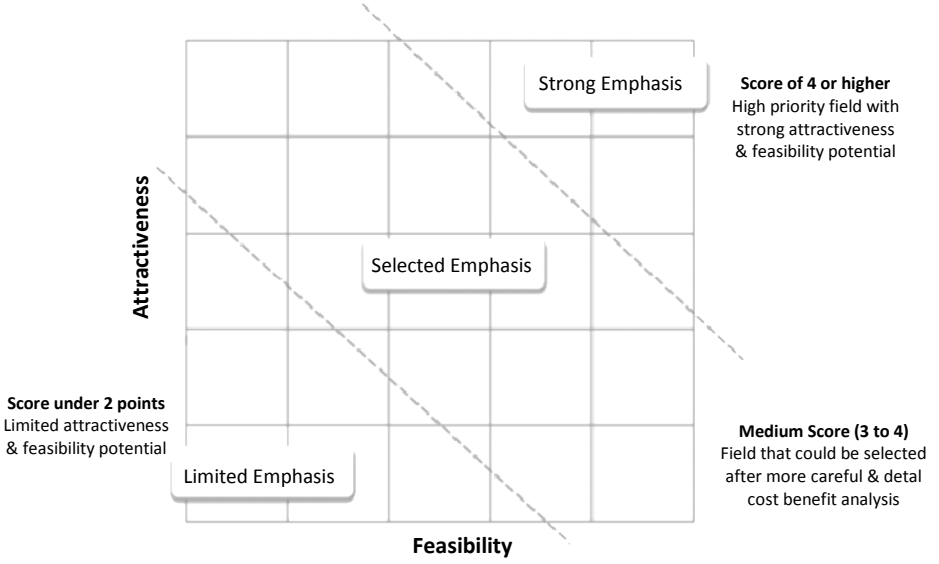

Fig. 3. Plotting of Technology Prioritisation

2.4. References to sectoral strategy

The exercise also significantly relies on the qualitative assessment and experience of the experts and participants of the initiative. However, in any means possible, the taskforce also refers to existing known sectoral and

development roadmaps as well as future oriented policies that are already in place.

This reference is communicated and shared during taskforce, expert panel, and subcommittee sessions, so that informed discussions can be made.

3. Processing the information

The R&D prioritisation initiative is a process which involves intense iterative periods of open reflection, networking, consultation and discussion, leading to the joint refining of future visions, long term goals, and the common ownership of the focus areas.

There is a hierarchy of information filters bringing all of the ideas and knowledge together, assigning values and analysing each one of them in order to have an exhaustive list of R&D areas. Levels are formed of committees and sub-committees, and a top-down approach is used for inputs congregated in a lower hierarchy to be presented to the higher groups in the hierarchy.

3.1. EWGs consultation

Before embarking on the initiative, it is important to take stock and scan the external environment. Therefore, leveraging on the EWGs respective scope and continuous consultations through a series of discourses, the R&D areas can be prioritised.

During the consultation sessions, members are responsible for providing quality inputs to the taskforce based on their debates and analysis of synthesised sources of knowledge, including survey results, research reports, and the outputs of forecasting methods, etc.

Initially, more than 500 research areas were registered during the R&D Prioritisation Workshop before it was grouped and synchronised.

3.2. Taskforce sessions

Inputs from the EWG's were immediately fed to the taskforce for further discussion and refinement. The taskforce's responsibility is to manage, collate and harmonise the information presented by the EWGs. The taskforce also checks the EWGs output for any discrepancies and clarifications.

The subcommittee members were represented by prominent individuals with a definite capacity in S&T and its development. During the taskforce sessions, the initial 500 research areas proposed by the EWGs were consolidated, filtered, and refined to avoid redundancy and inconsistency. Further consultations were also made with the heads of respective EWGs during these sessions to ensure that the process was exhaustive.

Conclusions

The outcome of the consultations and foresight exercise were the recommended R&D Priority Areas [2].

After numerous consultations and reiterations amongst the subcommittee members, head of the EWGs as well as the taskforce, the National R&D priority areas were clustered into two main components: enablers and issue-related research areas (Fig. 4).

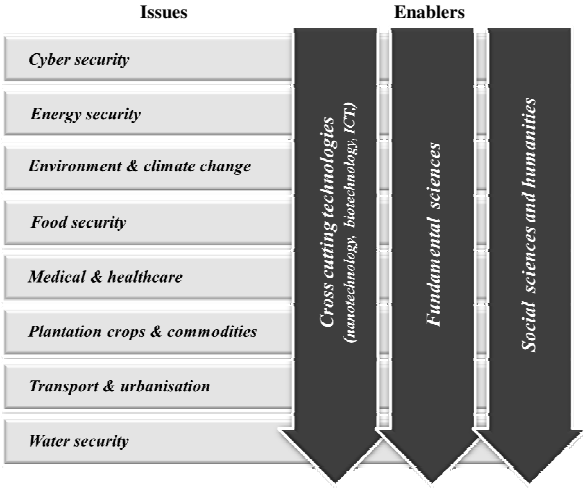

Fig. 4. Main components of areas prioritisation

Enablers can be defined as research that promotes knowledge generation & strengthening the areas of three sub-components:

- Cross cutting & converging technologies (Nanotechnology, biotechnology and ICT),
- Fundamental sciences, and
- Social sciences & humanities.

Issue-based research areas are those that contribute to the general well-being of the nation and the society and address national issues and areas that enable the country to cope with global issues that have direct impact on the country.

Within each of the Issue-related research areas, taking into account their long-term goals, Priority Areas were defined (Table 5).

Due to the exercise, it is expected that areas identified and proposed will provide a clear guideline for streamlining Priority Areas and be the basis for further work for their continuous improvement and refinement.

Table 5. Prioritised R&D areas

Issues	Long term goals	Priority Areas
Cyber Security	• A national autonomous and secure systems to reduce the dependency on foreign for systems of strategic importance	• Information security and autonomous system
Energy Security	• Sustainable energy supply with introduction of new energy resources and reduce dependency on fossil fuel	• Harnessing alternative resources and improving the efficient use of energy especially in the areas of renewable energy
Environment & Climate Change	• Sustainable environment	• Ecosystem management, protection and improvement to mitigate flood, drought & air pollution • Eco-tourism
Food Security	• Reduce dependency of import on staple food and increase the level of self sufficiency	• Improvement of food crops & animal feedstock • Exploitation of biodiversity for novel food/feed • Post harvest physiology & technology
Medical & Healthcare	• Improved health, wellbeing and longevity	• Diagnostic, prevention and treatment to enable the ability to mitigate the burden of lifestyle diseases as well as new and emerging diseases
Plantation Crops & Commodities	• Sustainable plantation crops and commodities sector	• Increasing the productivity and utilization, focusing on Oil Palm, Timber, Rubber & Pepper
Transport & Urbanization	• Reduce dependency of fossil fuel as source of power and enhance energy efficiency • Sustainable urbanization	• Enabling the use of alternative energy sources and energy efficiency vehicles for environmental friendly transport • Design and engineering in vehicles, infrastructure, systems and facilities • Efficient urban waste management (Reuse, recycle & reduce)
Water Security	• Ensuring sustainable water supply & optimizing water usage	• Sustainable sources and processing, treatment & distribution of water

References

1. MIGHT: National Technology Foresight for Ministry of Science, Technology & Innovation (MOSTI). MIGHT 2010.
2. MIGHT: National R&D Prioritisation Report for the National Science and Research Council (NSRC). MIGHT 2012.

Reviewer:
Adam MAZURKIEWICZ

Priorytetyzacja kluczowych obszarów badawczych w Malezji

Słowa kluczowe

Priorytetowe obszary badawcze, Krajowa Rada ds. Nauki i Badań w Malezji (NSRC), metodyka foresightu, foresight w Malezji, myForesight® – Malezyjski Krajowy Instytut ds. Foresightu.

Streszczenie

Artykuł prezentuje procesy i metodykę priorytetyzacji obszarów badawczych kluczowych dla rozwoju Malezji, które w najbliższym dziesięcioleciu otrzymają największe dofinansowanie. Priorytetyzacja obszarów badawczych przeprowadzona została na drodze iteratywnych konsultacji, dyskusji i networkingu, których rezultatem było opracowanie przyszłościowych wizji i długoterminowych celów wspólnych dla całego malezyjskiego społeczeństwa. Proces priorytetyzacji obszarów badawczych był monitorowany i koordynowany przez specjalnie powołane grupy ekspertów, których celem było zapewnienie spójności i integracji potrzeb społecznych. Zatwierdzenie rekomendacji stanowić będzie podstawę i wytyczne do dalszych prac w obszarze ukierunkowywania przyszłych działań badawczo-rozwojowych w Malezji.