

ICT Innovation Strategy in Malaysia Public Research Institutes and Government Agencies

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Abstract—Information and Communication Technology (ICT) play important roles within the rapid growth of innovation environment. The roles include as a change agent, enhancing e-business requirements, promoting globalization and innovation, contributing to productivity growth, strengthening competitiveness, improving business processes along the whole value chain, determining future business strategies and generating profits for business. Previous studies have shown that by adopting ICT, the organization will attain positive impacts of innovation especially in product innovation, process innovation and competitive advantage. This indicates that ICT has significantly contributed towards promoting innovation in the organization. This paper presents the results of the study of ICT innovation in Malaysian Public Research Institute and Government Agencies (IPA). The study focuses on existing ICT strategies that promote innovation in IPA. Data was collected through questionnaires which were distributed to the selected Heads of IT Division in IPA. The findings of the study shows ICT innovation helped IPA in areas of creativity, product development, capacity development and strategic. This research also shows that IPA produced several ICT strategic applications for promoting innovation derived from ICT Strategic Plan (ICTSP). This research will help other research institutes to learn from each other and practice innovation in their organization.

Index Terms— Computer Systems Implementation, Computer Systems Organization, Emerging Technology, Special Purpose and Application Based Systems



1 INTRODUCTION

Importance of all organization to place innovation grows rapidly with the continuous development of ICT technology. Today with android and smart phones, business connected globally and without boundary. ICT also benefit the citizens by providing government services online that saves a lot of time and increase government effectiveness. The growing importance of ICT enhance ICT roles; as a change agents, promotes e-business, promotes globalization, promotes innovation, contribute to productivity growth, strengthen competitiveness, improve business processes along the whole value chain, plays a key role in determining future business strategies and generate profits for business [1][2][3][4]. Previous studies also have shown ICT can promote organization innovation especially in product innovation, process innovation and competitive advantage [5][6][7][3][8].

Malaysia's Prime Minister, Dato' Najib Tun Razak has emphasized the important of all organizations to place innovation and creativity element in research and development process to improve national productivity and

excellence based on the New Economic Model. This is reflected in Malaysia's National Transformation Agenda where one of the focuses is on innovative citizen-centric model of public service delivery. This agenda require changes in the role of ICT to enable effective utilisation and application of information and communications technology (ICT) across multi-faceted service delivery and internal government operations. This is because the next wave of ICT is believe to be focused more on collaborative and co-operative arrangement of open consultation, open data, shared knowledge and expertise, consolidation of shared services and enhanced horizontal application[9].

In general, innovation is a new method or a new material useful and practical aim to bring major changes to the aspect of thinking, products, processes and organizations in order to provide better service and be able to solve the problem with a better way [10][11][12]. Innovation can be categorized into four main areas, namely the field of creativity, product development, process or capability and strategic areas [13]. The following are the objectives of the innovation area:

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- creativity area :The objective is to build creativity and innovation in organizational teams
- product development area :The objective is to create and coordinate synergies across the global community

- process or capability area :The objective is to produce performance metrics and better processes and systems
- strategic area :The objective is to exploiting change to shape and create new markets

Innovation also can be viewed on the aspect of innovation value chain. There are several researches that study on innovation value chain. Hansen and Birkinshaw propose that innovation can be viewed as a value chain which comprises of three phases: idea generation, conversion, and diffusion. Within these, there are six linking tasks which are performed across those phases: internal, external, and cross-unit collaboration; idea selection and development; and spread of developed ideas [14]. Roper et. al suggest that the innovation value chain comprises of three main links. It begins with firms' attempts to assemble the bundle of knowledge necessary for innovation. Then, the next link in the innovation value chain is the transformation of knowledge into physical innovation. The final link in the innovation value chain relates to the exploitation of firms' innovations [15]. Likewise for a consultant, Management Centre believed that the innovation value chain phase can be divided into seven phase; idea generation, integration cross-pollination, information sourcing from external, identify and select ideas, develop ideas, diffusion and finally learning what can be improved [16]. As a conclusion, innovation value chain can be divides into three main phases; first phase-knowledge sourcing activity for idea generation, second phase-transform knowledge into strategic ideas and knowledge diffusion, third phase- implementation and exploitation.

According to Masahudu Gunu, innovation starts with idea generating and brainstorming between the subject experts. An example of how ICT can help in idea generation and problem solving is as ahown in the key innovation systems within P&G, AskMe Enterprise Innovation System[17]. This system is used as a medium to share knowledge within organization and produce innovation in their product and services so that they will become more competitive. Besides this, Mc Nurlin highlights that ICT innovation in Microsoft, Shell Oil and Skandia Futures Centres occurred when they use sense and respond approach [18]. For Microsoft, internet strategy involves in acquisitions and alliances with companies, moves into a ariety of technologies (e.g., handheld operating systems, Xbox gaming platform and service) and diversification in a number of related sectors. While, at Skandia Future Centres developed a 'knowledge cafe' to discuss the future and accelerate innovation. Meanwhile, at Shell Oil, they initiated the concept of action labs, whereby front-line gas station employees could propose strategic projects for their gas stations. As a result, new 'guerrilla leaders' emerged and initiated innovative experiments. This indicates that ICT is being used to the great extend for the company to be the leader in product and service innovation.

Anderson and Markides research provide various of ICT innovation examples in Edward Jones, Progressive Insurance, CEMEX, Enterprise-Rent-A-Car and Smart Inc [3]. They emphasized ICT enables strategic innovation in firms to:

- reach consumers that most competitors cannot serve profitably;
- offer radically new value propositions to consumers that other firms cannot deliver in a cost-efficient way; and
- put in place value chains that no other firm could do efficiently.
- ICT also allows strategic innovators to scale up their business models quickly and so protect themselves from competitive attacks.

The analysis of the ICT Innovation practice examples can be viewed in the Table (1).

Keywords: C=Creativity Area, PD=Product Development Area, PC=Process and Capability Area, S=Strategic Area, SR=reach consumers that most competitors cannot serve profitably, SV=offer radically new value propositions to consumers that other firms cannot deliver in a cost-efficient way, SVC=put in place value chains that no other firm could do efficiently, SI=allows strategic innovators to scale up their business models quickly and so protect themselves from competitive attacks.

TABLE 1
ANALYSIS OF THE ICT INNOVATION PRACTICES EXAMPLES

Product/ Compa- ny Name	ICT Innovation Examples	Innovation Area						
		C	P D	P C	S			
					S R	S V	S V C	S I
Edward Jones [3]	-using hub and spoke satellite system to access real time data and video presenta- tion that enhance communication of HQ and also at rural bro- ker office.				/		/	/
Progres- sive Insur- ance [3]	-by targeting high risk drivers, it installed a proprietary software platform on the laptop of every claims repre- sentative that enables the representative to perform 20 separate transactions while in accident scene.				/			

Product/ Compa- ny Name	ICT Innovation Examples	Innovation Area							
		C	P D	P C	S				
					S R	S V	S V	S I C	
Enter- prise- Rent-A- Car[3]	-Automated Rental Management Systems (ARMS) that enables insurances claim agents log into ARMS and automatically place a rental reservation to the customer. Auto repair shops also can send regular updates on the status of the car repaired to customer and insurance company.				/	/	/		
Smart Inc.[3]	-SMART LOAD create a demand response stocking system for prepaid airtime that has special retailer SIM that enable the retailer to open or close their retail handset via sms and enabled them to sell their service outside a physical location and outside regular store hours.							/	
Cisco Sys- tems[3]	A single online point-of entry for the company's global sales force and support staff to plan, track, develop and measure their skills and knowledge. The intranet system had links to over 400 learning resources, online and leader led training resources, assessment exams, and learning roadmaps for the company's account managers and systems engineers.							/	
EMEX [3]	a new value proposition-total cost to the customer-the cost of cement and other costs that the customer has to incur from the moment of ordering cement till it is delivered to the construction site.							/	

Product/ Company Name	ICT Innovation Examples	C	P D	P C	S				
					S R	S V	S V	S I C	
CEMEX[3]	It deliver just in time cement, enable same day service, free unlimited order changes, 20 minutes scheduled delivery time.							/	
P & G Askme Enterprise [17]	-AskMe Enterprise Innovation System Is a medium to share knowledge within organization and produce innovation in their product and services so that they will become more competitive.	/	/	/					
Microsoft [18]	-acquisitions and alliances with companies -moves into a variety of technologies (e.g., handheld operating systems, Xbox gaming platform and service) -diversification in a number of related sectors.	/	/	/				/	
Skandia Future Centres [18]	-developed a 'knowledge cafe' to discuss the future and accelerate innovation	/	/	/					
IdeaScale [19]	Idea Management Systems	/							
Innovation Central [20]	Idea Management Systems	/							

2 RESEARCH INSTITUTES AND INNOVATION

Research Institutes had been described as an organization that had a creative, innovative, productive, dynamic and continuous environment [21][22][23]. The main role

of research institutes are to plan, administer, and executing research and development [21]. Usually, the research and development effort in research institutes do not have consistent planning. This is because the environment of new technology evolves quickly and dynamically. The organization needs to be alert all the time and must have the capability to capture and exploit the emerging opportunities.

In this new era, research institutes had developed a new role that is to produce radical innovation that can impact the whole industries segment. With the development of ICT technologies, research institutes also had build new group relationship across border. According to Nobelius, research institutes that succeed at commercializing new technology in a rapid and precise manner, will achieve the possibilities of accomplishing a greater market share, produce more revenue and produce dominance design that will leading the organization to much sharper competitive edge[21]. Hence, the use of ICT is to promote innovation in research institutes had been highlighted in German Research Institutes [24].

Nobelius had summarized R&D process into five generations of R&D Process[21] that he had develop and adapted from previous researcher [25][26][27][28]. The strategies of the R&D generation are as following:

- In the **First Generation**(1950s-1960s), R&D **having little or no interaction with the rest of the company or overall strategy.**
- In the **second Generation**(mid-1960s to early 1970s), R&D **strategy driven from the business side**, all under the umbrella of project management and the internal customer concept.
- In the **Third Generation**(mid-1970s to mid-1980s), R&D have **linkages to both business and corporate strategies.**
- In the **Fourth Generation**(early 1980s to mid-1990s), R&D **strategy is to learn from and with customers** . It had moving away from a product focus to a **total concept focus**, where activities are conducted in parallel by cross-functional teams.
- In the **Fifth Generation**(mid-1990s to 2000), R&D strategy focusing on **collaboration within a wider system and are involving competitors, suppliers, distributors, etc.**

Nobelius also discussed about the sixth generation of R&D processes and stated that the sixth generation R&D need to return to the roots, i.e. back to the purpose of the first generations corporate research labs, one pursuing more radical innovation through research in R&D. The main aim is to increase the likelihood of recognizing, joining, and developing breakthroughs affecting whole industry segments [21]. The strategic choices are related, for example, to the R&D intensity of the firm, the industry context, and the business strategies. To deliver these kinds of products, new alliances and cooperation need to be established cross borders and based on functions instead

of technology so that this will increasing the demands on companies combinatory capabilities.

Research institutes in Malaysia can be categorizes to public and private research institutes. Public Research Institutes in Malaysia can be divides to Government Agencies and Public Research Institutes (IPA) and Research Institutes in Institutes of Higher Learning. Roles of IPA are to carry out R&D, technical and consultancy services, provide diagnostic services, business joint-venture and licensing. According to MASTIC, there are 33 Government Agencies and Public Research Institutes [29]. Malaysian Public Research Institute and Government Agencies (IPA) is an organization under the public sector category.

Public Research institutes (IPA) play a critical role in forging the interface between science and industry. Malaysia's IPA perform mainly downstream or applied research in order to be relevant to their target customers or they are focused in undertaking activities that satisfy their departmental remits. Their core research areas range from primary commodities, industry and engineering to national healthcare. The 2008 National Survey of R&D in Malaysia revealed that, in the case of IPA, agricultural sciences dominated the top national R&D expenditure by field of research [30]. Other main areas of research focus include forestry sciences, material sciences, engineering science and biotechnology. Also, most of the research conducted is applied research, rather than basic or experimental development research. IPA account for almost 5% of the nation's total R&D expenditure and about 25% of the country's total number of research personnel [30].

The IPA in Malaysia has different governance structures. There are those that are statutory bodies with a governing board reporting to sectoral ministries, two are cess funded with a governing board responsible to sectoral ministries, and the remainders are departments or institutes of ministries. Most of these institutions have a sectoral focus and the Ministry of Science, Technology and Innovation (MOSTI) has no authority in directing their research agendas. As public sector agencies, the ICTSP development and implementation in IPA must be referred to Administration Modernisation and Management Planning Unit (MAMPU). MAMPU is the monitoring agency that is responsible to monitor the ICTSP implementation in public sector.

As IPA is a research institutes, it should be creative, innovative, and productive and dynamic in nature where the organization is continuously evolve within its environment (See Refs 21-22 for more details). Malaysia had been developing support system to support research and innovation in the country, Malaysia through National Innovation Systems (Research and Innovation Support Department ITIDA) [31]. In this innovation effort, ICT play important roles. In Malaysia, several agencies that focus on using ICT to promote innovation are Technology Park Malaysia (IT), MSC Malaysia National ICT Initiatives, MIMOS and MIGHT.

As innovation growing importance to Global Innovation Index, these study objectives are to identify the innovation importance in Malaysian Public Research Institute and Government Agencies (IPA) and identify existing ICT strategies that promote innovation in IPA. The innovation area that supported by ICT strategic application are also identified.

2 RESEARCH METHODOLOGY

A survey to study the ICT innovation strategy was conducted in 32 Public Research Institutes and Government Agencies (IPA). The source of the IPA list is from Malaysia Science and Technology Information Centre (MASTIC). Out of this, 27 IPA's responded to the questionnaire distributed and returned the forms. The method for this survey is exploratory in nature. One of this survey aims is to find out whether the ICT strategy generated from ICTSP contributed to innovation in the research institutes and what are the ICT strategies that can promote innovation in IPA.

The instrument used in this survey is an open-ended questionnaire. The questionnaire was designed this way to allow the respondents describe and elaborate how ICT is used to promote innovation in the organization. In order to get the information needed, a purposive sampling technique was used. The selection of the Head of ICT Division as the respondent is based on the rationale that the Head of ICT Division is usually the person most knowledgeable about ICT Strategic Planning process that will generate ICT strategies within organization and describe how the ICT strategies contribute to innovation in organization. The questionnaires were distributed to Head of ICT in 32 research institutes.

Data was analyzed using descriptive statistical methods and qualitative analysis techniques. The qualitative analysis techniques used are the constant comparative method and the 'content analysis' method. The findings of the study were sent to the respondent for verification.

4 SURVEY RESULTS AND DISCUSSION

Analysis of this study was based on 27 responses from 32 IPA respondents. The percentage of respondents who gave feedback is 84 percent. Based on literature review, a sufficient amount of feedback was evaluated. The evaluation is based on the type of cases or subjects studied and methods of data collection. The type of subject under study was based on individual or organizational studies unit of analysis. The study of the organization usually has a response rate of less than the study of the individual, where the rate responses 15 percent were accepted to study organizational [32][33]. Because the study organization are usually sent to work, factors such as busy at work, privacy, regulations and organizational policies may cause the rate of questionnaire responses to degraded [34].

As ICT innovation strategy produced from the imple-

mentation of ICT Strategic Planning, the importance of innovation in IPA is study in the point of view of innovation importance in ICT strategic planning. About 74.1 percent of the 27 IPA stated that one of their ICTSP aims is to produce ICTSP e that can promote innovation in organization, refer to Fig. (1). This shows IPA expected the ICT strategies produced from ICTSP can enhance innovation in organization.

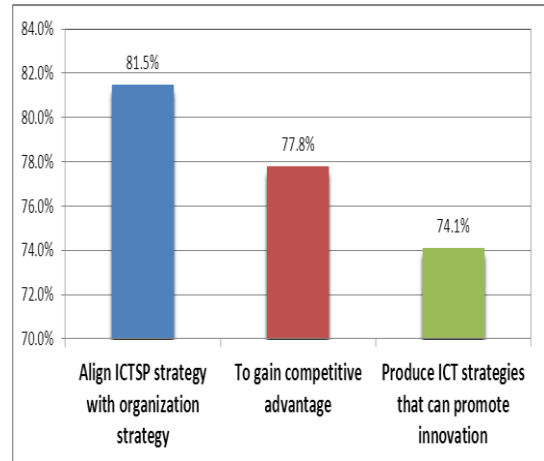


Fig. 1: The aim of ICTSP development in IPA

Based on analysis of four innovations area, ICT strategies is commonly used to promote creativity in innovation (72.4 percent). This followed by using ICT for product development innovation, 48.1 percent and capability development innovation, 40.7 percent. ICT strategies in IPA is least used to promote strategic innovation with only 29.6 percent of IPA, refer Fig. (2).

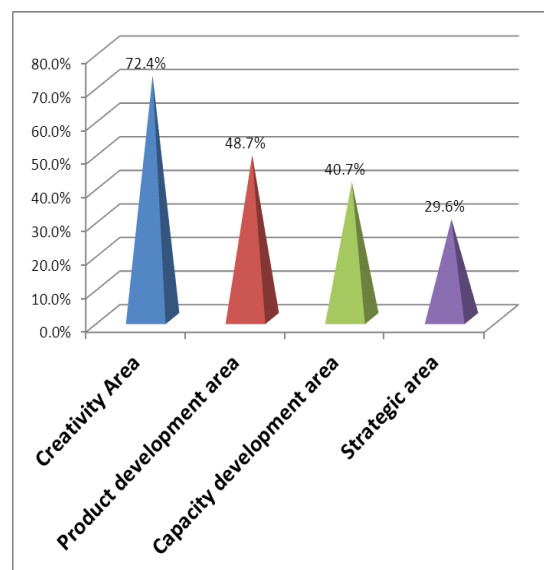


Fig. 2: The usage of ICT strategies to promote innovation area

One of the factors why ICT strategy is used for creativity innovation is because IPA used ICT to generate innovative ideas. ICT strategies are also used for innovation in area of product development. This is because IPA used ICT strategies to produce synergies and collaboration across border in order to generate innovative products. Only 40.7 percent or 11 IPA used ICT strategies to identify main innovation capability. ICT strategies are least used in IPA to achieve competitive advantage. This might be because some of the IPA feels that they have no competitors or because of budget and expertise constraints.

For ICT strategies that are used for promoting innovations initiatives, 40.7 percent or 11 IPA used ICT strategies for offering new opportunities that bring value for customers, *that other organization cannot manage the cost efficiently*. About 40.7 percent or 11 IPA also used ICT strategies to reach the customers sector that is not addressed by most competitors. Only 22.2% or 6 IPA used ICT strategies for allow 'Strategic Innovator' to develop organizational models quickly and protect them from attacks by competitive rivalry. About 22.2 percent or 6 IPA used ICT strategies for promoting innovation by implementing organizational value chain activity that other organization cannot implemented effectively (eg: BPR, change mgmt) , refer Fig. (3).

tomers that other organization cannot manage the cost efficiently. Besides that ICT strategies in IPA also often used to reach customer's sector that is not addressed by most competitors. IPA also places an important focus on customer services efficiency by providing value added services to customers and organization. One of the factors IPA less focus on competitive advantage is because they feel they do not have any competitors. Most IPA who felt that they have competitors compares their technology with research institutes overseas. The factors that might affect the low use of ICT strategy to generate unique value chain might be because of budgets and expertise constraints. The analysis of the ICT Innovation practice in Malaysia IPA can be viewed in Table 2.

Keywords: C=Creativity Area, PD=Product Development Area, PC=Process and Capability Area, S=Strategic Area, SR=reach consumers that most competitors cannot serve profitably, SV=offer radically new value propositions to consumers that other firms cannot deliver in a cost-efficient way, SVC=put in place value chains that no other firm could do efficiently, SI=allows strategic innovators to scale up their business models quickly and so protect themselves from competitive attacks.



Fig. 3: The usage of ICT strategies to promote innovation initiatives

This study shows ICT strategies are more often used for offering new opportunities that bring value to cus-

TABLE 2
ANALYSIS OF THE ICT INNOVATION PRACTICES IN MALAYSIA

IPA area	ICT Innovation Examples	Innovation Area						
		C	P D	P C	S			
					S R	S V	S V C	S I
Agri cul ture	-ASIS-Agriculture Statistic Information System	/					/	
	-PMUMS-Plant Machinery and Ve- hicle Monitoring Systems	/						
	-Corporate Opera- tional Monitoring System	/		/				
	-E-licensing, e- submission, e- registration						/	

IPA area	ICT Innovation Examples	Innovation Area						
		C	P D	P C	S			
					S R	S V	S V C	S I
Technology development	-Web 20.0-Microsoft sharepoint platform InnoX-change product development	/						
	-ICT trend awareness, improve workflow and sharing			/				
	-Patent search	/						
	-Development Management Systems, VOIP Systems, Backup and intranet sharing folder				/			
	-innovation team collaboration and integrated systems		/					
	-Portal GSIAC for group collaboration project with New York Academy of Science members.		/					
	-CRM-customer relationship management system				/			
Veterinar	-DAVETSA system-collect up-to-date data statewide which will form the core of the Veterinary Data-bank (DAVETSA) that enables data mining which assists in better decision-making based on the most current information	/	/	/	/	/	/	/
	-Web Portal	/						

IPA area	ICT Innovation Examples	Innovation Area						
		C	P D	P C	S			
					S R	S V	S V C	S I
Meteorology	-HPC (High Performance Computing) servers is used for generating Numerical Weather Prediction Model that provide data for MMS and WRF model that help to detect unusual weather.	/	/					
	-Application regarding data transmission from station instrument station, from satellite and radar, tsunami and earthquake model generation provide detail and diversified forecasting model and measure incident happened on land and sea.				/	/		
	-source code WAM, Wavewatch III	/						
	-HPC (High Performance Computing) servers is used for generating Numerical Weather Prediction Model that provide data for MMS and WRF model that help to detect unusual weather.	/	/					
	-Ocean General Circulation Mode (MITacm) models	/						
	-Generate map and chart figure from the database that can be customized to customer application for insurance company and police investigation and shipping company cruise planning.				/			

IPA area	ICT Innovation Examples	Innovation Area						
		C	P D	P C	S			
					S R	S V	S V C	S I
Irrigation	-SMART System	/	/	/				
	-Infoportal JPS, Info Banjir,	/	/	/	/	/	/	/
	-ArcGIS Data Center	/						
	- DID1Geo Info System	/	/	/	/	/	/	/
	-Performance Systems	/			/	/	/	/
	-eComplaint for managing customer complaint				/	/	/	/
Environment	-Procurement Online System				/	/	/	/
	-Technology-microprocessor inserted into portable devices	/						
	-EIA Report		/					
	-EHS: Environmentally Hazardous Substances		/					
	-MDMR: Monthly Discharge Monitoring Report		/					
	-ECN: E-Consignment Note		/					
Fisheries	-Automatic food controller	/						

Based on the Table 2 analysis, the ICT strategic applications in IPA mostly promotes creativity innovation. This follow by ICT strategic application produce for product innovation and strategic innovation. More effort should be geared to produce ICT strategic application that can promote process and capability innovation. ICT innovation examples vary from ICT strategic application, portal, innovation practice and strategic innovation

tor lead. This shows that during ICT strategic planning for innovation; this aspect should be look deeper into. The ICT strategic application for strategic innovation mainly focus for reach consumers that most competitors cannot serve profitably and offer radically new value propositions to consumers that other firms cannot deliver in a cost-efficient way. This is because Malaysia Public Research Institutes and Government Agencies focus on innovative-centric model of public service delivery.

5 CONCLUSION

The study shows ICT strategic applications from ICTSP promote innovations in Malaysia Public Research Institutes and Government Agencies. ICT applications generated are used to produce new ideas, form synergy and collaboration for product development, used to identify organization capability, and produce innovation competitive strategies. The efforts geared out by Malaysia Public Research Institutes and Government Agencies are aligned with Malaysia National Transformation Agenda. This agenda focus towards public sector services model that is innovative and citizen-oriented. Malaysian Administration Modernisation and Management Planning Unit (MAMPU) had produced ICT Strategic Planning for Public Sector Agencies (ISP) that place innovation as one of public sector strategic direction. However current ICT Strategic Planning methodology need to be look deeper so that it will promote greater innovation and maximize the impact of innovation in IPA and fulfil Malaysia National Transformation Agenda.

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