Worldwide AI

■ *Thailand, a country of 65 million people, has had an active AI community for almost three decades. With limited research funding (less than 1 percent of GDP), AI researchers have had to maintain a focus on producing concrete results. They have set clear research goals to ensure that smart or intelligent systems are developed and applied to help reduce costs, improve efficiency, and increase productivity in integrated public services.*

The guest editor for this column was Eduard Hovey.

Asanee Kawtrakul, Prasong Praneetpolgrang

A History of AI Research and Development in Thailand: Three Periods, Three Directions

The Pioneering Period: 1988–1999

Artificial intelligence (AI) was first taught in Thailand at government universities more than 30 years ago. Thai-language lecture notes on artificial intelligence (AI) were used in 1975 for teaching an AI course at a university. In 1992 the first AI laboratory was established at the Department of Computer Engineering, Kasetsart University. Research on Thai language processing and expert systems was then concentrated on at the laboratory. King Mongkut's University of Technology Thonburi also set up its own AI center — as a loosely affiliated group.

Yuen Poovarawan was the pioneer in computer language processing of the Thai language. Since 1990 he has produced a wide range of well-recognized pieces of work, including a Thai text editor, a Thai thesaurus, e-dictionary, a morphological analysis tool,

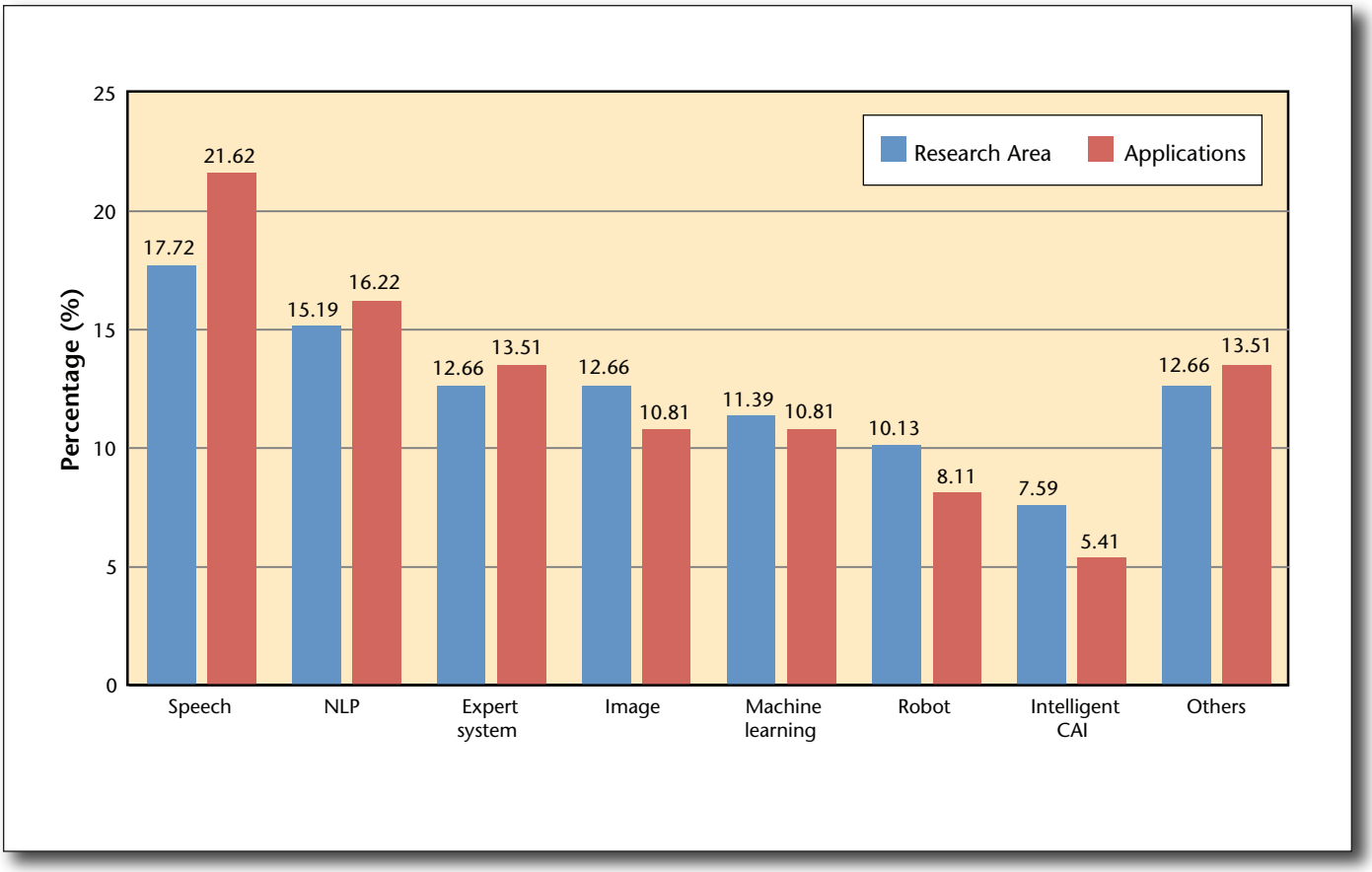

Figure 1. The Ratio of Research and Development and Application Areas.

Modified from Kijsirikul and Theeramunkong (1999)

and the first book on natural language processing (NLP) in Thai. The first NLP laboratory, called the NAiST Lab, was founded at the Department of Computer Engineering, Kasetsart University, formerly a subdivision of the first AI laboratory. It is now expanded to the Center of Excellence, supported by National Electronics and Computer Technology Center (NECTEC), and focuses on merging together two types of technology: knowledge engineering and language engineering, thus leading to the setting up of the Center of Excellence, called UKNOW, at Kasetsart University.

The first national-level research project in Thailand focused on machine translation. From 1988 to 1991 this project included the Center of the International Cooperation for Computerization of Japan (CICC), NECTEC, and Thailand's Chulalongkorn University, Kasetsart University, King Mongkut's Institute of Technology Lad Krabang, King Mongkut's Institute of Technology North Bangkok, and Kriek University. CICC and NECTEC are very important cores in developing NLP technology in Thailand.

In 1992 and again in 1999 (Kijsirikul and Theeramunkong 1999), questionnaire surveys of NECTEC and CICC about AI technological development, which revealed that the national research plan (1997–2001) did not clearly encourage the development of in-depth research in AI. As a result, the National Electronics and Computer Technology Center (NECTEC) put together research development plans in AI-related fields, for example, natural language processing, expert systems, and intelligent image processing. Rapidly, AI research by universities and major research organizations in Thailand grew to cover speech processing, NLP, expert systems, image processing, machine learning, robotics and other mechanical instruments, intelligent computer-aided instruction (Intelligent CAI), intelligent information retrieval, information extraction and summarization, data mining and knowledge engineering, intelligent control systems, and forecasting systems. Figure 1 shows the most popular areas as of 1999. In those early days, AI researchers mainly graduated from Edinburgh, Japan, and the USA. They obtained funding from the National Research Council of Thailand (NRCT) and the National Electronics and Computer Technology Center (NECTEC) of the National

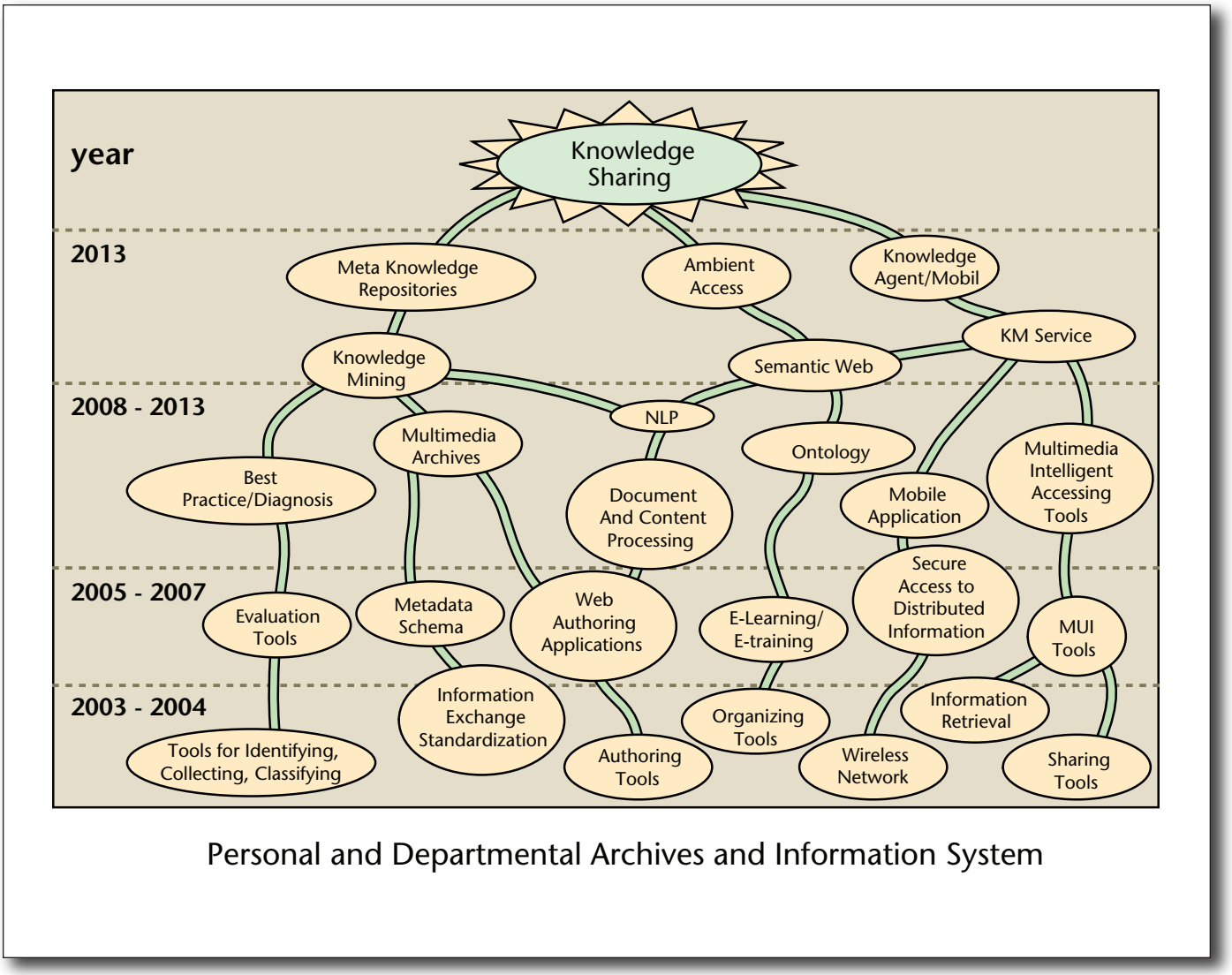

Figure 2. A Technology Roadmap for Knowledge Sharing Platform Development.

(National Research Council of Thailand 2001)

Science and Technology Development Agency (NSTDA).

In NLP and speech processing, AI research focused on machine translation, word segmentation, spell and style checking, speech recognition, speech synthesis, and speaker identification. Examples of AI research in expert systems were agricultural expert systems, student consulting systems for registration processing, and environmental expert systems. More universities took part in this area of AI research, including King Mongkut's Institute of Technology North Bangkok and Bangkok University. In image processing, research on Thai optical character recognition, handwritten Thai character recognition, and medical photograph recognition was conducted with collaboration from two more private universities, Rangsit University and Mahananakorn University. Research on robots had an emphasis on electric chairs for the disabled and robot contests.

Research Roadmap Creation: 2000–2005

During the period between 2000 and 2005, the National Research Council of Thailand (NRCT), Thailand's major fund granter, concentrated on creating research roadmaps. The ICT Master Plan Years 2001–2010 was created with the goal to make Thailand a knowledge society with five areas of strength: e-Government, e-Education, e-Society, e-Industry, and e-Commerce. In 2001 Kasetsart Uni-

versity, granted by NRCT, produced 10 additional roadmaps (National Research Council of Thailand, 2001). One of them, for developing knowledge sharing, aimed at transforming the country into a knowledge-based society. Figure 2 illustrates this roadmap. Obviously, instruments for storing, processing, and accessing knowledge were needed, giving AI research a great chance to become embedded in Thailand's national development plan. For instance, this included natural language processing systems for extracting and coding data from unstructured text, algorithms for data mining and knowledge discovery, ontologies and the semantic web, and knowledge service development.

Synergy and Alignment: 2006–2010

AI research from 2006 to 2010 was conducted through collaboration among national research institutes and universities under national strategies for ICT. Research questions or objectives were for the first time determined by the national development plan instead of by researchers themselves. Outcomes assessment no longer relied on the number of publications, but instead consisted of measuring impacts, incomes, publications, prototypes, and patents. The development of AI research in the third period thus underlined application-oriented work, for it was had to be integrative, tangible, and assessable. The number of publications or patents was not the only concern.

NECTEC was one of the institutions responding to the new research direction between 2007 and 2010. It developed an empowered research program, called the knowledge engineering technology (KET) development platform, which aimed to transform Thailand into a knowledge society. The KET program was an engineering discipline that addressed industrial problems and served the technology development needs of a knowledge society. It emphasized acquisition, collection, accessing, processing, sharing, and integration, and services of knowledge. NECTEC also determined three flagships[1] in support of more integrative work — Smart Health, Smart Farm, and Digitized Thailand — to create links among research outputs from collaborating educational institutions. Figure 3 shows a link between the National ICT Master Plan (Ministry of Information and Communication Technology 2010) and the Smart Health Flagship.

In figure 3, one of the main pillars in the ICT 2020 framework (left side) is Smart Health, corresponding to the Smart Health Flagship in the roadmap at right, where AI research is embedded in both technology and application tracks. The left track contains AI-related software and hardware, for example, image processing, speech processing, speech processing, biosensors, and intelligent devices, while applications are the diagnosis system, the reminder system, the early cancer detection system, and the expert system.

Apart from their research grant policy, NSTDA/NECTEC also worked in partnership with various universities to establish Centers of Excellence on university campuses. The Center of Excellence: Unified Knowledge Engineering and Language Engineering (UKNOW CoE) at Kasetsart University, founded in 2009, has created a roadmap for AI-related technological development for 2009–2014 (Center of Excellence: Unified Knowledge Engineering and Language Engineering 2010) (see figure 4), in alignment with the strategies proposed by NECTEC and the Ministry of Information and Communication Technology. Information extraction, question answering systems, machine translation, ontology construction, and tools were focal points. The following domains are highlighted: agriculture, education, medicine, and tourism. The right side of the figure shows how to apply knowledge representation and processing in the development of an agricultural knowledge bank used for transforming an agricultural society into a knowledge society.

Practical Applications of AI Research (From 2011 Onwards)

Research institutes that have continuously carried out AI-related research with practical applications include research institutes at NECTEC; the Knowledge, Information, and Data Management (KIND) Laboratory at Sirindhorn International Institute of Technology of Thammasat University; and the Unified Knowledge Engineering and Language Engineering (UKNOW) Center at Kasetsart University. KIND particularly pays attention to information extraction technology and language processing. The following are two outstanding AI research projects with practical applications.

Speech Technologies and Health Care

Among a number of technology branches, text-to-speech (TTS) synthesis has shown itself a mature technology applicable for practical use. TTS for Thai is considerably more complicated than those of other well-known languages due to the uniqueness of the Thai language.

Vaja, a bilingual Thai/English TTS developed by Speech and Audio Technology Lab (SPT) at NECTEC, is a successful research result that has been integrated in a variety of applications and services. Since 2011, more than 70 state hospitals have used Vaja to call patient names in compliment with patient registration numbers in their queuing systems. Vaja has been applied for voice information services in some telephone call cen-

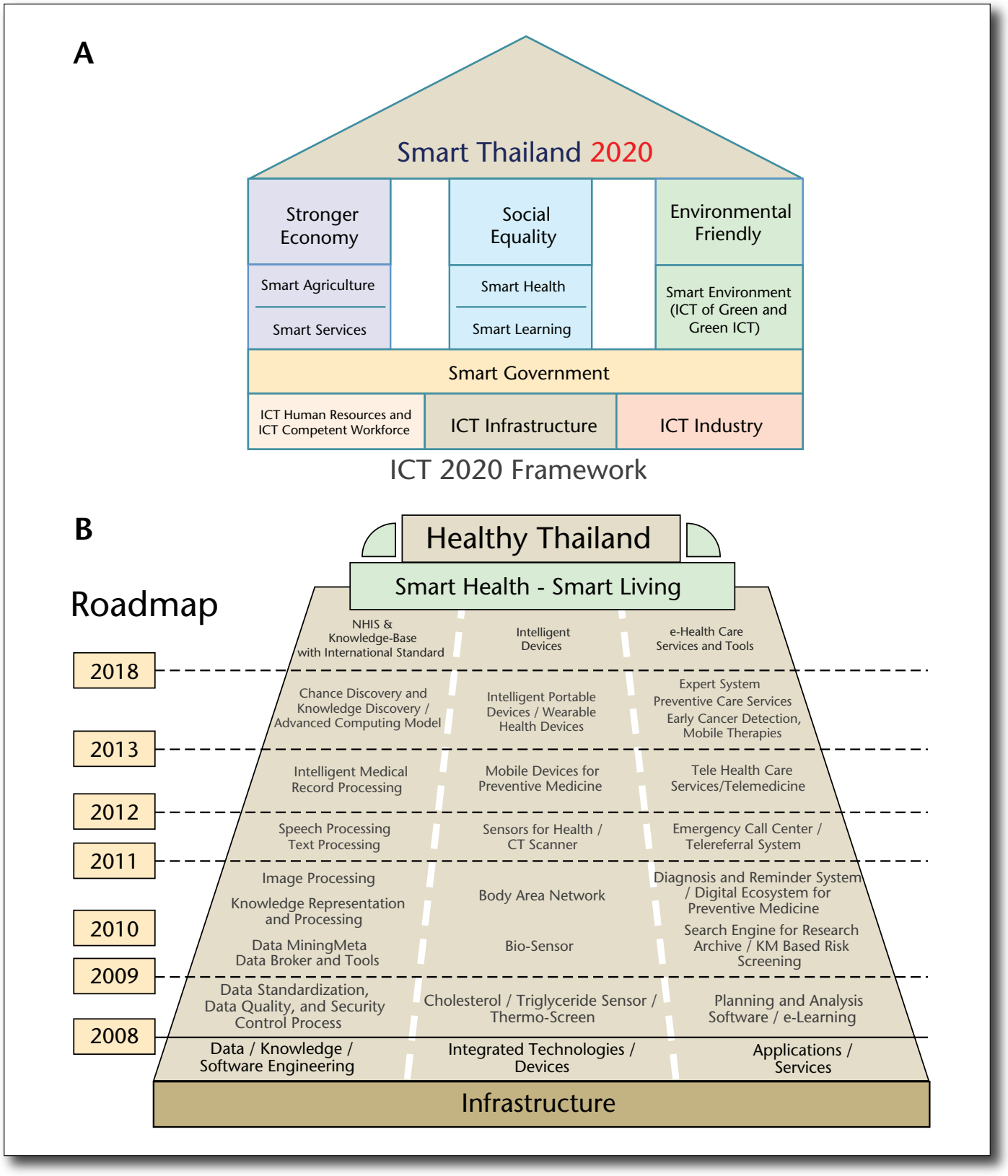

Figure 3. Alignment of the Smart Health Flagship with the ICT Master Plan.

(a) ICT Master Plan for 2020. (b) The Smart Health Flagship of NECTEC.

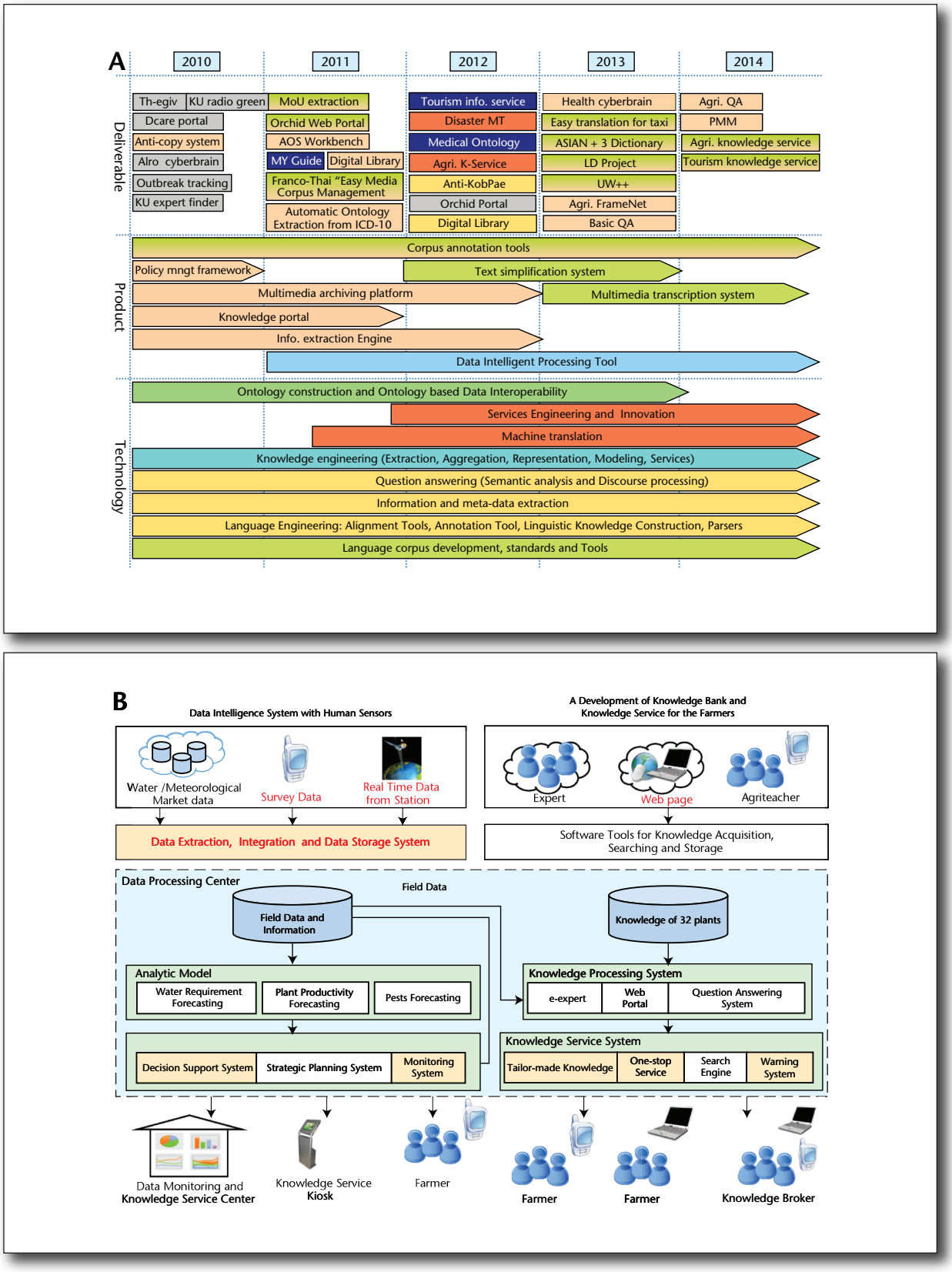

Figure 4. A Roadmap for AI-Related Technological Development for 2009–2014.

(a) Knowledge Engineering and Language Engineering Roadmap developed by UKNOW CoE. (b) An Example of Knowledge Bank in Agricultural Construction for Agricultural Knowledge Society Development.

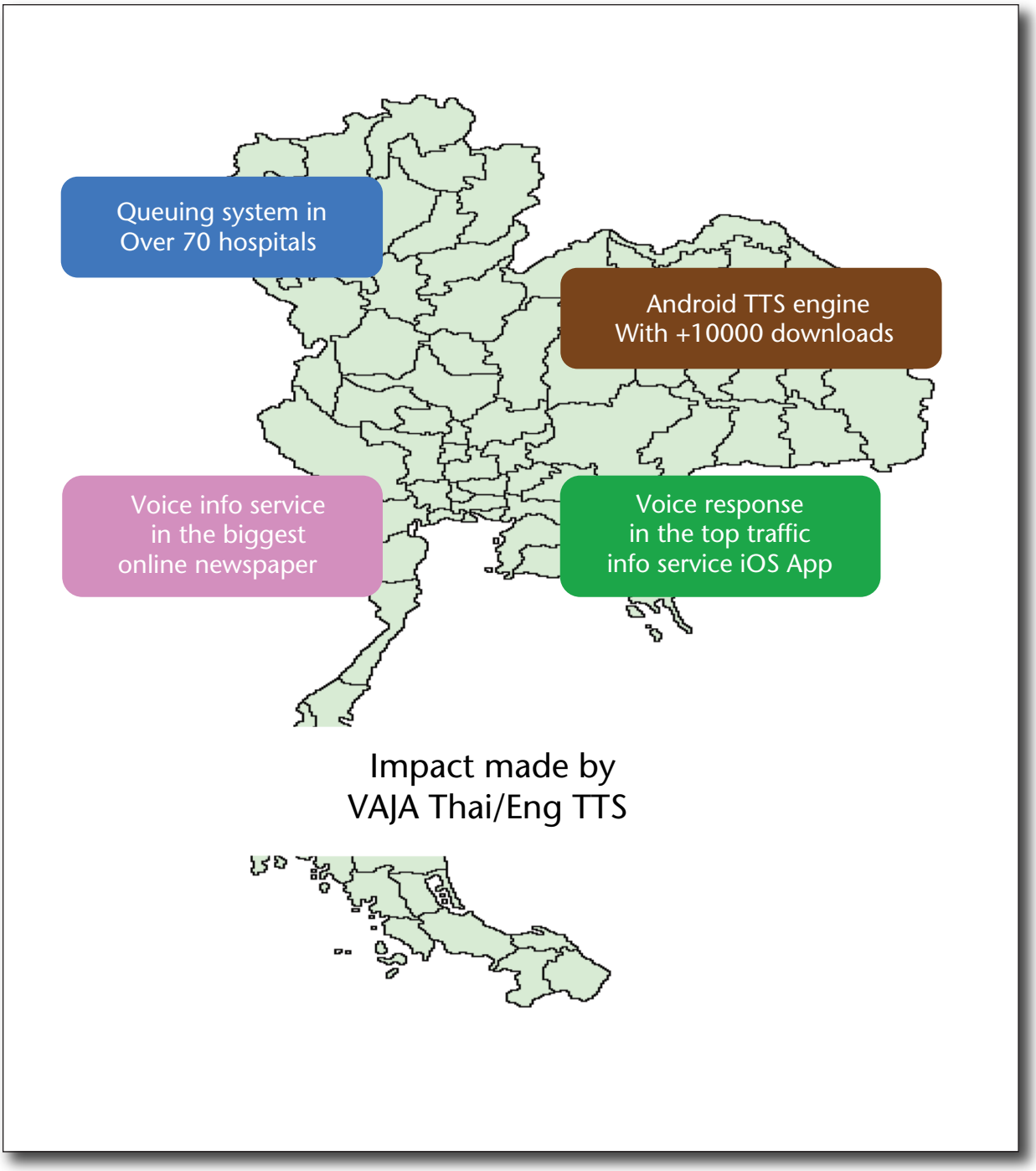

Figure 5. The TTS Application and Its Impact.

ters such as a diabetes self-care service at Chulalongkorn hospital and a traffic information service at NECTEC. It has also been exploited in a multilingual speech translation mobile application developed under an international collaboration called U-STAR.[2]

Regarding the assistive technology, Vaja has been applied as an interface for people with visual disability to access information in online newspapers since 2010. Figure 5 shows its applications and its deployment throughout the country.

Knowledge Engineering and Agricutural Cyber Brain

With the development of the Internet and the world wide web, the enormous number of knowl-

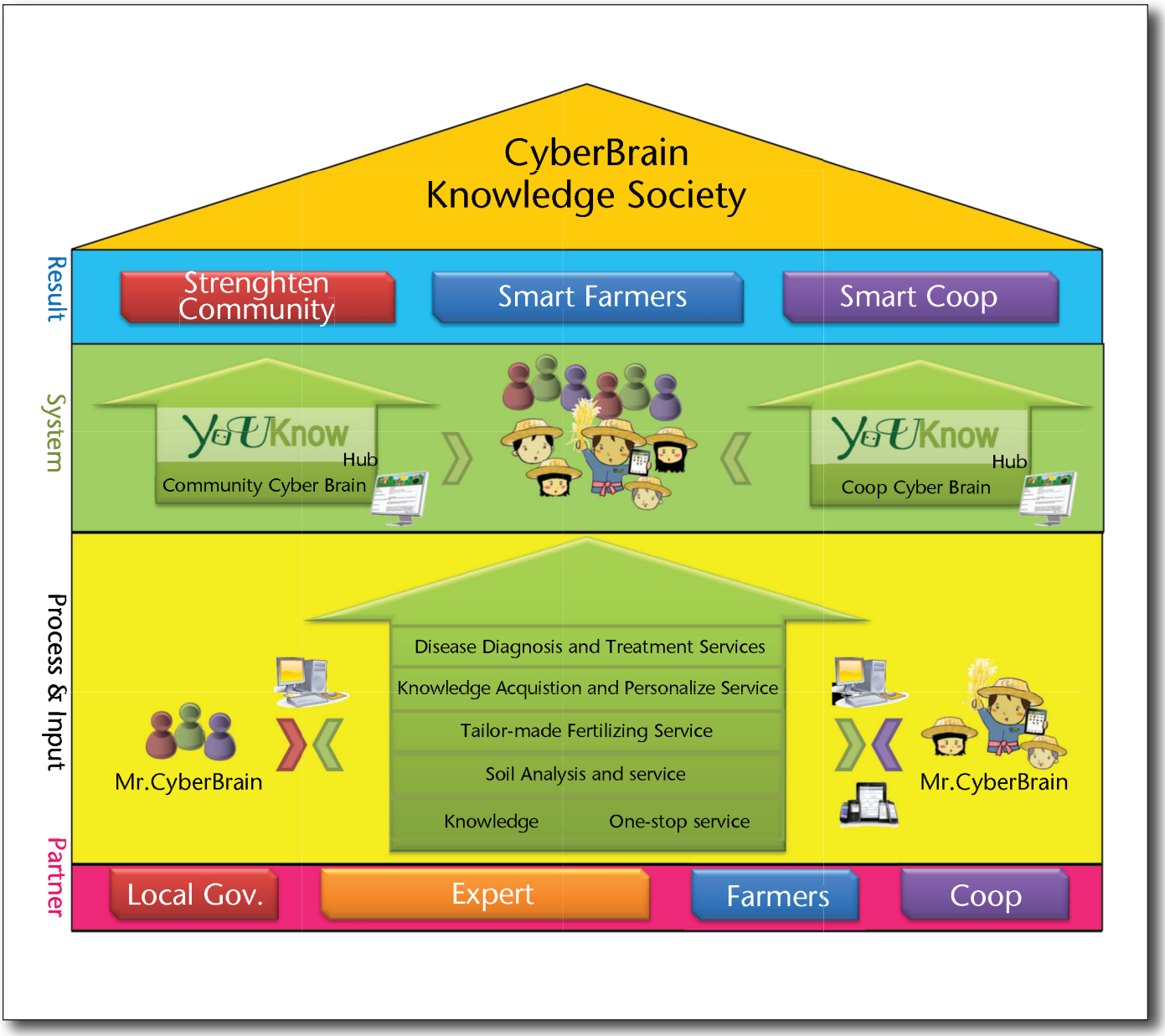

Figure 6. An Implementation of Expert System and Knowledge Services for Agricultural Domain.

edge resources prevents knowledge consumers from effectively and efficiently accessing the information they need. Knowledge fusion is one of the solutions. Cyber-Brain (Kawtrakul et al. 2008, Kawtrakul et al. 2013) is a community-based platform of services and tools that facilitates IT infrastructure consolidation, information sharing, and collaboration across agencies, partners, and public boundaries. This platform operates to avoid IT duplication between agencies and facilitates integration of IT resources within the federal government and among federal, state, and local governments. With Cyber-Brain, appropriate and personalized knowledge services will be provided to support problem solving, decision making, and early warning.

Since the world population will increase from 7 to 9 billion by 2050, more food will be needed to meet demand. In Thailand, rice is the national food staple and represents the main income sustaining farmers (66 percent of 5.7 million agricultural households are rice farmers). The Cyber-Brain, as a platform of community knowledge sharing and delivering services in the agricultural domain (especially rice), has been implemented for evaluating nontechnical interoperability and har-

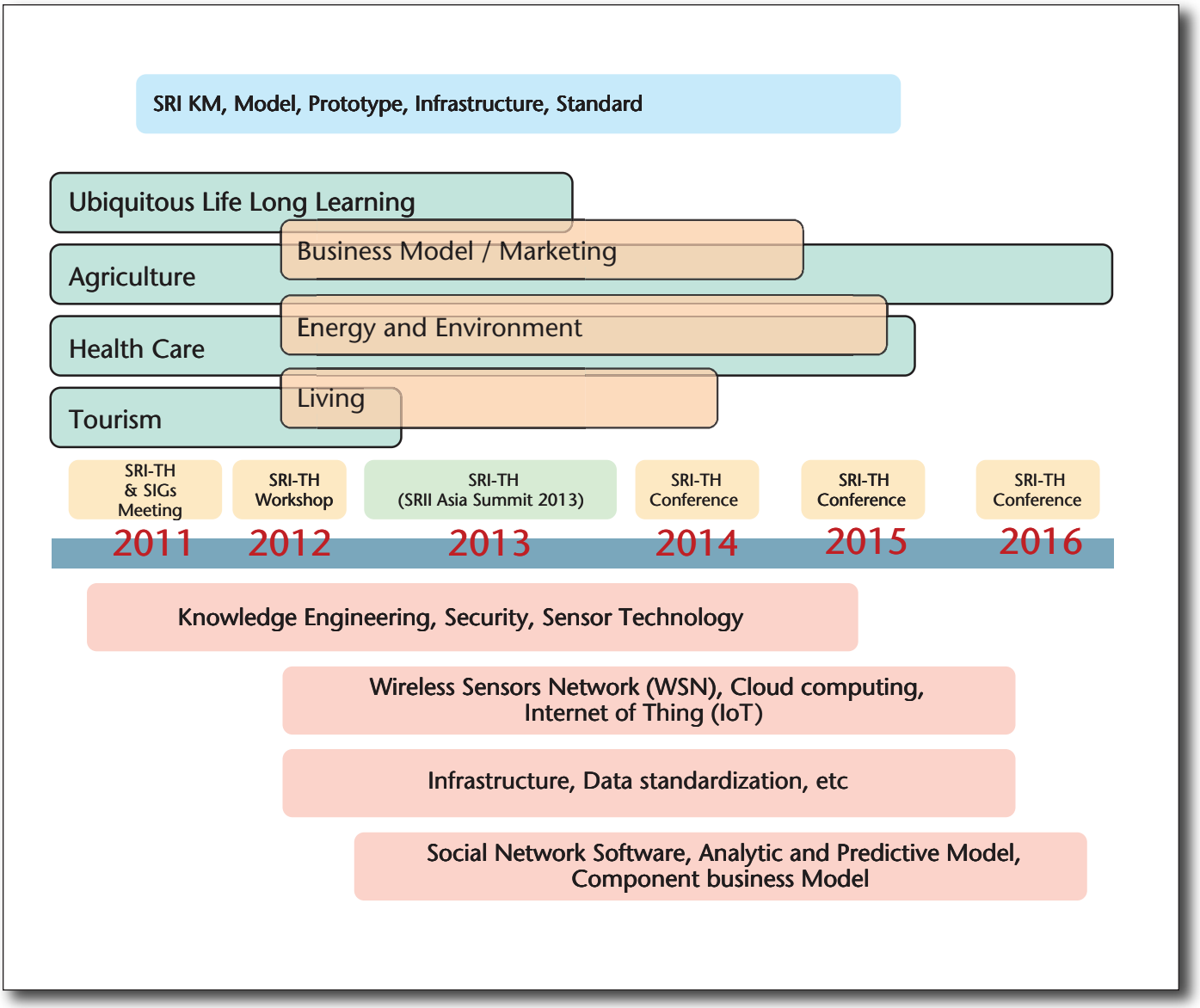

Figure 7. Service Innovation Roadmap Developed by Service Research Innovation of NSTDA and SRII Thailand Chapter.

vesting the best practices for knowledge society development. Figure 6 shows the implementation platform through a collaboration with Agricultural Cooperatives who are the drivers of implementation of rice diagnosis and treatment services, tailor-made fertilizing services, and soil analysis and service.

Four of 4500 agricultural cooperatives have been implementing such strategies to formulate the framework and guidelines for best practices in e-agricultural information services. The success factors strongly depend on cohesive working networks and multisector engagement, including the government agencies that own the data.

The Future by 2020: AI Inside Smart Services for Better Life in Thailand

AI research has become increasingly important in application systems to meet the growing demands of the country. Impacts are required on national economic, social, and industrial development. NECTEC therefore has assembled researchers interested in putting AI research to practical use. The SRII (Service Research and Innovation Institute) Thailand Chapter[3] was founded in 2011 to develop service innovation roadmaps based on AI-related technologies such as knowledge engineering,

analytic models, big data analysis, and information extraction (see figure 7). Displayed in figure 7 is the Smart Province pilot project,[4] proposed by the Governor of Nakhon Nayok in 2012. This challenging project, supported by NECTEC and Kasetsart University in alignment with the Ministry of ICT's strategy Smart Thailand 2020, aims to demonstrate the accomplishment of AI and ICT research investments over the last 25 years.

Today, as a result of collaborations among universities, private organizations, and the government sector, the number of killer applications for various public services is growing, as evident in Smart Health, Smart Education, Smart Tourism, Smart Energy, Smart Home, and Smart Agriculture. It is a good sign that the Ministry of Information and Communication Technology has seen the importance of integrated service innovation leading to the development of Smart Government and better quality of life for Thai people as a whole.

Notes

1. See the National Electronics and Computer Technology Center, 2011. Flagship Projects (in Thai). Available at nectec.or.th/index.php?option=com_content&view=article&id=2221&Itemid=1071.

2. See www.ustar-consortium.com.

3. See www.sri-thailand.org.

4. See www.ny-thailand.net.

References

Center of Excellence: Unified Knowledge Engineering and Language Engineering. 2010. Knowledge Engineering and Language Engineering Roadmap. In Annual Report (in Thai). Bangkok, Thailand: Ministry of Science and Technology.

Kawtrakul, A.; Pusittigul, A.; Ujjin, S.; Lertsuchatavanich, U.; and Andres, F. 2013. Driving Connected Government Implementation with Marketing Strategies and Context-Aware Service Design. Paper presented at the 13th European Conference on Government (ECEG13), Varese, Italy, 13–14 June.

Kawtrakul, A.; Sriswasdi, W.; Wuttilerdcharoenwong, S.; Khunthong, V.; Andres, F.; Laovayanon, S.; Jenkollop, D.; Narkwiboonwong, W.; and Pusittigul, A. 2008. CyberBrain: Towards the Next Generation Social Intelligence. Paper presented at the Joint World Conference on Agriculture Information and Information Technology, IAALD, AFITA, WCCA 2008, Tokyo, Japan, August 24–27.

Kijsirikul, B., and Theeramunkong, T. 1999. Survey on Artificial Intelligence Technology in Thailand, December. Survey Report, Chulalongkorn University, Department of Computer Engineering.

Ministry of Information and Communication Technology. 2010. Thailand's ICT Master Plan 2020 (in Thai), revised version 2.0. Bangkok: Kingdom of Thailand.

National Research Council of Thailand. 2001. A Study of Information Technology Research in Thailand, Research Report (in Thai). Bangkok, Thailand: NRCT.

Asanee Kawtrakul is currently an associate professor in language and knowledge engineering technologies at Kasetsart University and a senior consultant with NECTEC. She obtained a B.Eng. and M.Eng. in electrical engineering (honors) from Kasetsart University in Thailand and a D.Eng. in information engineering from Nagoya University, Japan. Her current research focuses primarily on language technologies to support knowledge acquisition and management, utilization and knowledge service. She has led various large-scale research projects related to country strategy such as Agricultural Knowledge Service, Smart Health Project, Smart City Project, and others. She also leads the Natural Language Processing and Intelligent Information System Technology Laboratory (NAiST) at Kasetsart University. She has published more than 90 papers and books.

Prasong Praneetpolgrang received a B.Sc. (1st Hons) in electrical engineering from the Royal Thai Air Force Academy, Bangkok, Thailand, in 1987, a Master's degree in computer engineering, 1989, a Master's degree in electrical engineering, 1993, and a Ph.D. degree in computer engineering from Florida Institute of Technology, Florida, USA, in 1994. He currently has the rank of associate professor at the Faculty of Information Technology, Sripatum University, Bangkok, Thailand. His research interests are in the areas of computer and information security, trust management and it governance, e-commerce, and cloud applications. Prasong Praneetpolgrang has more than 100 published articles and books in these areas. He has served on program committees of both international and national conference on computer science and engineering, information technology, and e-business. He is a member of IEEE and ACM. He is listed in *Who's Who in the World in Information Technology.* In addition, he received ASEAN Outstanding Engineering Achievement — Contribution Award in 2013.