ANNUAL REPORT 2017

สถาบันวิจัยวิทยาศาสตร์และเทคโนโลยีแห่งประเทศไทย (วว.)
Thailand Institute of Scientific and Technological Research (TISTR)
กระทรวงวิทยาศาสตร์และเทคโนโลยี (วท.)
Ministry of Science and Technology (MOST)

Content

Message from the Governor

Amid the national changes driven by the government's "Thailand 4.0" policy, science, technology and innovation (STI) are key factors in enhancing and developing the nation's economy towards prosperity. In this context, Thailand Institute of Scientific and Technological Research (TISTR), has played a major role as a research, development and service agency for science and technology to operate the works in accordance with the government policy in many areas. For the year 2017, TISTR has been very successful in driving various projects to respond to government policies and provide benefits to the people, namely, the pilot project for farmers' development with STI (Innovative Agriculture: InnoAgri), which is the integration of cooperation between agencies under the Ministry of Science and Technology with other agencies. The project combined research, technology and innovation together to support the leverage of the country's agricultural competitiveness in line with the direction of Thailand 4.0, shifting from traditional labor-intensive agriculture to smart agriculture. Another project that brought benefits of technology to help increase productivity throughout the sustainable value chain was the safety assessment of medical materials and products (Biocompatibility Testing) to be used in humans or animals by using the international standard method according to the ISO 10993 system. This ensured that exposure to extracts from medical device materials was safe, including development plans for raising and using experimental animals complied with international standards.

Another mission that TISTR is proud to undertake is the establishment of TISTR: Railway Transportation System Testing Centre (RTTC) for testing and developing rail systems in order to raise standards and sustainable rail transport safety. This Centre can provide testing services for both performance and safety development of materials

and equipment in the rail system as well as consultation to develop entrepreneurs in this field. Moreover, RTCC has a network and agencies in different regions of the world for the collaborative activities concerned.

When considering the performance of TISTR in terms of economics in the past 2017, this can be assessed from the economic added-values of the service recipients and the added value from the investment from 3 sample groups, namely: the commercial group, the industrial group receiving science and technology services, and the social group. It was found that the total economic added-value was 66,741,900 baht. In these three groups, TISTR played a role in providing full support, particularly the projects that TISTR collaborated with agencies under the Ministry of Science and Technology, for instance, the development of the Science Coupon for OTOP project, in which TISTR participated in supporting the OTOP industry up to 400 projects, representing the financial support by TISTR accounting for 60,317,704 baht. Since the beginning of the operation during 2014-2017, TISTR could create total economic added-value for the OTOP/SMEs up to 154,381,666 baht.

In terms of organisational management, in the past fiscal year 2017, TISTR's performance was assessed according to the criteria of the State Enterprise Performance Appraisal (SEPA) that aimed for the organisational changes towards modernity, transparency and good governance. In addition, TISTR has developed many processes to be transformed into digital systems such as financial and treasury systems, online customer service systems, one-stop service systems, human resource management systems, staffs and employees' performance evaluation systems, internal audit system and contract management systems. These digital work systems brought benefits to the organisation in terms of operational flexibility, convenience and speed. Both service providers and users involved in the systems could retrieve information for operations or verification at the same time, thus increasing transparency in auditing. As a result, TISTR finally received a top-ranked award of transparency organization in Integrity & Transparency Assessment (ITA) from the Ministry of Science and Technology among a total of 15 agencies.

In full response to the government's "Thailand 4.0" policy, TISTR is on the way to be certified of Information Security Management - ISO 27001. So far, for the digital system development, TISTR also received an award for the Agency that provided basic internet network services for IPv6 systems in the year 2017 from the Ministry of Digital Economy and Society as well.

These are prides of 2017 that TISTR has strived towards the future and we would like to express our gratitude to the achievements that are the driving force for TISTR to take the next step in creating valuable works for the benefits of the nation and the people in the long run.

Luxsamee Plangsangmas

Governor of Thailand Institute of Scientific and Technological Research

Board of TISTR

General Gen. Tagerngkarn Sri-am-pai
Board Chairman
(16 Apr 2015-2017 and 23 May 2017-present)

01 **Mrs. Hirunya Suchinai**
Board Member
(6 November 2014-30 September2017

02 **Mr. Parametee Vimolsiri**
Board Member
(1 October 2015-present)

03 **Prof. Sirirurg Songsivilai**
Board Member
(30 December 2016-present)

04 **Miss Wiparat De-ong**
Board Member
1 October 2016-29 December 2016)

05 **Mr. Chen Namchisiri**
Board Member
16 April 2015-15 April 2017)

06 **Mrs. Wannipa Bhakdibutr**
Board Member
(16 April 2015-15 April 2016)

07 **Mr. Apichart Todilokvej**
Board Member
(23 May 2017-present)

08 **Mr. Pasu Loharjun**
Board Member
(16 April 2015 - 15 April 2017 and
23 May 2017 - present)

09 **Asst.Prof.Dr. Tanawan Sinthunawa**
Board Member
(16 April 2015 - 15 April 2017
and 23 May 2017 - present)

10 **Assoc.Prof. Supot Teachavorasinskun**
Board Member
(21 November 2016 - 15 April 2017
and 23 May 2017- present)

11 **Mr. Somchai Saengratmaneedet**
Board Member
(26 February 2016 - 15 April 2017
and 23 May 2017 - 30 September 2017)

12 **Mr. Nakah Thawichawatt**
Board Member
(23 May 2017- present)

13 **Dr. Luxsamei Plangsangmas**
Board Member and Secretary
(21 Dec 2015-Present)

TISTR Executives

Dr. Luxsamee Plangsangmas
Governor

01 **Mrs. Chantara Phoonsiri**
Deputy Governor
Research & Development for Bio-Industries

02 **Dr.Aparat Mahakhant**
Deputy Governor
Research & Development for
Sustainable Development

03 **Mr.Wirach Chantra**
Deputy Governor
Industrial Services

01 02 03

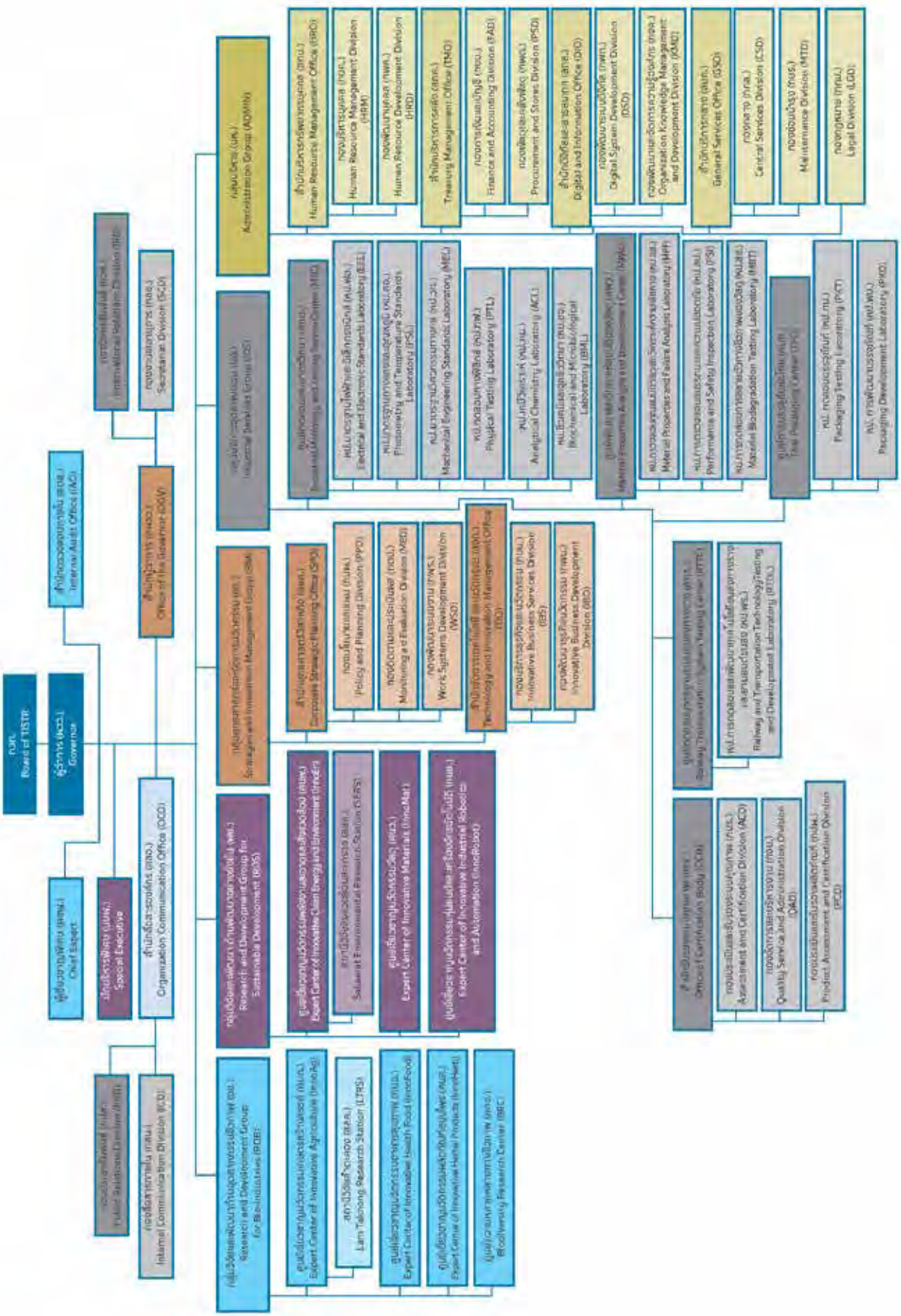
TISTR Executives

04 **Dr. Chutima Eamchotchawalit**
Deputy Governor Administration

05 **Dr.Teerapatr Srinorakutara**
Chief Research Expert

06 **Mr.Anun Rungporntavewat**
Chief Administrative Expert

Organisational Chart of TISTR



Factors affecting TISTR's operational management

In driving TISTR's policies into actions to achieve organisational goals and reach the direction, there are some factors that have a major impact on the organisation as follows:

Making use of research and development, including science and technology services for social and commercial benefits.

TISTR has a mission to conduct integrated research and development in order to obtain innovations that can be applied both socially and commercially, such as food innovations, health products, medical equipment, renewable energy and environmental management. It also provides science and technology services in analysis, testing, calibration, quality system certification, consultancy services with international quality standards, including promoting the research results or innovations and services that meet the needs of the target customers, especially those in the manufacturing and service sectors based on the concept of domestic self-sufficiency and moving towards ASEAN through strong business and marketing management. Therefore, factors that could affect TISTR's operations could be the R&D products/services that are inconsistent with customers' needs, or not yet ready for use, or not in line with future technology trends. Besides, there could be fewer attempts for the promotion of TISTR's research products/technologies to be utilised.

To cope with these issues, TISTR set the date to review the technology roadmap in order to make sure that the direction of product/technology development is in line with future trends and can meet the needs of customers and society in the future. Opinions on various needs from the targeted private sector are gathered. In addition, the readiness of the product/technology is evaluated through the technology readiness assessment system. There are measures to support or motivate the use of STI knowledge and utilisation of products/technology. The public relations scheme has been set to disseminate TISTR's products and services to reach the target groups through various media, especially digital media.

Increasing competitiveness for target entrepreneurs.

TISTR's corporate plan 2012-2021 has set an important goal in capacity development for the private sector by using science and technology. More participation is focused, particularly on increasing research and development investment funds and S&T services. Therefore, the important factors are creating a process to reach the needs of the target entrepreneurs, bringing scientific knowledge to develop the capability of entrepreneurs, developing operatioal support processes, marketing development, intellectual property management, and developing funding soure These are the crucial factors to develop competitiveness for entrepreneurs and bring about investment in research and development.

TISTR's operations, therefore, focus on development of research collaborations with the private sector in order to enhance competitiveness, especially large projects that will bring the expertise of the Innovation Centre to make more benefits to the private sector, jointly developing research that meets the needs of the private sector. In addition, in the science and technology service sector, researchers' ability and potential is needed to be strengthened in order to accommodate a new service expansion plan to create a difference in services and a plan to open new markets as well.

Building innovation capacity through the development of TISTR Expert Centre

The establishment of TISTR's Expert Centres in various fields aims to respond to the creation of innovations in order to promote entrepreneurs' competitiveness.

TISTR set the direction to operate focusing mainly on meeting the needs and promoting participation with private sector through the STI development process and building cooperation with networks both domestically and internationally. It is an integrated work model between departments to create a broad impact on strengthening of knowledge adaptable to future changes, building confidence for investors and entrepreneurs as well as reducing the gap for Thai entrepreneurs in accessing technology and innovation. TISTR's Expert Centres also focus on enhancing the quality of STI personnel that meets the needs of the economic and social sectors and create collaboration networks for utilising STI for social, economic and resource development of the country. Therefore, the operations of the Expert Centres that are not yet able to create awareness among various stakeholders to get involved and interested in the work may affect the Expert Centres not to achieve the goals of the organization.

In order to reach the targets of the Expert Centres, TISTR has formulated a plan to drive all 8 Innovation Centres as follows: building cooperation with research and development network agencies both domestically and internationally, developing flagship projects using expertise in research integration which are crucial to the development of the country, building linkages in working with important agencies and setting a guideline to build expertise in each field.

Developing and updating laws and regulations to be in line with the direction of organisational development

TISTR has implemented projects in accordance with the government policies that match with TISTR's mission in many aspects, both the original and new missions that are area-based and need involvement of outside stakeholders. For some work operations, laws and regulations of TISTR are needed to be updated and developed in order to support the goals as well as the organisation's future development. In this regards, TISTR is striving towards agility and efficiency. Moreover, TISTR has reviewed the guidelines for preventing any actions that breach the laws or regulations, especially those concerned with the conduct of research projects in Technopolis Khlong Ha areas, including a review of guidelines and action to prevent environmental and social impacts from implementation of area-based project in each station TISTR has been located.

Industry and Future Trends

Based on the 1st National Science, Technology and Innovation Plan (2012-2021), Thailand, it aims the country to be a thriving economy, stable quality and a fair distribution of benefits to the local community. With that it requires the efficiency development of science, technology and innovation (STI) to drive economic and social knowledge base and enhance the competitiveness of the country. Besides, it has to increase capability of personnel who involved in both in quantity and quality terms, to reduce technology import from abroad, and people receive benefit from their investment in R&D and those R&Ds can be beneficial to the quality of living.

National Science, Technology, and Innovation Policy Office (STI) summarised the situation in STI development in 2016 that Thailand's competitiveness in technology was ranked by IMD at the 27th from 61 countries. In 2015, the government budget allocation for STI was at 4.07 per cent of the country's overall budget. The proportion of investment by the private and public sectors in R&D was at 70 : 30 per cent. In addition, the country increased its investment in R&D to 0.62 per cent of GDP, and had its population ratio between the R&D personnel and the total population at 13.6 : 10,000 in 2015.

Office of the National Economic and Social Development Board predicted the economic growth of Thailand in 2016 at 3.3-3.8 per cent, bythe supportive factors from (1) the recovery of exports regarding the better economy of those trading partner countries and the world market price, (2) the expansion of public investment in higher and faster level, (3) the improvement of agricultural production and the price, (4) the expansion of the tourism sector, and (5) the improvement of the domestic car market.However, the Thai economy was still constrained by the low capacity in the industrial sector. The risk factors of capital flow and exchange rates regarding the measure of trade barriers in the United States, including the continuation of oil price recovery and price of primary products in the world market. With that, the export value was expected to increase at 3.6 per cent. The consumer of the private sector and total investment growth at 3.0 and 4.4 per cent respectively. The inflation was in the range of 0.8 - 1.3

percent, and the current account was surplus at 8.9 percent of GDP.

Kasikorn Bank Research Center expected the Thai economy in 2017 that its growth should be in line with what in 2016. However, in 2017-2020, the economy is expected to grow gradually at 2.5-4.0 per cent driven by the recovery of domestic spending and the continual growth of tourism sector. In addition, there is another support from the government sector that uses a budget policy having a deficit of 2.6 percent of GDP to stimulate the economy, including pushing for more concrete investment projects in infrastructure.

The 12th National Economic and Social Development Plan focused on integrating the development of STI to enhance development in all dimensions to increase economic value in terms of production, innovative product development and services.The National Research Agenda then clarified and focused the specific areas in consistent to the country development and strategies of integrative innovation of R&D for commercialsation and innovation. It was to enhance the capability of the country by enhancing the competitiveness and overcome the middle-income trap.

Highlight & Achievements in 2017

1. Dairy-free Butter from Rice

Focusing on the need of health-concerning customers, vegetarian customers and food processing development which use raw-material from nature as substitute for meals, TISTR has been successful in research and development on dairy-free butter from rice by developing technological recipe for food processing of dairy-free butter from rice products in the form of 'vegan butter', carrying low calories and low sodium. Product of 'vegan cheese slice' is one of dairy-free butter from rice product, which has non-trans fat, non-cholesterol while it is gluten-free, soy-free, and dairy-free. butter has been developed and it was successful as two health food products with dairy-free butter have been obtained, which are sponge cake and sandwich (bakery products).

Moreover, TISTR has selected suitable rice varieties for developing food recipe and food processes for prototype food products of soy-free tofu/bean junket from rice. The prototype products were tested on customer acceptance by:

- Product of tofu rice has ingredient of sesame milk, rice flour, protein from rice berry extract, by α-amylase and Glucosidase 0.3 %, stirring in hot temperature at 85°C for 15 minutes, and leaving for its recovery. After testing its quality, it was found that this tofu recipe contains protein 4.15%, moisture 72.37%, and had antioxidant ability by DPPH 14.94% IC; and
- Product of bean junket has ingredient of coconut milk, rice berry water, and protein from rice berry extract, by by α-amylase and Glucosidase 0.3 %, forming with jelly powder and gelatin. After testing its quality, it was found that this bean junket recipe contains protein 14.36% and had antioxidant ability by DPPH 18.54% IC.

VEGAN BUTTER

√ Low Calorie (Lower 48.64%)
√ Low Fat (Lower 48.17%)
√ Low Sodium (Lower62.25%)

VEGAN CHESSE SLICES

√ Dairy free
√ Gluten and Soy Free
√ Non Cholesterol
√ Non Trans fat

2. Product of Functional Drinking 'RUSSULA' from Indigenous Mushroom in the Northeastern Thailand

Referring to the success of the project on research and development on utilisation of indigenous mushroom which has potential to be produced as dietary supplement for reducing mutation rate and cancer risk, TISTR's research team has conducted research on indigenous mushroom in the Northeastern Thailand to develop dietary supplement product with essential extract from four types of *Russula alboareolata*, which was safe and useful and can reduce the cancer risk. After testing, it was found that the product could help strengthen the function of immune system (function of white blood cells), phagocytosis system and anti-inflammatory system. The outstanding property of *Russula alboareolata* is that it contains more than 2 times antioxidant ability and more than 2 to 3 times amount phenolic compound.

3. Skin Care Product from Dong Quai Herb for Skin Tightening

Referring to the success of the project on research and development of skin care product from Dong Quai, one kind of herbs with well-known medicinal property commonly cultivated in the Northern Part of Thailand, TISTR has conducted this research to support the Royal project, by using this Dong Quai's property to develop skin care product for skin tightening. The product was developed by extracting essential substance of Ligustilide and Ferulic acid, testing its Collagen production capability, forming product figure and developing product formula by the method of Nanoparticles Fabrication and Formulation. After testing, it was found that the product was capable of stimulating Collagen production at 151.00 ± 4.92 ng/ml. The product was tested by 30 – 60 years old female volunteer. After applying the product for 4 and 8 weeks, their skin was tightened significantly. Technology of this product is ready to be transferred to the interested party.

4. Cosmetic Product of Nano-Essence Serum from Thai Grape Seed 'VITISTRA'

To further expand the success of the technology transfer of cosmetic product 'VITISTRA', nano-cosmetics and dietary supplement from Thai grape seed extract developed by TISTR to the entrepreneurs in 2016, in 2017, TISTR has conducted research and development of cosmetic product of nano-essence serum 'VTISTRA' technology, combination of 'essence' and 'serum', with high and essential substance extract of Vitamin C and Vitamin E, from Thai grape seed of *Vitis vinegary* (Pok Dum), indigenous Thai grape which is rich in antioxidant substance of oligomeric proanthocyanidin (OPC).TISTR has used storing techniques for drug stability at particles smaller than 100 nanometers, so that it could soak to beneath skin and stimulate fibroblast cells to product Collagen up to 70%, and Elastin upto 15%. It can enhance skin with elasticity, strength, and smoothness. It is able to replenish and restore aging skin by recovering moisture, gentleness, smoothness and youthfulness of skin. The product is presently produced and distributed commercially.

5. Innovation of Intensive Serum Extracted from Jellyfish

TISTR has supported entrepreneurs by jointly developing technologies to increase value addition to waste from jellyfish export business. TISTR has conducted research by using the properties of collagen contained in jellyfish and hydrolysis process. The product obtained was the extract substance at small scale. After passing a biological test, it was found that the substance, inhibited Tyrosine enzyme, stimulated Collagen while being non-toxic to cells, and non-irritating to skin.TISTR's research team has expanded this result by developing various forms of cosmetic products, namely serum, skin lotion, facial cleansing gel, facial cleansing foam and liquid soap, used for skin treatment and rejuvination. The products were tested by whose faces were dull and had some wrinkles. It was found that, after using Jellyfish serum together with Jellyfish cleansing gel, the volunteers' facial skin was better as the products could brighten the dull skin within 7 days, and reduce wrinkles within 3 days. It proved the success of R&D and value addition to business sector and entrepreneurs with technology and innovation.

6. Dietary Supplement from Beta Glucan in Mushroom for Lowering Gout Risk

The Expert Centre of Innovative Agriculture (InnoAg), TISTR, in coopration with Faculty of Pharmaceutical Sciences of Ubon Ratchathani University, has successfully developed a dietary supplement product. Its raw material passed the quality control processing, including selection of oyster mushroom and angel mushroom containing high beta glucan, processing of special formula for beta-glucan production, dietary supplement production with beta-glucan 0.16% w/w (approximate 0.5 mg per tablet), and testing on cytotoxicity and anit-inflammatory activity. The production of tablet product was up to the standard according to pharmacopoeia, and was safe as it was produced from natural raw material with beta-glucan extract. The product can help stimulate the immune system while reducing inflamation and uric acid as well as gout risk.

7. Pro-Fruits

Pro-Fruits are dietary supplement of freeze-dried fruits containing local probiotic strain. TISTR developed health food product for all consumers, especially groups of children and the elderly Pro-Fruits can help consumers balance microbes in the digestive tract so that the digestive system and nutrient absorption could work better. Pro-Fruits are crisp fruit made from 100% domestic fresh fruits as raw materials, such as strawberry and pineapple, and do not contain any preservatives and additives. The product utilised local probiotic strain as listed in the notification of Ministry of Public Health of Thailand, which had high resistance to the production process. The product also can be stored for at least two months, at room temperature. Its taste is acceptable to the consumers In 2016, Pro-Fruits received the second plate of 'Food Design Award' given by the National Innovation Agency (NIA), Thailand.

8. Materials Produced from Interlocking Block and GeoTech Products from Natural Rubber Used for Protecting Riverbank Erosion

The Expert Centre of Innovative Materials (InnoMat) of TISTR has conducted research and development of innovative materials produced from interlocking block and GeoTech products from natural rubber. This material from natural resource can be used to protect riverbank erosion. TISTR has developed the erosion-protecting layer from of interlocking blocks, which are easy to be used for construction, low-cost, and able to fit to the curve and slope surface of riverbank. Thus, it could erosion rate and impact caused from declination. The block shape is designed to be fit with curves of the waterways and have holes to collect natural sediment during slow flows and can be used as holders for riverside plants. Meanwhile, Geotextile sheets from renewable materials of petroleum products are developed to make a layer of filter material covering the river bank and can act as an erosion-resistant layer from the interlocking block. It can be designed to have a porous layer that helps to keep sediment from being washed away from the river bank surface. It is also possible to design a structural feature on the surface of the sheet that tends to capture sediment from the flow of water in another way, thus promoting the accumulation and formation of sedimentary layers on the sheet material through which plants can grow and form a vegetation barrier by natural means.

9. Development of Gantry Robot on Truck for Sampling of Raw Materials for Animal Feed

The Expert Centre of Innovative Industrial Robotics and Automation (InnoRobot) of TISTR has designed and developed a gantry gantry robot on trucks for sampling of raw materials for animal feed, by applying gantry and crane structures which are able to move on the axis of X, Y and Z, and using industrial computer to control type and size of truck automatically. The machine is able to use for sampling in all areas of a pick-up truck and specify sampling points in each time.This invention can reduce contamination low quality material and save time as well as manpower in operation process

10. Service on Standard to ASEAN in "Testing and Evaluation of Boiler"

Material Properties Analysis and Development Centre (MPAD) of TISTR has more than 20-year experience in providing service on testing and evaluation of boilers to the industrial sector.

Boiler is an important power engine used for steam power production in various kinds of industry especially those involving in steam power for electricity production.Since the boiler is closed container with high pressure and high temperature, it needs to be monitored and maintained properly and correctly to prevent causing any harmful incidents to any life and property. To use the boiler cautiously, all factories have to work under the relevant rules and regulations to check and maintain their boilers regularly. Besides, TISTR was assigned by Department of Industrial Work (DIW) of Thailand, to provide testing and calibration on standard curriculum for boiler controllers.

In 2017, MPAD was entrusted by Hongsa Power Limited Company, located in Hongsa city, Chaiya district, Lao PDR, to test and evaluate lifetime of three large boiler units of Hongsa's electricity power plants. These plants use lignite as fuel for electricity production, and have total production capacity of 1,878 MW (3x626 MW). Since they can deliver electricity production of 1,437 MW to Electricity Generating Authority of Thailand (EGAT), they are important to the energy security of Thailand. This project is a part to expend service on standard to ASEAN region, according to market plan and development of the Industrial Service Group of TISTR.

11. The Thailand's First Plastic Biodegradation Laboratory Accredited on IEC 17025

Bio-plastic is a new wave industry of Thailand and the transitional point from plastic and petrochemical packaging industry of which degradation cycle takes 300 – 400 years, into a form of that focuses on environmentally friendly properties through biodegradation. It can help reduce the amount of plastic waste and residue, and solve a concrete problem of global warming. It also can reduce dependence on petroleum which is consistent with environmental conservation trends and clear policies of foreign countries such as Italy, Germany, the United States and Japan, where the standards and requirements of each country are different.

However, even raw materials for production are biodegradable, the use of some additives or some processes can affect biodegradability of the end products. Standard laboratory and testing can help the products to be accepted and be ensured that the bio-plastic of the products meet the international standards and requirements.

Material Biodegradation Testing Laboratory (MBT), under Material Properties Analysis and Development Centre (MPAD) of TISTR, was accredited on ISO 17088 by DIN CERTCO, Federal Republic of Germany, in 2014. In 2017, MBT is the first and only one laboratory in ASEAN region that has been accredited on ISC/IEC 17025 (in the fields of chemistry and plastic biodegradation) by Thai Industrial Standard Institute (TISI). Therefore, the customers will be ensuredthat they can receive testing services in compliance with international standards from TISTR. Besides, they can save their cost because they do not need to send their samples to receive testing service in foreign countries.

Honorable Awards and Pride

Organisation Awards

Certificate of Safety Management System for Chemical Laboratories (TIS 2677 – 2588)

TISTR received certificate of Safety Management System for Chemical Laboratories (TIS 2677 - 2588) given by Thai Industrial Standard (TIS). As a representative of TISTR, Mrs. Chantara-Phoonsiri, Deputy Governor of Research and Development Group for Bio-industries, received plate and certificate of Safety Management System for Chemical Laboratories (TIS 2677 - 2588) from Air Chief Marshal Prajin Juntong Deputy Prime Minister, in the event 'Thailand Research Expo 2017', organised by National Research Council of Thailand (NRCT), at Centara Grand at Central World Bangkok Hotel.

Gold Award at Thailand Research Expo 2017

On 27 August 2017, as a representative of TISTR, Dr. Aparat Mahakhant, Deputy Governor of Research and Development Group for Sustainable Development, received Gold Award from Prof. Sirirug Sonsivilai Secretary-General of National Research Council of Thailand (NRCT), for exhibition booth presenting a research project on'Sustainable Management on Community Waste by Science, Technology and Innovation (STI)', conducted by Dr. Rewadee Anuwattana, Senior Researcher of the Expert Centre of Innovative Clean Energy and Environment (InnoEn), in the event 'Thailand Research Expo 2017',at Centara Grand at Central World Bangkok Hotel.

Laboratory Accreditation according to TIS 17025 (Plastic Degradation)

Material Biodegradation Testing Laboratory (MBT) of TISTR is the first institute in Thailand, which has been accredited its testing capability (TIS 17025 - 2005) in the field of plastic degradation, given by Thai Industrial Standards Institute (TISI). On 11 September 2017, Dr. Luxsamee-Plangsangmas, Governor of TISTR, received the certificate from Mr. Pisit Rangsaritwutikul Secretary-General of TISI, in the event 'TISTR and Friends', at Central Plaza Ladprao Bangkok.

IPv6 Excellence Award 2017

TISTR received IPv6 Excellence Award 2017, as one of the Internet Service Providers with IPv6 Internet Protocol, given by Ministry of Digital Economy and Society (MDES). On 26 September 2017, as a representative of TISTR, Dr. Chutima Eamchotchawalit Deputy Governor of Administration Group, received award from Gp.Capt. Somsak Khaosuwan, Deputy Permanent Secretary of MDES, at Grand Ballroom, Century Park Hotel.

Individual Awards

Outstanding Paper Award

Dr. Anat Hasap, Director of Railway and Transportation Technology Testing and Development Laboratory (RTDL) of TISTR, received 'Outstanding Paper Award'for the academic presentation on the topic 'The Study on the Influence of Toe Load on the Failure of Railway Fastening System in a Thailand MRT Project', in the event 'The 1st International Workshop on Structural Health Monitoring for Railway System', co-organised by CRRC Qingdao Sifang Co., Ltd., CRRC Institute (China) and Stanford University, on 12 – 14 October 2016, in People's Republic of China.

Role Model Award 2017 in Good Governance and Anti-Corruption

Ms. Lawan Chatanon, Researcher of Biodiversity Research Centre (BRC), received Role Modal Award 2017 in the field of Good Governance and Anti-Corruption, given by Office of the National Anti-Corruption Commission (ONACC).

Highlight Activities

The Visit of Prime Minister and Top Executives

Prime Minister visited the exhibition of TISTR on Utilisation of Research to Develop Agriculturists, and Enhance SMEs/OTOPs by STI"

H.E. General Prayut Chan-o-cha, Prime Minister visited the exhibition booths of TISTR that displayed the project of InnoAgri for development of agriculturists by using science, technology, and innovation (STI) and project of STI for OTOP Upgrade. On that occasion, Dr. Atchaka Sibunruang, Minister of Science and Technology, Assoc.Prof. Soranit Siltharm Permanent Secretary,
and Dr. Luxsamee Plangsangmas, Governor of TISTR gave a welcome welcome during the top executive meeting at ministerial level 3/2017 at the Ministry of Science and Technology, Bangkok.

Mr. Somkid Jatusripitak, Deputy Prime Minister Visited the Ministry of Science and Technology.

H.E. Mr. Somkid Jatusripitak, Deputy Prime Minister visited and followed up the works of Ministry of Science and Technology. Dr. Atchaka Sibunruang, Minister of Science and Technology, and her executives gave welcome on 16 March 2017 at Ministry of Science and Technology, Bangkok.

Minister of Science and Technology Visited TISTR

Dr. Atchaka Sibunruang, Minister of Science and Technology and her delegation visited TISTR and gave a speech regarding the policy on Chairman of the Board of TISTR, Asst. Prof. Dr. Chirapol Sintunawa and Dr. Laxsamee Plangsangmas, Governor, together with the executvies and staff welcomed the Minister on 10 February 2017 at TISTR Technopolis.

Minister of Interior Visited the Exhibition booth of TISTR at the OTOP City 2016.

Gen. Anupong Paochinda, Minister of Interior visited the exhibition booth of TISTR at the event OTOP City 2016 on 19 December 2016 at Challenger Hall 1-3, Muang Thong Thani, Nonthaburi TISTR by Dr. Teerapatr Srinorakutara, Chief Research Expert, and Mr. Sakkhee Sansupa, Director of Thai Packaging Centre gave a warm welcome. The event also presented the "Science Coupon for OTOPs", which is the activity to support OTOP business launched by Science and Technology.

Outstanding Events

Opening Ceremony of Longan Technology Transfer Centre for Export

TISTR hosted the opening ceremony of its Technology Transfer Centre for technology for extend longan's shelf life for export on 26 November 2016 in Tambon Loa Yao, Ampheo Ban Hong, Lamphun. The Centre was established by the government's policy to use the knowledge of science and technology as a role model to enhance the capacity of private sectors, communities, and Longan farmers to apply the appropriate technology to solve the problem of perishable waste from longan oversupply reduce the impact to the environment, and increase the export standard.

"Road of Science" on the National Children's Day 2017

Dr. Atchaka Sibunruang, Minister of Science and Technology presided over the opening ceremony "Road of Science" on the National Children's Day 2017, under the concept of "Little Scientists Followed the King and Continue His Majesty's Works" In this occasion, Dr. Luxsamee Plangsangmas, TISTR's Governor attended the opening ceremony and hosted a visit to the exhibition booth under the theme "Green Station: Aromatherapy with Essential Oil" on January 12, 2017 at the Ministry of Science and Technology, Bangkok.

The 7th Thai-Lao Ministerial Meeting on Science and Technology Cooperation and the 2nd Joint Committee (JC) on Science, Technology and Innovation (STI) between Thailand - Lao PDR

The Ministry of Science and Technology (MOST) hosted the 7th Thailand-Laos Ministerial Meeting on Science and Technology Cooperation and the 2nd Joint Committee (JC) on Science, Technology and Innovation (STI) between Thailand-Lao PDR. Dr. Atchaka Sibunruang, Minister of Science and Technology, Thailand and Prof. Dr Bosengkham Vongdara, Minister of Science and Technology, Lao PDR chaired the said meetings together during 31 January – 3 February 2017 at Le Meridien, Chiang Rai. At the meetings, Dr. Luxsamee Plangsangmas, Governor and TISTR delegation participated in the 7th Thailand-Laos Ministerial Meeting on Science and Technology Cooperation on 3 February 2017.

TISTR Joined Hands with Entrepreneurs of the Community enterprise group of rubber products processing industry in Rayong and Hand Over the Rubber Sheet to Wang Chan Hospital

Mr. Theerawat Sudsuk, Deputy Governor of Rayong Province participated in the hand-over ceremony of "Rubber Sheet" on 20 July 2560, at Wang Chan Hospital. The rubber sheet was a R&D achievement of TISTR in collaboration with the Community enterprise group of rubber products processing industry in Rayong and the Thailand Research Fund (TRF). It is used for flooring the physiotherapy room of the hospital.

TISTR Joined Hands with Saraburi / Tan Deaw Subdistrict Administrative Organisation Created the Prototype of Community Waste Seperation

TISTR, Saraburi Province, and Tan Deaw Subdistrict Administrative Organisation signed the collaboration agreement on Prototype of Community Waste Separation. The project was driven by the policy of Clean City that the government expected to tackle the environmental problemsand to reduce plastic waste in the community. The signing ceremony was held on 7 February 2017 at Saraburi Provincial Administrative Organisation, Saraburi.

TISTR's 54th Anniversary on TISTR 4.0

Mr. Somchai Tiamboonprasert, Deputy Permanent Secretary of Ministry of Science and Technology presided over the opening ceremony of TISTR's 54th Anniversary and its exhibition under the theme "The Way of Change to TISTR 4.0" on 25 May 2017 at TISTR Technopolis. The event consisted of certification ceremony to those sponsors, employees whose works made a great contribution to TISTR, employees who have been working with TISTR over 20 and 30 years, including the scholarship to those employees' children.

TISTR's From Local to Global International Forum : Food Industry 4.0

Dr. Atchaka Sibunruang, Minister of Science and Technology presided over the opening ceremony of the "TISTR's Form Local to Global International Forum : Food Industry 4.0" on 12 June 2017 at Centara Grand at Central Plaza Ladphrao, Bangkok. The conference was aimed at the development of the country's industrial sector to be driven into the world market sustainably in compliance with Thialnd 4.0 policy.

Ministry of Science and Technology Joined Hands with the Bank for Agriculture and Agricultural Cooperatives, and National Farmers Council to open InnoAgri Project for the Farmers Development

Dr. Atchaka Sibunruang, Minister of Science and Technology witnessed the signing ceremony for the Farmer Development Project with Science, Technology and Innovation (Innovative Agriculture: InnoAgri) in the framework of cooperation "Efficient transfer of technology and results from research and development and innovation to farmers". The project was initiated by the Ministry of Science and Technology (MOST) and joined hands with the Bank for Agriculture and Agricultural Cooperatives, and National Farmers Council. On this occasion, Dr. Atchaka Sibunruang also chaired in the press conference of this opening of InnoAgri on 3 July 2017 at MOST, Thailand

Governor and Executives of TISTR Participated in Recording of Birthday Blessing for HM Queen Sirikit

Dr. Luxsamee Plangsangmas, Governor of TISTR and the executives participated in recording of birthday blessing on for HM Queen Sirikit of HM King Bhumibol Adulyadej (Rama IX) of Thailand on 31 July 2017 at the Studio of TV Chanel 11, the Government \Public Relations Department, Bangkok.

Opening Ceremony of National Science and Technology Fair 2017

Dr. Atchaka Sibunruang, Minister of Science and Technology presided over the opening ceremony of National Science and Technology Fair 2017. Dr. Aparat Mahakhan, Deputy Governor of TISTR also participated in the ceremony on 18 August 2017 at IMPACT Exhibition and Convention Center, Nonthaburi.

The 4th TISTR and FRIENDS 2017 to Enhance Thai SMEs to 4.0

TISTR and its partners from public and private sectors organised the event on "The 4th TISTR and FRIENDS 2017" under the concept Creative Innovation for Business Advances to Lead Thai entrepreneurs to 4.0 during 11-13 September 2017 at Central Plaza Ladprao The event aimed to encourage Thai entrepreneurs to use Science, Technology and Innovation (STI) in upgrading products to be competitive in the world market consistent with the Thailand 4.0 policy in a concrete way.

Patents and Petty Patents

Items filed for patents

1.	Drying process for freeze dried fruit fortified with probiotic supplement
2.	Process and system for producing biomethanol from carbon dioxide with biogas and water
3.	Protein extraction process from Isan native mushrooms with lysis buffer solution in combination with thiourea and Tris
4.	Large-scale algae biomass cultivation pond by Upflow Thin Layer Cultivation (UTLC) System
5.	Formula and production process of food supplement for menopause from Dong Quai mix (Chinese Angelica)
6.	Formula and production process of topical anesthetic from Paracress (*Acmella oleracea*)
7.	Thermoformed food container
8.	Anti-oxidation film production process from Indian gooseberry extract
9.	Process of increasing antioxidants in Dong Quai root
10.	Process of extracting astaxanthin from yeast by supercritical carbon dioxide extraction method
11.	Formula and production process of natural rubber compounds
12.	Process of increasing the weight of the stems and roots of Dong Quai
13.	Process of increasing the yield of Indian gooseberry
14.	Long thermoformed food containers
15.	Process for producing rambutan starch
16.	Formula and production process of fragrance-releasing rubber coated fabric
17.	Formula and production process of geotextile from natural rubber composites
18.	Microbial cell preservation with polysaccharite from edible mushrooms
19.	Polymer block
20.	Formula and process of encapsulating Extracts from black plum (*Syzygium Cumini*)
21.	Production process microemulsion containing extracts from Yanang leaves (*Tiliacora triandra*)
22.	Semi-solid orchid tissue culture formula
23.	Formula and production process of pasteurized brown rice yoghurt
24.	Formula and production process of Synbiotic rice seasoning powder

25.	Formula and production process of tea from longan extract
26.	Formula and production process of products from Dong Quai extract
27.	Brown rice yogurt formula and production process
28.	Ammonia-based fiber pretreatment equipment
29.	Equipment for volatile product recovery in bioreactor
30.	Formula and production process of composite reflective rubber paint
31.	Production process of copper compound treatment products from bagasse ash
32.	Production process of aromatic charcoal from tree bark
33.	Process for increasing GABA content in fruit by fermentation with lactic bacteria
34.	Production process for bacteria degradation of pesticides
35.	Method for extracting fungal control agents from endophytic *Fusarium oxysporum* fungi
36.	Cultivation process of micro-algal oil *Coelastrum* spp. using artificial seawater
37.	Formula and production processes of coffee to reduce the risk of colon cancer from Wan Nang Kham (*Curcuma aromatica*)
38.	Process for extracting protein isolate from chickpea (*Cicer arietinum* Linn.)
39.	Production process of sulfur dioxide indicator sheet
40.	Production process for rancidity indicator sheet
41.	Machine for coating cloth gloves with rubber using a pulsating disk
42.	Apparatus and ozone gas in water for micro-particle shearing
43.	Process of using chlorine dioxide (Clo2) to extend the shelf life of longan
44.	Chloroamine detoxifier
45.	Formula and process of cultivating algae in outdoor convective tanks to produce pigments in one step
46.	Algae cultivation equipment, continuous rotating tube, extension type
47.	Multi-pipe algae culture
48.	Production process of biomass from *Nostoc commune* algae in an outdoor aquaculture system
49.	Production process of biomass from *Nostoc commune* with reactor

Items filed for petty patents

50.	Formula and production process of GABA-fortified snack food
51.	Soursop propagation process with different varieties of rootstocks

National and International Publications in 2017

International publications – 18 articles

No.	Journal Title	Article Title
1.	Food Control	Utilization of Shellac and gelatin composite film for coating to extend the shelf life of banana
2.	Atomization and Sprays	Multiresolution reconstruction of local drop-sized distributions and liquid volume concentration from finite-width laser diffraction data
3.	International Journal of GEOMATE	Feasibility study of biodiesel production from residual oil of palm oil mill effluent
4.	Acta Horticulture	Cloning and sequence analysis of chalcone synthase gene in *Curcuma alismatifolia*
5.	Acta Horticulture	Evaluation of *methylbromide* alternatives to control thrips in orchid cut-flowers
6.	Biodiversitas	Morphological characteristics and molecular identification of a wild Thai isolate of the tropical mushroom Hed Taen Rad (*Macrocybe crassa*)
7.	Key Engineering Materials	*In vivo* testing of sericin-polyurethane nanofiber mats for wound healing in rats
8.	CMU J.Nat.Sci.	Characterization of bio-oils from Jatropha residues and mixtures of model compounds
9.	J.Chromatography B	Purification of β-mannanases derived from *Bacillus subtilis* ATCC 11774 using ionic liquid as adjuvant in aqueous two-phase system
10.	Malaysian Journal of Microbiology	Identification and lactic acid production of bacteria isolated from soils and tree barks
11.	Malaysian Journal of Microbiology	Identification and lactic acid production of bacteria isolated from soils and tree barks
12.	Ferroelectrics	Enhanced sinterability and electrical properties of Bi2O3-added Ba0.85Ca0.15Zr0.1Ti0.9O3 ceramics
13.	J.Nanosci.Nanotech.	Characterization of phase evolution, microstructure, and electrical properties of sol-gel auto-combustion derived BCZT ceramics
14.	Edinburgh Journal of Botany	Curcuma prasina (*Zingiberaceae*), a new species from Thailand
15.	Carbohydrate polymer	Thiolated pectin-doxorubicin conjugates: Synthesis, characterization and anticancer activity studies

16.	J.Rail& Rapid Transit	Influence of toe load on the fatigue resistance of elastic rail clips
17.	European review for medical and pharmacological sciences	Bioactivities of crude mucus proteins from *Eudrilus eugeniae* (African night crawler) and *Perionyx excavates* (Blue worm)
18.	International J. Systematic and Evolutionary Microbiology	*Streptomyces cerasinus* sp. Nov., isolated from soil in Thailand

National publications – 18 articles

No.	Journal Title	Article Title
1.	Food and Applied Bioscience Journal	Production of mushroom protein hydrolysates by enzymatic hydrolysis and their physicochemical properties
2.	Thai Journal of Pharmaceutical Sciences (TJPS)	Comparison of *Spilanthesacmella* (L.) and *Zanthozylum limonella* Alston: comparisons and analgesic effect in rats
3.	Thai Journal of Pharmaceutical Sciences (TJPS)	Pilot study of anti-nail fungal infection efficacy of nanoemulsion cream containing *Eleutherine americana* (Aubl), Merr. extract
4.	Thai Journal of Pharmaceutical Sciences (TJPS)	Development and validation of HPLC method for curcumin in joint pain relief gel containing *Zingiber cassumunar* Roxb. extract
5.	Thai Journal of Pharmaceutical Sciences (TJPS)	Phytochemical constituent and antioxidant activity of Yanang (*Tiliacora triandra*) leave ethanolic extract
6.	Thai Journal of Pharmaceutical Sciences (TJPS)	Total phenolics content, free radical scavenging capacity and tyrosinase inhibition activity of various edible mushroom extracts
7.	Thai Journal of Science and Technology	Propagation technique for indigenous fruit plant “Nom Chang (*Uvaria cordata* L.)”
8.	Thai Journal of Science and Technology	Efficiency of Konjac coating agent for postharvest prolonging shelf life of tangerine orange (Citrus reticulate Blanco.)
9.	Thai Journal of Science and Technology	The interspecific hybrid plants (*M. alba* x *M. keithii*) in genus Mitrephora of Annonaceae family
10.	Thai Journal of Science and Technology	The interspecific hybrid plants (*M. alba* x *M. sirikittiae*) in genus Mitrephora of Annonaceae family
11.	Thai Journal of Science and Technology	Influence of auxin on rooting and growing of ornamental sweet potato
12.	RMUTT Science and Technology	Identification of pig DNA using loop-mediated isothermal amplification
13.	Khon Kaen Agr. J. (แก่นเกษตร)	Effect of alumina particle film on growth rate of Chinese morning glories

14.	Songklanakarin J. Pl. Sci.	Tissue culture of herbal plant, *Kaempferia parviflora* Wallich. Ex Baker
15.	Songklanakarin J. Pl. Sci.	Effect of harvesting time on yields and nitrate production of *Murraya siamensis* Craib leaves
16.	Songklanakarin J. Pl. Sci.	Effect of growing media on growth and yields of edible fern (*Ceratopteris thalictroides* (Linn.) Brongn)
17.	Isan Journal of Pharmaceutical Sciences	Effect of liquid and solid fat on physical characteristics, particle size, zeta potential, viscosity, and pH of the preparation of nanometer -sized fat carrier particles
18.	Isan Journal of Pharmaceutical Sciences	Effect of liquid and solid fat on physical characteristics, particle size, zeta potential, viscosity, and pH of the preparation of nanometer-sized fat carrier particles

National and International Proceedings – 14 papers

No.	Conference	Paper Title
1.	The Pure and Applied Chemistry International Conference 2017 (PACCON 2017)	Pyrolysis of palm oil in a continuous flow micro channel reactor
2.	The Pure and Applied Chemistry International Conference 2017 (PACCON 2017)	Synthesizing biodiesel from high free fatty acid feedstock with super critical methanol in micro-tubular reactor
3.	The Pure and Applied Chemistry International Conference 2017 (PACCON 2017)	Co-pyrolysis of glycerol and palm empty fruit bunch: A preliminary study via PY-GC/MS
4.	The Pure and Applied Chemistry International Conference 2017 (PACCON 2017)	Upgrading of pyrolysis Eucalyptus bio-oil over Ni/Al2O3 catalyst
5.	The Pure and Applied Chemistry International Conference 2017 (PACCON 2017)	Esterification of high acid value oil by carbon-based solid catalysts
6.	The Pure and Applied Chemistry International Conference 2017 (PACCON 2017)	An enhanced photocatalytic activity of methylene blue using visible light responsive V-doped TiO2 nanoparticles

7.	The Pure and Applied Chemistry International Conference 2017 (PACCON 2017)	Catalytic methanol conversion to hydrocarbons in batch reaction using solid acid catalysts
8.	The 2017 International Electrical Engineering Congress (iEECON2017)	Formation and electrical properties of lead zirconate titanate films on platinum substrate by electrophoretic deposition
9.	The 13th Conference on Energy Network of Thailand	Methanol synthesis via biogas catalytic reforming over Ni-based catalysts
10.	The 13th Conference on Energy Network of Thailand	Catalytic methanol conversion to hydrocarbons in fixed-bed reactor by using H-ZSM-5 catalysts
11.	The 9th Electrical Engineering Network (EENET) Conference at Rajamangala University of Technology	The preparation and microstructural study of thin film PZT by electrophoretic deposition
12.	The 1st International Workshop on Structural Health Monitoring for Railway Systems	The study on the influence of toe load on the failure of railway fastening system in a Thailand MRT project
13.	The 25th European Biomass Conference and Exhibition	Value enhancement of microalgae utilization employing mild extraction and hydrothermal liquefaction for protein and bio-crude production
14.	The 2nd International Conference on Herbal and Traditional Medicine	Research and development of dietary supplement from bioactive compounds in Thai grape seeds

Science and Technology Services

In fiscal year 2017, TISTR had overall results in science and technology services as follows: a total of 2,733 users of industrial services, with quality assessment and accreditation services of 329 items, analysis testing, and calibration services 148,307 items, skills development and upgrade the country's workforce skills to highly skilled workforce by providing training services of 58 courses.

As TISTR is an agency that provides comprehensive science and technology services and has been accredited in accordance with international standards such as ISO/IEC 17020, ISO/IEC 17021, and ISO/IEC 17025 and provides servicesby 3 major groups as follows:

Analysis and testing services of product samples, instrument calibration, and quality system certification

1) Analysis/testing of materials and products according Thailand and international standards/regulations.

2) Calibration of all fields of industrial measuring instruments of metrology of which services can be provided both on and off-site.

3) Performance testing and failure analysis of materials, equipment, and machinery in industrial plants.

4) Inspection body servces for boilers, liquefied petroleum gas cylinders, and pressure regulators.

5) Quality system assessment and certification in accordance with various standards such as ISO9001, ISO14001, TIS/OHSAS 18001, ISO 22000, GMP, HACCP, including Thai travel standards.

2. Services for supporting Industry 4.0

1) Analysis and testing services for railway transportation safety standards by TISTR : Railway Transportation System Testing Center (RTTC) which has served for 2 leading domestic rail parts manu facturers, i.e. Xenix- Electech Co., Ltd. and Sakdaporn Industry Co., Ltd. In addition, RTTC also conducted 13 rail tests that could reduce the export of rail parts from being tested abroad at the amount of 5,805,513 Baht.

2) Assessment and products certification services such as products made from biodegradable materials and bioplastic products (for specific purposes) in cooperation with the Thai Bioplastics Industry Association (TBIA), which has selected products for testing in order to improve the quality to be exported to the ASEAN markets for six products, as In 2017, there were 2 laboratories which were firstly accredited in Thailand according to TIS 17025 - Degradable bioplastics, and tourism services for tourism activities in compliance with Thailand Tourism Standard of the Department of Tourism, Ministry of Tourism and Sports.

3. Training/Consulting Services

1) Training/consultancy services for laboratory quality system according to ISO/IEC 17025 and related technical knowledge such as quality management system, failure analysis techniques, and risk assessment

2) The project on an in-depth study on the impact of the enforcement of the guidelines and methods for Good Distribution Practice for Medical Devices (GDPMD) in collaboration with the Medical Device Control Division, Food and Drug Administration (FDA).

Commercial Technology Transfer

TISTR is an innovation-driven organization having its mandates to meet the country's demands under Thailand 4.0 policy. The mission is to conduct research and development of which outcomes in Science, Technology and Innovation (STI) R&D projects and various types of contract research will lead to utilisation, In 2017, TISTR transferred technology commercially as follows:

Research and development in semi-instant birds' nests product to Mr. Prakob Boonchuayperm - anentrepreneur in farming bird 's nest and producing bird's nest products as a main business, who aimed to bring raw produce of birds' nests to be developed as a semi-instant dried birds' nests product which was ready-to-eat by adding hot water. This technology transfer can be used as a guideline in developing semi-instant birds' nests product and commercial production in the future. The transfer was carried out by Expert Centre of Innovative Food Products.

Study of biological activities and development of facial nourishing product from cartilaginous fish to Pinmisa community enterprise. This community enterprise group that manufactured cosmetics for both domestic and overseas sales was interested in further research of exploitation of cartilaginous fish extract for development into cosmetic products. The project was carried out by Expert Centre of Innovative Herbal Products.

Transfer of gantry robot raw material sampling machine with automatic computer control to CPF (Thailand) Public Co., Ltd. This sampling machine had its good point in the optimum use of the entire space cab of a pickup truck. It was also fully automated control and had been reviewed for several times. Passing the continuous improvement, it had been developed and revised of many week points so as to work more rapidly. Designed and developed by Thai researchers, the sampling machine can help reduce loss in import volume and also enhance staff expertise while strengthening sustainable Thai industrial sector.The project was carried out by Expert Centre of Innovative Industrial Robotics and Automation.

Research and development on pilot scale production of biomethanol from carbon dioxide separated from biogas for a capacity of not less than 1 liter per day to R. E. Power Service Co. Ltd. and Cryotech Co. Ltd.

TISTR conducted the project of a methanol synthesis reactor byautothermal reforming in continuous mode of 0.1 litre per day capacity in the 2010-2012 fiscal budget. This project was recently patented covering the process and production system of biomethanol from carbon dioxide together with biogas and water. However, such process is a laboratory scale and its capacity is not sufficient for industrial sector. From this success, R. E. Power Service Co. Ltd., a leading company in biogas production from cassava and palm wastes, and Cryotech Co. Ltd, which had the potential of biogas separation, were interested in expanding the results for further steps in conducting feasibility project concerning investment in the production of biomethanol from carbon dioxide separated from biogas. This aimed to increase the opportunity in business competitiveness for the biogas production by developing into other products, apart from utilisation in electricity production by investment in research to obtain engineering data and to assess the rate of return for economic potential in industrial production of biomethanol from carbon dioxide separated from biogas. The project was carried out by Expert Centre of Innovative Clean Energy and Environment

Project of inspection and certification services of liquefied petroleum gas tanks to Thai Gas Cylinder Co.Ltd.

These services were offered to entrepreneurs on the basis that they were realised of TISTR's role as an institute providing independent audits in quality of various industrialproducts.Moreover,TISTRhasbeencertifiedbysome government agencies, which are Department of Energy Business and Department of Land Transport, and has been approved by the agencies in Israel and Hong Kong as an independent audit in inspecting for quality of tanks and valves for liquefied petroleum gas. Inspection and certification services are part of industrial promotion policy for export. This project was carried out by Expert Centre of Innovative Clean Energy and Environment

Project of packaging development and technology transfer for Kayee Kaew (cashew nut snacks) to Methee Phuket Co. Ltd. - an OTOP entrepreneur who produces and sells cashew nut products and various local goods of Phuket province. The company has developed value-added cashew nut products by processing pieces of cashew nuts into bars similar to sweet peanut snack. The entrepreneur also had a purpose of developing the structure and graphics of a new packaging style suitable for easy-to-eat snacks having the product filled in small laminated sachets, then stored in a large stand-up zip lock pouch containing 15 sachets. The packaging material used should maintain the product quality and taste while being attractive, modern and having longer storage period. The laminated sachets also provided good protection from moisture and oxygen,This project was carried out by Thai Packaging Centre.

In addition, TISTR has networks and integrated cooperation with government agencies, government organisations, state enterprises and private sector to support implementation of scientific research and development, technology transfer with international quality standards for increasing competitiveness of Thai small and medium enterpreneurs (SMEs) by meeting the real needs and practical usage of entrepreneurs, as well as expediting the action plan and pushing toward mechanisms, tools and convenience systematically for technology transfer and implementing the results of science, technology and innovation for commercialisation under the Innovative Startup from the Office of Science and Technology for 2 projects and Innovation Coupon form National Innovation Agency (Public Organisation) for 1 project, respectively, as follows:

Technology transfer of production of VITISTRA nanocosmetics essence face nourishing serum from oligomeric proanthocyanidin extract from grape seeds for commercialisation to Cosceutic Innovation Laboratories Co. Ltd.

Technology transfer of freeze-dried strawberry and pineapple products fortified with probiotic (Profruit) to Greater Pharma Co. Ltd.

Development of formulation and production process of healthy sugar-free ice cream in ice cream and instant ice cream powder with no refined sugar to Chiang Rai Homemade Ice Cream Co. Ltd.

Social Technology Transfer

TISTR has transferred technology to farmers, community enterprises and the public on a basis of bringing Science, Technology and Innovation (STI) to a concrete utilisation, thus leading to promoting farmer careers, community enterprises, adding value to local products, and developing production processes to meet standards. TISTR has diversities of expertise in transferring technologies such as agricultural technology, agricultural produce processing, food technology, manufacturing of interlocking blocks and construction, ceramic fabrication technology, machinery technology, energy and environment technology, etc. In 2017, there were a total of 5,329 social customers. Major activities were as follows:

Food processing from agricultural produce to promote alternativecareer for community enterprises in the southern part of Thailand. Technologies of processed products for oversupply agricultural produces, such as banana, cassava, lukyee (Dialium cochinchinese) and Champedak (Artocarpus integer), were transferred to interested target groups at the levels of community enterprises and SME's industry. Then, TISTR conducted a follow-up and technology transfer evaluation to ensure that the customers would be able to produce and make additional incomes.

Technology transfer of community fertilizer production and enhancement of organic fertilizer plant for sustainable fertilizer production. Using residual materials locally available in the community to produce organic fertilizer could help farmers in lowering fertilizer production costs. There were farmer groups attending in technology transfer totaling 14 provinces, which were Buriram, Kalasin, Bueng Kan, Maha Sarakham, Mukdahan, Lamphun, Roi Et, Udonthani, Nong Khai, Pathum Thani, Yasothon, Amnat Charoen, Surin and Nakhon Phanom.

Transfer of organic farming practices or good agricultural practices (GAP) standard. Technical workshop on good agricultural practices, crops, foods complied with GAP were organised in Nakhon Ratchasima province, and Bueng Kan province. Three technologies developed

were microorganisms for promoting rice growth good agricultural practices for mushroom production technology and production technology of antagonistic microorganisms for preventing bacterial leaf blight of rice.

Technology transfer of enhancing productivity and community crop value, Prachuap Khiri Khan province. Postharvest technology transfer of fresh pineapple fruit to alleviate internal browning symptom in fresh pineapple fruit and provide consulting service in packaging, as well as technology transfer of processing of food and drink products from pineapple to pineapple planting farmer group in Prachuap Khiri Khan area for domestic and export sales.

Technology transfer of microorganisms for controlling bacterial leaf blight of rice for 2 times to farmers inSrisaket province and Nan province by giving knowledge about disease and insect pest of rice, plant

disease component, microbial control mechanisms and simple microbial cultivation method, etc.

Technology transfer of off-season lime production and lime processing in Phitsanulok province and Chanthaburi province, emphasizinng on productivity and quality of produce, reducing production costs from using chemicals, fertilizers and hormones.

Technology transfer of bio-fertilizer production using wastes from papers factory in the area nearby in Kanchanaburi province, helping reduce costs in agriculture for farmers more than 10%.

Technology transfer of interlocking blocks manufacturing and construction of buildings from interlocking blocks for 2 times to Karen Group organised by the Christian Foundation Chiang Mai province and those interested in Amphoe Kantharalak Srisaket province.

Development and enhancement of OTOP, ceramics and pottery products by transferring design technology and developing production process to enhance OTOP ceramic products to 3 groups at Lampang province, Kalasin province and Songkla province.

Develoment of harvesting process, postharvest process and longan processing to increase the effectiveness of residue control to meet standard requirements for export, in which TISTR provided guidelines and solutions to problems of entrepreneurs of a longan fumigation plant in Lamphun province's area by modifying a nonstandard fumigation plant to obtain certification for a standard longan fumigation plant.

Training and transfer of knowledge and innovation of value added production of charcoal from fruit peels and aroma scented charcoal to Tandaew Subdistrict Administrative Organisation, Saraburi province in order to reduce environmental problem, create community income, and create work and career.

Transfer of knowledge in water hardness andtest method for water hardness. Reduce hard water problems by water softening material from biomass ash capable of turning hard water into drinking water.

Training and transfer of knowledge in biogas production from liquid food waste, construction of fermentation tank and operating procedure.

Reduction of malodur and problems resulting from liquid food waste. Increase value of domestic food waste.

International Collaboration in 2017

In fiscal year 2017, TISTR collaborated with those international organisations in various kinds as follows:

Collaboration under the MOU with the institutes

In 2017, TISTR had 32 projects collaborated with the international institutes in bilateral level with those in ASEAN member countries, dialogue partners of ASEAN+6, and in oversea e.g. France, United Kingdom, Germany, including the multilateral level by participating in the Asia-Pacific Metrology Programme (APMP).

Examples of current collaborative activities

Organisation	Activities
Universiti Kabangsaan Malaysia (UKM),Malaysia	The researchers selected the 4 nitrogen-fixing algae strains that had the potential growth in the waste water from the production of Palm Oil Mill Effluent (POME) from the 30 strains.Then they stimulated the starter of those algae to test the color reduction in palm oil waste-water.
Renewable Energy and New Materials Institute (REMI), Lao PDR	TISTR delegation participated in the JC Thai-Lao PDR Meeting during 1-2 February 2017 in Le Meridien Hotel, Chiang Rai. At the meeting, TISTR presented the topics of collaboration with REMI e.g. a survey on the status of biodiesel production in Lao PDR, joint international conference on energy strategy, training for REMI researchers on high-quality biofuel production. 
Biomedical Research Institute (BMRI) under National Institute of Advanced Industrial Science and Technology (AIST), Japan	TISTR researcher participated in the Intensive Exchange Program at BMRI, AIST during December 2016 – March 2017. She learned the safety evaluation in laboratory, technique on cell culture, cell senescence assay, cell synchronize assay, ICC technique, and conducted research on anti-aging and anti-melanogenesis. 

New Collaborations

In 2017, TISTR developed new collaboration with the important institutes in other countries as follows:

National Agriculture and Food Research Organization (NARO), Japan.

The executives of TISTR visited NARO, Tsukuba in April 2017 and discussed the collaboration in food technology, agricultural robotics, plant gene improvement. After the visit, TISTR received honor from NARO's researchers namely Dr. Baltazar Antonio, Senior Principal Researcher, and Dr. Mari Maeda-Yamamoto, Director of Division of Food Function Research, Food Research Institute (NFRI)who accepted to be the speaker at TISTR's International conference on ASEAN+6 Organic Agriculture Forum, ASEAN Workshop on Development of Functional Food based on Antioxidant. After being a speaker, both sides discussed the collaboration respectively.

University of Science and Technology of China (USTC), China

TISTR was interested in the collaboration on food technology with this university. Besides, Prof. Dr. Xuebin Yin, Director of Key Lab for Functional Agriculture, USTC was one of the speakers at the ASEAN+6 Organic Agriculture Forum held by TISTR.

Collaborations with other important partners

1. TISTR received support from these important partners from overseas namely Japan Analytical Instruments Manufacturers' Association (JAIMA) , National Metrology of Japan (NMIJ), and Chinese Academy of Science which participated in displaying at the exhibition booth at the TISTR's From Local to Global International Forum: Food Industry 4.0.

2. As being member of The World Association of Industrial and Technological Research Organizations (WAITRO), Dr. Luxsamee Plangsangmas, Governor of TISTR was selected to be a Regional Representative for Asia and the Pacific during 2017-2018, and TISTR had benefits and opportunities to participate in many events and training programmes held by the WAITRO member organizations as follows:

a. WAITRO – ISESCO – LIPI Research Technology Organization (RTO) Management Program Workshop during 16-19 May 2017 in Bandung, Indonesia. At the workshop, Dr. Luxsamee Plangsangmas, Governor was a speaker and provided her presentations namely (1) Creating Values from R&D and Commercialization of Technology, (2) Future Trend of Food Research. Besides, she was also a panelist at the session Asia and the Pacific Technology Forum – Opportunity, Challenges & Forecast.

b. Jiangsu, China – 2017 Cooperation Symposium for Top Universities and Institutes during 5-6 July 2017 in Nanjing, China. Mr. Wirach Chantra, Deputy Governor Industrial Services presented the introduction to TISTR, being the WAITRO member, and potential to collaborate with China. Also, TISTR participated in the exhibition on technology transfer and S&T services showed.

c. APEC Symposium on Policy and System for Promoting Micro, Small and Medium Enterprises (MSMEs) Modernization toward Industry 4.0 during 22-25 September 2017 in Hangzhou, China. TISTR delegations were invited to be the speakers to shared experience on policy and MSMEs promotion in Thailand.

3. Mr. Fortunato T. De La Peña, Secretary of Department of Science and Technology and Seniors Officials on STI Cooperation, Philippines visited TISTR Technopolis on 25 August 2017. Both sides discussed the collaboration concerning biomass and agricultural innovation.


TISTR