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**ScienceDirect**

Procedia Engineering 212 (2018) 519–526

**Procedia  
Engineering**

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7th International Conference on Building Resilience; Using scientific knowledge to inform policy and practice in disaster risk reduction, ICBR2017, 27 – 29 November 2017, Bangkok, Thailand

## University-Industry Linkages in the Disaster Resilience Sector: A Case Study of Thailand

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### Abstract

University-industry linkages in the Disaster Resilience Sector in Thailand were studied at two main levels: the national level and the institutional level. Comparisons were made of specific data such as the linkage structures, lessons learnt, policies and barriers, between Thailand and developed countries such as the United Kingdom. This analysis was done to identify the key elements, factors and contexts in constructing and maintaining university-industry linkages in various spectrums and approaches, and to apply these to the Disaster Resilience Sector. These results can be further developed as guidelines for universities in developing countries that wish to develop university-industry linkages. The study also addressed a specific university-industry linkage called 'secondment plan' which includes university policies on the detachment of university staff from their regular work or position in the university for temporary assignment in industry sectors. For this part, the Talent Mobility Project, a governmental project that supports Thai university staff, particularly academic staff, in doing cooperative work with the industry sector, was analysed. This project is the responsibility of the National Science Technology and Innovation Policy Office (STI) of Thailand. The weakness and the strengths of this project were identified through interviews with senior staff of STI, Science Park and Naresuan University. The results have been developed into a guidelines model for universities in developing countries.

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Peer-review under responsibility of the scientific committee of the 7th International Conference on Building Resilience.

*Keywords:* University-Industry Linkages; Secondment Plan

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## 1. Introduction

Previously in Thailand, university-industry cooperation was established through training activities, provision of services and consulting, and research work [1]. Most of the cooperative work was based on personal contact between academia and industry. Recently the “University-Industry Linkages (UILs)” programme has been promoted by Thai government. UILs are of benefit not only for research and development (R&D) but also to exploit synergies and complementarities of scientific and technological capabilities between, especially, the developing countries. The UILs have been successful in increasing new product introduction and issuing of patents as a result of such collaborations [2]. UILs can expand the relevance of research carried out in public institutions, foster the commercialization of public R&D outcomes, and increase the mobility of labor between the public and private sectors. Typologies of UILs can vary from low to high intensity, depending on the objectives, scope and institutional arrangements. The activities in each level of intensity of the linkages are: in the low intensity linkages, transferring and commercialization of intellectual property, scientific publications, and informal interaction. The medium intensity linkages imply mobility of participants and functions such as academic entrepreneurship and human resource training and transfer, and closer relationships are envisaged in high intensity linkages including research partnerships, research services and shared infrastructure [3]. As well, skill development can be done through the UILs, including education and training, the generation, acquisition and adoption of new knowledge (innovation and technology transfer), and the promotion of entrepreneurship via start-ups and spin-offs [4].

UILs may take place with different focuses depending on the university’s mission. Such focus may be on training in the teaching university, on R&D in the research university, and on technology commercialization in entrepreneurial university [5]. UILs may be short term or long term collaborations. Short-term collaboration generally consists of on-demand problem solving with predefined results and tend to be articulated through contract research, consulting, and licensing. Long-term collaborations are associated with joint projects and public-private partnerships including privately-funded university institutions or chairs, joint university-industry research centers, and research consortia [6].

Thailand has been stuck in a middle-income trap for over 20 years. In 1999 the Triple Helix system of innovation [8], a tool to strengthen the connection of government, university and industry in Thailand, was introduced by STI as a tactical process aimed at pulling Thailand out of the middle-income trap. This model was superseded in 2016 when the Thai Government launched a new campaign entitled Thailand 4.0 which is a new tactical and economic model with similar intentions to push the country into the high-income range. The government aims to enhance the country’s standing and to become a high-income nation through development of its knowledge-based economy with an emphasis on research and development, science and technology, creative thinking, and innovation. The key components in the country’s national innovation system are the UILs which can help Thai producers to initiate, import, modify and diffuse technology [7].

Thailand is located in an area with a low frequency of usually low intensity disasters. Big disasters rarely happen in Thailand, notwithstanding the disaster of the great flood in 2011 and the tsunami in 2004. Disaster resilience (DR) research work is not therefore considered as a priority research focus group in Thailand 4.0 which is more focused on economic development rather than social development. Research funding is usually allocated according to national priorities, meaning that researchers should tie their research work in the DR area into one of the main priority national research fields to receive funding. Industry, in the DR sector, means all of government organisations, non-profit organisations and the private sector as a whole.

Therefore, the objectives of our research, as will be presented in this paper, were to explore the situation of UILs in Thailand, especially in the field of disaster resilience, and to analyze the “University-Industry Linkages (UILs)” programme at two main levels: the national level and the institutional level, and to compare the linkage structures, lessons learnt and policies and barriers identified from these activities in Thailand and developed countries, such as the United Kingdom (UK). The research methodology of the study included a literature review and data collection through in-depth interviews with senior officials, and content analysis of the interview responses. The study concentrated on a specific UIL called ‘secondment plan’, which covers university policies for the detachment of university staff from their regular work or position for temporary assignment in industry sectors.

## 2. Analysis of University-Industry Linkages (UILs)

The UILs have been promoted by Thai government for increasing industry's competitiveness. The knowledge of science, technology, R&D and innovation emanating from universities has been applied for solving industry's problems. The potential linkages are initiated from policies and operations on different levels from national to institutional. The findings of all levels of the UILs were explored from content analysis of UIL policy documents and in-depth interviews. Subsequently, the relationships between the various Thai UILs were investigated and developed to explain the linkages between national and institutional levels as well as amongst the stakeholders. In addition, the enablers and barriers in and of the UILs were compared between the Thailand and UK cases to develop suggestions for the improvement of the Thai UILs. The common elements and policy points relevant and particular to DR were identified. These are as follows:

### 2.1. National Level

The three main matters of interest in the UILs, at the national level, are (1) the policies and strategies described, (2) the national policy regarding the development of action plans based on the policies, and communications with relevant stakeholders, and (3) the provision of services, resources, and budgets for basic infrastructure development.

At the national level, the policies and strategic plans related to the UILs have been developed by the Thai government sector. These are very significant for matching with university capabilities and local needs to utilize science, technology, R&D and innovation actions and research for driving economic growth and solving social problems [9]. The three dominant aspects of applying science, technology and innovation throughout the National Policy and Plan of Science Technology and Innovation (2012 - 2021) are (1) local, social and communities strengthening, (2) improving productivity of agriculture, manufacturing, and service sectors, and (3) supporting security of energy, natural resources and environment [10]. Recently, a new paradigm, called "Thailand 4.0", has been devised for the development of the Thai economy with advanced science, technologies, and innovation. This also emphasizes The Internet of Things. This has been established by the government in order to build smart government units, industry sectors and organisations, and communities, for the purpose of achieving global competitive advantage [11]. Therefore, the UILs are now necessary because these governmental and industry organisations need specialists from universities to assist and cooperate with them to achieve the proclaimed goals of Thailand 4.0.

The national UILs' policies and strategies have been deployed through the Thailand Research Organisation Network (TRON) and the various Ministries; viz. Education, Science and Technology. The national UILs' policies and strategies have involved matters relating to resources and budget support, basic infrastructure provision, and UIL development programmes promotion. The successful UILs need the cooperation among policy makers and availability of resources from the government sectors, expertise from universities and research institutions, and meeting the technological development needs of industry [12]. The related national policies and strategies of the UILs are mainly generated from the TRON, the Ministry of Education and the Ministry of Science and Technology (see Table 1).

Table 1. An example of research and development (R&D) in national and ministries' policies and strategies.

| Source of strategies                          | Example  |
|---|--|
| Government strategy                           | To develop and promote the utilization of science, technology, R&D and innovation  |
| National research strategy (TRON)             | To support R&D for achieving the goals of the National development plan, strategy and missions of government units<br>To support and promote R&D in the private sector<br>To establish the mechanisms of applying research output, knowledge and innovation for social and economic development<br>To integrate the research system for unity and sustainability of research activities in the future<br>To strengthen the basic infrastructure of R&D<br>To increase the number and capability of research staff for support the upgrading of national competitiveness<br>To build a research network at both national and international levels |
| Ministry of Education's strategy              | To support research for national development<br>To increase the research capabilities of academic staff  |
| Ministry of Science and Technology's strategy | To accelerate research development and innovation for social and economic development and to transfer knowledge into industry, agriculture, the service sectors, communities and society in general  |

TRON has played a significant role for supporting and managing of funds and scholarships for research projects. To solve industry and community problems, research projects have been sought from and proposed by university academic staff who have responded to those industry and community needs.

Furthermore, the UILs have been promoted by various programmes from many ministries. Most ministries have collaborated with universities in order to transfer advanced knowledge, technology and innovation for achieving the ministries' missions and serving their responsibilities to support industries and communities. The three types of activities of UILs include training and education, service and provision of consulting services, and research work [1]. However, these activities have been focused on different and diverse approaches. The government has classified two main groups of universities in order to promote and allocate resources and budgets related to their different missions. The two groups of universities are teaching-based universities and research-based universities. The teaching-based university emphasizes teaching and learning, focusing on developing a set of courses to be taught at both the undergraduate and graduate levels, with budgets to support improvements in teaching resources, and the objective of producing quality graduates to serve the private sectors in labor market. On the other hand, the research-based universities have the primary role of undertaking research, supported by research budgets and resources from the government with the mission to produce and publishing research papers and increasing the number of research projects in the areas of science, technology, R&D and innovation to serve needs of industry and the and community.

When compared with the UK, the allocation of R&D funding suggested by Hughes [13] has been done in a similar way in Thailand: i.e. funding support from government sectors such as the Research Council, the Ministry of Science and Technology, the Ministry of Education, and other Ministries. In the EU, the sources of research funding is different to the situation in Thailand. In the EU, research funds are received from the EU Framework Programme. In addition, UK companies who invest in R&D can get special tax credits from the Treasury and the Inland Revenue Department. The mechanisms of UILs in the two countries, the UK and Thailand, are different. The UIL activities in Thailand are mostly pushed by universities and ministries in order to achieve only KPI goals, but in the UK the UILs are pulled from industries' needs which require knowledge from universities to meet those needs.

## 2.2. Institutional Level

Management and operational decisions from inside the universities are the main mechanisms driving the UILs in Thailand. Management support includes statement of university policy, the development of the UIL networking environment or eco-system, the development of the basic research infrastructure: resources, database, budgets etc. Effective administration is also provided to facilitate academic staff in easily becoming involved in and cooperating in the UILs. The functions comprised in the UIL relevant to university staff at both the management and operational levels (academic staff activities and responsibilities) are exhibited in Table 2. The academic staffs need to be strengthen their capacity through these three activities for serving industries' and communities' needs inevitably.

Table 2. Functions of management and academic staffs involved in the UILs

| Level             | Function  | Detail  |
|-------------------|---|---|
| Management level  | <ul style="list-style-type: none"> <li>• Policy Development and Deployment</li> <li>• Basic Infrastructures</li> <li>• UIL Environment support</li> </ul> | <p>Generating and deploying university policies to strive 4 missions; teaching, research, academic service, and preservation for Thai culture and relate to UILs</p> <p>Establishing basic research infrastructures included (1) budget (2) human resources both academic and supporting staffs (3) facilities and services</p> <p>Supporting research culture and network to encourage staffs for cooperating research between university and industries</p> |
| Operational level | <ul style="list-style-type: none"> <li>• Training and Education</li> <li>• Service and Consulting</li> <li>• Research</li> </ul>                          | <p>Providing curriculum and training courses for serving industries' needs</p> <p>Transferring knowledge, technologies and innovation for solving industries' problems</p> <p>Developing co-research projects and applying research outputs to support industrial development</p>   |

In Thailand, there are three processes for industries and communities to submit requests for support These processes are appropriate to national organisations (Ministries etc.), to universities, and at the academic personnel level. Firstly,

the target missions for supporting industries and communities at the national level have been identified and stated in government policies and budgets. Secondly, universities can focus on specific problems relevant to local needs, at the community, provincial or regional levels. As well, university researchers can individually cooperate with industry by applying their specialized knowledge and technology and may receive funding from those industry organisations. This is illustrated in Fig. 1.

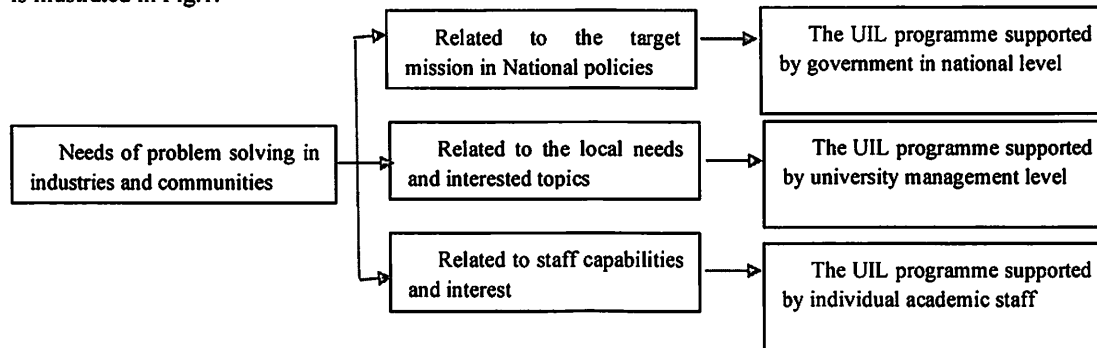


Fig. 1 Three patterns of involvement in the UILs

In Thailand, cooperative working between universities and industry sectors has been happening over a long period, even before the launching of the “University-Industry Linkages (UILs)” programme. The cooperation envisaged within UILs can be follow either the formal and informal patterns [1]. The formal patterns stated in the UILs are recognized in “Memorandums of Understanding - MoUs” by university administrators and industrial entrepreneurs. The action plans for working together to achieve the cooperating organisations’ goals rely on the provisions of the MoUs. However, numerous informal activities related to the UILs which have not been specified or envisaged in the MoUs, or in cases where there has not been a formal MoU signed, are undertaken between the university participants and the industry participants, such as advisers from industry presenting at the university, and university academics operating in the industrial organisation offering advice and expertise.

### 2.3. The relationship of UILs between National and Institutional levels

The UIL models that have been developed for the national and institution levels, are illustrated in Fig.2. The two Ministries that have key roles and responsibilities for transferring knowledge and technology on UILs are OHEC in the Ministry of Education and the Ministry of Science and Technology. However, in the DR area, the Department of Disaster Prevention and Mitigation in the Ministry of Interior has a role in cooperation with universities under these UILs.

### 2.4 The Enablers and Barriers of the UILs in National and Institutional levels

National policy development in UK and Thailand is both enabler and barrier. Recommendations on policy development in the UK, by Hughes [13], suggest that the keys to success in the development of UIL policies are the integration of existing relevant policies, together with the development of new initiatives. This could apply equally to the development of Thailand’s national UIL policies, particular in DR which requires integration of various national policies. For instance, the policy of disaster management mostly comes from the Department of Disaster Prevention and Mitigation in the Ministry of Interior. In order to effectively manage emergency responses when a disaster occurs, other government Ministries must be involved, such as the Ministry of Transport, the Ministry of Public Health, and others. Knowledge and technology essential for DR must be continuously developed and applied, using the best up-to-date science and technology. As experts and researches are the main developers of knowledge and technology, it is necessary for the Ministry of Education and the Ministry of Science and Technology to have their policies applied to

support disaster resilience. Overall, the number of different Ministries that need to be involved demonstrates the complexity of policy development in DR.

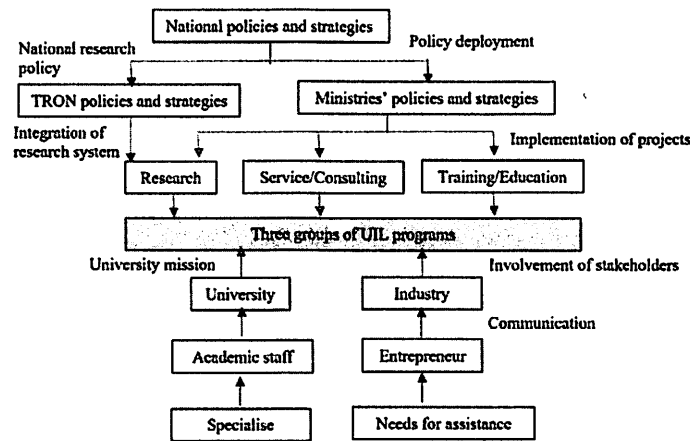


Fig.2 The model of university – Industry Linkages at the national to institution levels

In Thailand, the policies of universities often seem to be barriers, a situation identified by many interviewees in this study. The vision of university administrator teams is required to set research and innovation (R&I) policy as a key success. The collaboration and strengthening of networks for achieving university's missions of UILs are also mentioned as significant policy. University needs to cooperate with all stakeholders among public and private sectors in order to increasing economic growth and solving social problem. In similar to UK, the benefits from collaborative research need to clarify sharing between university and industry, in particular to licensing of R&I output. Moreover, when UILs policy is deployed, the university need effectively communication to faculties for achieving university goals of UILs

The important barriers to implementing UIL supported research and innovation at the Faculty level are lack of basic infrastructures including: (1) human resources both academic and supporting staff, (2) facilities and services (i.e. working space, advanced laboratory, equipment, machine, software, database, IT services etc.), and (3) budget. Therefore, following the deployment of UIL policy, it is necessary to eliminate these barriers by providing sufficient, efficient basic infrastructure. In a developing country such as Thailand, the national budget is limited, and it is suggested that resources sharing system among universities should be applied.

However, barriers to DR research occur at both the national and institutional levels. There is little research available in this area, especially in Thailand, because it is not an important focus in national policy. In this situation, university policy is not given priority and therefore there is little or no provision of sufficient and efficient basic infrastructure (i.e. lack of experts, budget and advanced laboratory equipment) to serve the needs of research in the area of DR.

UILs have been recognized by the Thai government as being useful for serving industries' needs and contributing to economic growth. There are various tactics for strengthening linkages between universities and industry, such as cooperation on curriculum development, internship, cooperative education, joint research project, staff exchange, secondment plans etc. STI launched the secondment plan project called "Talent Mobility" in 2015, which is on-going, in order to be a power tool for achieving UILs.

### 3. Secondment Plan

Secondment is one of a tactics that can be used to strengthen university-industry knowledge and technology transfer relationships. A secondment plan, at the university level, means university policies on the detachment of university staff from their regular work or position, for temporary assignment in industry sectors. Secondment is viewed as a full time stay where the secondee is working alongside the company's staff, effectively as a member of their team [14].

In Thailand, the government, and most universities, realize that the UIL is important but there is no concrete framework or procedure to operate a secondment scheme. The related regulations are also an obstacle to implementation of any secondment scheme within universities. The ‘Talent Mobility’ project that was launched by the National Science Technology and Innovation Policy Office (STI) in 2015 is a project where the government provides funding support to academic staff and institutions; both university and industry, to allow and support knowledge and technology transfer. The purpose of the Talent Mobility’ project is to facilitate the mobility of researchers in government agencies and higher education institutions to industrial sector.

Recently, the Talent Mobility project addressed the food innovation sector. The Thai government deployed the Thailand 4.0 policy to create the concept of a food ‘innopolis’, a global food innovation hub gateway to Asia, with linkage to ASEAN member countries. However, the main subject areas addressed in the Talent Mobility project are related to Thailand 4.0 policies relevant to Food & Agriculture, Health & Wellness, Smart Devices & Robotics, Digital & IoT and Creative & Culture, and there is no specific linkage to research projects that are directly related to DR. Therefore, DR researchers must link their DR research work into one of the main themes of Thailand 4.0, perhaps Food & Agriculture, to raise priority of their DR research to receive funds. Another barrier facing the DR sector is that most of the organisations with an interest or involvement in DR are non-profit organisations, such as the International Red Cross. Given that these organisations are not seen as contributing to economic development, they do not fall into an industry category of interest.

To understand the Talent Mobility project, data collection was done via review related documents and in-depth interviews with the staffs of STI and the Science Park of Naresuan University. The strengths and weaknesses of the project were analyzed and the outcomes are shown in Table 3.

Table 3 Strength and weakness of the Talent Mobility project

| Strength   | Weakness   |
|--|--|
| <ul style="list-style-type: none"> <li>University and industry get funding support from government</li> <li>Researcher can work full time at the industry</li> </ul> | <ul style="list-style-type: none"> <li>There is no IP framework agreement in place, must do it case by case / conflicts of interests between the private sector and government agencies and higher education institutions</li> <li>There is only 1 secondment model which is secondee works within the industry</li> <li>Researcher concerns about their career path and it hard for them to work full time with industry</li> </ul> |

From the lessons learned from our review of [1][6][14] *inter alia*, and our analysis, certain actions and understandings are required to enable and facilitate knowledge and technology transfer between universities and industry in Thailand. These actions include:

- Championship by senior personnel on both sides with clear objectives.
- Management skills are essential.
- Raising the academic standards of Thai universities, setting graduate education and research as core activities of universities.
- Research and Innovation should be aligned with technological needs.
- Investment in the latest research equipment and research funding support.
- Develop IP agreements that do not need frequent refinement or renegotiation.
- Use a variety of secondment models based on the objectives, such as embedded corporate laboratory, secondee work with company teams or secondee works within the corporate partner.
- Clear criteria and incentives to motivate academics to join in the secondment programs.
- Develop appropriate administrative regulations that encourage academics to join the secondment programs

#### 4. Conclusion and Discussion

In Thailand, both government bodies and universities realize that university-industry linkage is important. However, there is a significant lack of concrete frameworks or procedures to define and support the operation of UILs. The related regulations are also obstacles to the implementation of UILs, especially within universities. The ‘Talent

Mobility' project, launched in 2015 by the National Science Technology and Innovation Policy Office (STI), is a project initiative under which the government provides funding support to universities, at both the institutional and individual academic levels, and industry, to facilitate knowledge and technology transfer, and the mobility of researchers in government agencies and higher education institutions into the industrial sector. There are 4 types of activities that the Talent mobility project supports include (1) Research & Development (Basic Research, Applied research, and Translational Research), (2) Technical or Engineering problem solving, (3) Standard test and analysis, and (4) Technology & Innovation management. UILs focusing on disaster resilience have not been of interest to universities and industry partners because it is often unclear who the stakeholders are, and which industry sector they have an interest in, and there are few university experts working in disaster resilience research, and, most importantly, DR is not a main focus in Thailand's national policies.

#### Acknowledgements

This research was supported by the Advancing Skill Creation to ENhance Transformation (ASCENT) project co-funded by the Erasmus+ Programme of the European Union. The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Many thanks to Mr. Roy Morien of the Naresuan University Language Centre for his editing assistance and advice on English expression in this document.

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