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# How can academic innovation performance in university–industry collaboration be improved?

Mu-Hsuan Huang [a], Dar-Zen Chen [b,*]

[a] Department of Library and Information Science, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, 10617 Taipei, Taiwan
[b] Department of Mechanical Engineering and Institute of Industrial Engineering, National Taiwan University, No. 1, Sec. 4, Roosevelt Road, 10617 Taipei, Taiwan

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ABSTRACT

As universities gradually become the center of society's knowledge production system, their role in innovation becomes more diverse. In the pursuit of such a role, universities are encouraged to establish a university–industry collaboration (UIC) context that supports faculties and students to engage in entrepreneurial activities. On the basis of the organizational control perspective, we investigated how UIC factors, namely implementing a formal UIC management mechanism, implementing UIC regulations, and supporting an innovative climate, influence the academic innovation performance of universities. The results of partial least squares analysis of 141 Taiwanese universities showed that UIC-subsidized universities have more advantages for developing their UIC environment and improving academic innovation performance. We found that a formal UIC management mechanism might be the most essential factor for enhancing the academic innovation performance of non-UIC-subsidized universities. Furthermore, the innovation climate was found to moderate the relationship between formal UIC management mechanisms and academic innovation performance.



## 1. Introduction

In the knowledge economy era, universities are vital in the innovation system for contributing to the economic development of a nation (Etzkowitz et al., 2000; Florida and Choen, 1999; Phillips and Eto, 1998; Laredo and Mustar, 2001) through activities such as developing skilled human capital, transferring knowledge and technology to industry, and becoming the seedbed of new enterprises (Lazzeroni and Piccaluga, 2003). This indicates that university roles in knowledge and technology innovation tend to become more diverse (Godin and Gingras, 2000).

The traditional missions of a university are teaching, research, and service to industry. Scholars have claimed that a new aim of universities is to become entrepreneurial universities that contribute to national economic development and that attain a financial advantage through the commercial and industrial application of research (Etzkowitz et al., 2000; Martin, 2003). Currently, universities are implementing various mechanisms for encouraging faculties and students to engage in entrepreneurial activities (Tornatzky et al., 2002).

The ability of a university to engage in entrepreneurial activities is affected by its context, resource-based capability, and capacity (Williams and Kitaev, 2005). Where a university develops its university–industry collaboration (UIC) context influences its ability to become a successful entrepreneurial university; furthermore, an appropriate combination of entrepreneurial activities can maximize its contribution to society. To more clearly understand how academic innovation performance in UIC can be improved, this study investigated the influence of UIC context on academic innovation performance in 141 Taiwanese universities. Three facets of UIC context were investigated: formal UIC management mechanisms, implementation of UIC regulations, and support for an innovative climate.

Prior studies have indicated that collaboration among three institutional spheres, namely industry, academia, and government, can be a critical factor for success in improving regional and national innovation systems (Etzkowitz et al., 2000; Motohashi, 2005; Gibbson et al., 2006). To improve academic innovation, the Taiwan government encourages universities to engage in UIC with industry. Most Taiwanese universities have their own UIC program. Every year, the National Science Council (NSC) of Taiwan calls for UIC proposals from academia and provides financial support to selected universities. We investigated and compared the academic innovation performance of universities with and without government funding from the NSC UIC program in order to determine the effectiveness of the funding. In this paper, "UIC-subsidized" indicates universities whose UIC activity is subsidized by the NSC UIC program, whereas "non-UIC-subsidized" refers to universities that run their UIC program without NSC subsidization.

The remainder of this paper is organized as follows. First, we review the literature related to the academic innovation performance of universities and four hypotheses. Second, we present our data analyses, which are conducted by performing structural equation modeling

* Corresponding author.
*E-mail addresses:* mhhuang@ntu.edu.tw (M.-H. Huang), dzchen@ntu.edu.tw (D.-Z. Chen).

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(SEM) through partial least squares (PLS), which is regarded as one of the most appropriate techniques available for analyzing our type of research model (Chin, 2003). Finally, we discuss our results and provide several implications for UIC research and practice.

## 2. Literature review and hypotheses

### 2.1. Academic innovation performance of universities

Under the framework of the National Innovation System, "innovation" signifies the creation of knowledge or technology (Metcalfe and Ramlogan, 2005). Prior studies have suggested that papers (Rosenberg and Nelson, 1994; Nelson and Rosenberg, 1998) and patents (Pouris and Pouris, 2009) are direct indicators for evaluating knowledge accumulation. For example, Rosenberg and Nelson (1994, 1998) have suggested that papers are critical for industrial technology development. Scientific papers are the only medium of reporting scientific achievements (Wouters, 1998), and citation patterns can also be used for examining knowledge exchange among scientists and interdependencies among disciplines (Small and Garfield, 1985).

In addition to papers, patents have become a key indicator to assess invention performance, the diffusion of knowledge, and the internationalization of innovative activities at different levels (Pouris and Pouris, 2009). Patents have several advantages for use in policy making (earlier, Archibugi and Pianta, 1996); for example, they contain the direct outcome of inventions intended to be used commercially as well as information on the rate of inventive activities, and are easily accessible. Patents are a means of protecting original inventions, and patent data are readily available and operational tools. Thus, this study used the numbers of papers and patents to measure the academic innovation performance of universities.

### 2.2. Development of university–industry collaboration in universities

Organizational controls are the mechanisms utilized by managers to direct the attention and motivation of organization members to perform in desired manners for achieving an organization's objectives (Cardinal, 2001; Snell, 1992). Prior studies have adopted a more instructive viewpoint than the colloquial notion of "control" for explaining control theory; specifically, the studies have described the capabilities of establishing structures and rewards that motivate and influence organization members. For example, Owen-Smith (2001) proposed the notion of scientific skepticism as a form of organizational control in ambiguous managerial situations. This notion can further be categorized as a form of input control in which the professional etiquette and knowledge of actors within an innovative setting facilitate the development of management mechanisms that contribute to the success of the system. Different types of controls have been defined: structural control, also called bureaucratic or behavior control (Lebas and Weigenstein, 1986); input control (Mintzberg, 1983); output control (Jaworski, 1988); market control (Williamson, 1975); cultural control (Wanous, 1980); and integrative control (Roth et al., 1994). In this study, three facets of the control types, namely the formal UIC management mechanism, the implementation of UIC regulations, and the innovation climate, were investigated in the context of UIC development.

#### 2.2.1. Formal UIC management mechanism

Formal UIC management mechanisms are beneficial for interorganizational collaborative relationships (Boardman, 2009; Thune and Gulbrandsen, 2011). Thune and Gulbrandsen (2011) argued that institutionalization facilitates improving the interaction between universities and industry. However, how the changes of formal UIC management mechanisms are implemented has seldom been addressed. The current study contends that implementing formal UIC management mechanisms within universities can facilitate UIC development. Formal UIC management mechanisms can be considered an arrangement for control and coordination in collaborative relationships (Ring and Van de Ven, 1994). Specifically, this study measured the formal UIC management mechanism by using the number of industry professionals employed by the university whose job is to find UIC partnerships and the number of university staff responsible for UIC services.

In research policy studies, Youtie et al. (2006) and Corley et al. (2006) have claimed that exploring collaborative relationships requires focusing on changes in mechanisms through which collaboration becomes more formal, standardized, and structured. In addition, formal UIC management mechanisms can be defined as a control process that permits the interorganizational relationship to be reproduced and perpetuated. Therefore, this study investigates the implementation and effects of formal UIC management mechanisms in universities.

**Hypothesis 1.** Implementing formal UIC management mechanisms in universities positively affects the academic innovation performance of universities.

#### 2.2.2. UIC regulation implementation

Few studies have explored the influence of regulation implementation on the academic innovation performance of universities in the UIC context. From a behavior control perspective, the agency theory of the organization involves monitoring members' behaviors and then stipulating productive behaviors (Eisenhardt, 1985). Behavior control has a long research history and is usually associated with rules and regulations designed to ensure that the behavior of members aligns with the goals of managers. Feldman (1989) argued that innovation requires the simultaneous regulation of autonomy and control for promoting creativity. Cardinal (2001) performed an empirical investigation and found that regulation implementation may improve the outcomes of radical innovation ventures in the pharmaceutical industry. The current study contends that UIC regulation implementation in universities can motivate the development of UIC activities. Two regulations associated with UIC development were used for measuring UIC regulation implementation in universities, namely the perceived effectiveness of UIC management regulations in encouraging UIC-related activities and the perceived effectiveness of UIC outcome distribution regulations in encouraging teachers and students to participate in UIC projects, as assessed on a 5-point scale by university directors of UIC activities.

**Hypothesis 2.** UIC regulation implementation in universities positively affects the academic innovation performance of universities.

#### 2.2.3. Innovation climate

A university's support for entrepreneurial activities is a key factor affecting its academic innovation performance (Clarysse et al., 2011). Developing an innovative climate in universities is a management practice that facilitates enterprise and benefits both entrepreneurs and universities. In this study, support for an innovative climate was considered to include a series of initiatives and actions taken for providing a support service by conducting UIC forums, holding entrepreneurial contests, and offering intellectual property courses. When faculties and students perceive that their university is supportive of entrepreneurial activities, they are more likely to perceive the organizational work environment as supportive and thus are highly motivated to demonstrate innovation performance. This study measured the innovation climate of a university according to the number of UIC conferences and forums held by the university, the average number of intellectual property-related courses offered by the university each academic year, and the average number of entrepreneurial contests and lectures held by the university each academic year.

**Hypothesis 3.** The innovation climate in universities positively affects the academic innovation performance of the respective universities.