The development of a knowledge flow paradigm in engineering education: empirical research in Taiwanese universities

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ABSTRACT: The purpose of this study is to explore the relationship between knowledge flow directionality, organisational learning processes and related influential factors. Based on relevant literature, the authors first established a research framework, formulated research inventories and constructed a basic hypothesis about knowledge flow in engineering education. Next, the authors carried out an empirical survey of 148 engineering professors from universities throughout Taiwan in order to understand the relationships between these variables. The conclusions reached in this research indicate that organisational learning processes and knowledge influential factors can directly influence knowledge horizontal flows. Knowledge flow factors can also indirectly influence knowledge flows through the organisational learning process. It is envisaged that these research results will serve to shed new light onto the relationship between organisational learning processes, knowledge flow directionality and related knowledge flow influential factors. Moreover, the suggestions provide concrete information for engineering education executives to enhance the development of knowledge flows on campus.

INTRODUCTION

Research Background

Knowledge flow is a process that an organisation utilises in order to absorb and apply new knowledge. It is also a source for acquiring comparative advantages for an organisation. Engineering education at universities is a mechanism for knowledge production. Knowledge flow can develop more value through innovative activities. As a result, knowledge flow at engineering universities is a main concern of the authors.

Since 1986, the study of knowledge flow within corporations, as revealed by Gupta and Govindarajan, has become an important subject and its magnitude and directionality have been tested [1]. This study focused on influential factors of knowledge flow directionality, which is a secondary concern of the authors [2].

Schulz studied the knowledge flow directionality from organisational learning processes, which received more support from empirical research and influenced the development of the production and transfer of knowledge, which is a tertiary concern of the authors.

Research Objectives

This study reviewed previous literature and applied an empirical survey administered to engineering professors from Taiwanese universities in order to understand the current situation of knowledge flows. The two objectives are as follows:

- To explore the literature on organisational learning processes, knowledge flow influential factors and knowledge flow directionality between engineering education campuses.
- To establish a theoretical model and construct a paradigm for organisational learning processes for engineering education at universities.

LITERATURE REVIEW

This study discusses the materials concerning organisational learning processes, knowledge flow directionality and related influential factors, which are described in more detail below.

Knowledge Flow Directionality

Knowledge is a flowing comprehensiveness. It includes valuable experiences, literal information, unique opinions and the learning structure of a new experience. This kind of knowledge is a feeling of oneself and others [3]. The flow in an equal unit is called horizontal flow. The flow in an upper and lower unit is dubbed vertical flow [4]. The present study focuses on knowledge flow in engineering education that includes knowledge inflow and knowledge outflow.

Organisational Learning Processes

An organisational learning process is a process of acquiring, transforming and creating knowledge [5]. This includes the process of collecting new knowledge, codifying the knowledge and combining old knowledge [6].

Collecting new knowledge through various organisational channels is undertaken in order to implement knowledge collection, which consists of experimental learning, target learning and corporate memory learning [7]. Experimental learning involves implementing a project in order to acquire new knowledge [8]. Target learning involves learning more knowledge from a target university or competitive opponent [5]. Corporate memory learning, on the other hand, is a kind of

generative learning that can acquire new knowledge by advancing and improving capability [9].

Codifying knowledge involves a knowledge possessor, who transmits knowledge coding to a knowledge receiver, and then decodes it to an acceptable message [10]. This changes knowledge to a normal order and word, so that it can flow easily into the organisation, as well as in the sharing process [11].

Combining old knowledge entails integrating the old and new knowledge so that a new knowledge emerges [12]. It provides an integrated structure that increases, reconstructs, changes and innovates knowledge [3].

The organisational learning process has a significant and positive influence on knowledge outflow; meanwhile, its inflow and outflow creates a reciprocal effect. Strengthening an organisational learning process also helps knowledge inflow [6]. Consequently, in regards to engineering education in universities, an organisational learning process has a positive influence on knowledge inflow and outflow.

Knowledge flow influential factors influence knowledge flow directionality including knowledge itself, the receiver, the provider and the state of the four dimensions [13].

Gupta and Govindarajan summarised the following five factors as follows:

- The value of the source unit's knowledge is the value that is stored and created by a knowledge database [14].
- The motivational disposition of the source unit means that knowledge provider outflows knowledge and receives financial and non-financial encouragement [15].
- Channels of knowledge flow derive from formal and informal channels, such as workshops, seminars, correspondence exchange and training [16].
- Motivational disposition of the target unit means that the knowledge receiver acquires financial and non-financial encouragement [3].
- The absorptive capability of the target unit means that the absorbing language, culture, educational level and the economic standard of the knowledge receiver indicates the capability for absorbing new knowledge [17].

Gupta and Govindarajan's experiment showed that the value of the source unit's knowledge, motivational disposition of the source unit and knowledge flow channels have a significant and positive influence on knowledge outflow. Moreover, the knowledge flow channel, motivational disposition of the target, unit and absorptive capability of the target units have a significant and positive influence on knowledge inflow [4]. Furthermore, knowledge flow influential factors have a significant and positive influence on organisational learning processes. Knowledge flow influential factors also influence knowledge flow directionality, which has an intervening influence on an organisational learning process [18].

METHODOLOGY

According to the literature review, the researchers built a knowledge flow framework for engineering education in universities as shown in Figure 1.

Instrument

The study established three inventories using Cronbachs' value above 0.70, with a factor loading over 0.50, and an eigene value above 1.00, as recommended by Nunnally to measure reliability and validity, respectively [19]. The three inventories listed below have been found to be reliable and valid, and all the questions are designed based on a five-points Likert-type scale. These are summarised below.

Knowledge flow influential factors include five variables, namely: the source university's knowledge, the motivational disposition of the source university, the channels of knowledge flow, the motivational disposition of the target university and the absorptive capability of the target university.

The organisational processes include three variables, namely: collecting new knowledge, codifying knowledge and combining old knowledge.

The knowledge flows include two variables, which are knowledge inflow and knowledge outflow.

Sample

The research project is a study on the concept of knowledge flows. This research utilises a stratified sampling method. The samples were divided into public university, private university, public college and private college. The authors identified 160 engineering departments' chairpersons from 32 Taiwanese universities and collected 148 valid responses in order to implement an empirical survey.

Hypotheses

The researchers set up the following three hypotheses and utilised a multiple regression analysis so as to test the foregoing hypotheses at the 0.05 significance level.

- H01: Knowledge flow influential factors have a significant influence on organisational processes;
- H02: Knowledge flow influential factors have a significant influence on knowledge flow directionality;
- H03: The organisational learning process has a significant intervening influence between knowledge flow influential factors and knowledge flow directionality.

ANALYSIS OF RESULTS

Table 1 shows the multiple regression analysis. Knowledge flow influential factors have an influence on the organisational learning process. Model 1 shows five kinds of knowledge flow

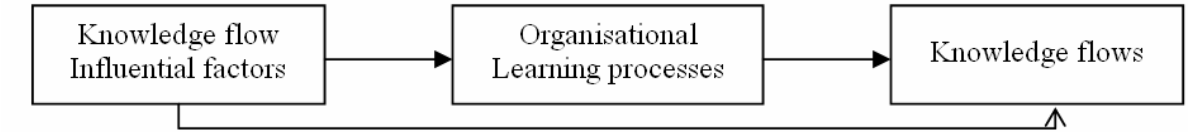

Figure 1: The research framework.

influential factors that have a significant and positive influence on collecting new knowledge (R^2 is 0.44, while the F value is 12.51). Model 2 shows five types of knowledge flow influential factor combinations that have a significant influence on codifying knowledge (R^2 is 0.35 and the F value is 12.86). Model 3 also shows five forms of knowledge influential factors that have a significant influence on combining old knowledge (R^2 is 0.43 and the F value is 12.51).

The individual variable of knowledge flow influential factors influences the organisational learning process (see Table 1).

Table 2 shows the variable influence of engineering education in a university's knowledge horizontal inflow and outflow in each study. Model 4 shows that the combination of knowledge flow influential factors has a significant and positive influence on knowledge inflow (R^2 is 0.34 and the F value is 16.74). For individual variables, the channels of knowledge flow, motivational disposition of the target unit and absorptive capability of the target unit have a significant and positive influence on knowledge horizontal inflow (β value is 1.85, 1.62 and 1.89 separately).

Model 5 has three variables after adding the organisational learning process. The combination of each variable also has a significant influence on knowledge inflow (R^2 is 0.53 and the F value is 63.52). For individual variables, collecting new knowledge, codifying knowledge and combining old knowledge have a significant and positive influence on knowledge horizontal inflow (β value is 2.89, 2.78 and 2.04, separately). Models 1, 2, 3, 4 and 5 demonstrate that knowledge flow influential factors influence knowledge inflow because it is an intervening influence of the organisational learning process.

Model 6 shows the combination of knowledge flow influential factors that have a significant influence on engineering education in a university's knowledge outflow (R^2 is 0.49 and the F value is 18.32). For individual variables, the value of the source university's knowledge, motivational disposition of the source university and knowledge flow channels have a significant and positive influence on knowledge outflow (β value is 2.32, 2.69 and 6.25, separately).

After adding the organisational learning process, Model 7 shows that the combination of each variable has a significant influence on knowledge outflow (R^2 is 0.52 and the F value is 79.71). For the individual variables, knowledge flow channels, new knowledge collection, knowledge codifying and combining old knowledge have a significant and positive influence on knowledge outflow (β value is 3.23, 2.32, 1.84 and 3.21, respectively). Based on Models 1, 2, 3, 6, and 7, knowledge flow influential factors that influence knowledge outflow have an intervening influence on the organisational learning process.

Table 1: The influence of knowledge flow influential factors on the organisational learning process.

Independent Variables	Collecting new knowledge	Codifying knowledge	Combining old knowledge
	Beta (model 1)	Beta (model 2)	Beta (model 3)
Value of source university's knowledge	1.74	1.04	2.98*
Motivational disposition of the source university	1.85	2.61*	1.09
Channels of knowledge flow	2.84*	4.03*	3.39*
Motivational disposition of the target unit	2.69*	1.37	1.21
Absorptive capability of the target unit	1.15	1.08	1.93
R^2	0.44	0.35	0.43
F	12.51*	12.86*	12.12*

Table 2: Multiple regression analysis of knowledge horizontal flow to knowledge flow influential factors and organisational learning process.

Independent Variables	Knowledge inflow		Knowledge outflow	
	Beta (Model 4)	Beta (Model 5)	Beta (Model 6)	Beta (Model 7)
Major Influences				
Value of source university's knowledge	1.09	0.84	2.32*	1.01
Motivational disposition of the source university	1.04	0.78	2.69*	1.54
Channels of knowledge flow	1.85*	1.43	6.25*	3.23*
Motivational disposition of the target university	1.62*	1.05	1.41	1.25
Absorptive capability of the target university	1.89*	1.01	1.01	0.89
Intervening Influences				
Collecting Influences		2.89*		2.32*
Codifying knowledge		2.78*		1.84*
Combining old knowledge		2.04*		3.21*
R^2	0.34	0.53	0.49	0.52
F	16.74*	63.52*	18.32*	79.71*

*P<0.05

CONCLUSION

The literature review and results of the empirical research indicate the subsequent findings.

Engineering education in a university's knowledge flow incorporates influential factors such as the value of the source universities' knowledge, motivational disposition of the source university, channels of knowledge flows, motivational disposition of the target university and the absorptive capability of the target university.

For engineering education in universities, the organisational learning process is a link of knowledge production that includes collecting new knowledge, codifying knowledge and combining old knowledge. The previously mentioned combination indicates that knowledge flow influential factors have a significant influence in the three processes of organisational learning.

Engineering education at universities shows a level of influence over knowledge flow directionality that includes inflow and outflow. The influence over knowledge inflow in universities includes three factors, namely: knowledge flow channels, the motivational disposition of the target university and the absorptive capability of the target university. Moreover, the influence over knowledge outflow includes the following: the value of the source university's knowledge, the motivational disposition of the source university and the channels of knowledge flow.

The research paradigm constructed for this research illustrates how knowledge flow influential factors influence knowledge inflow and outflow for engineering education in universities and how it has an intervening influence on the organisational learning process.

This article presents research that should be considered as a preliminary research of knowledge flows. Its conclusion provides a research paradigm and establishes relevant propositions for the practical application of knowledge flows for engineering education at a university. It is suggested that further research be designed based on this study. Researchers could enrich the content of the structure and quantitative research instruments for advanced research in this field.

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