

INDUSTRIAL INNOVATION IN RESEARCH MANAGEMENT AS KNOWLEDGE OUTCOME: A CASE STUDY

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Abstract *Objective: This paper aims to provide the concept of industrial innovation in research management.*

Methodology: This paper reviewed the diferent kinds of literature on industrial innovation and research management. The study formulated the knowledge outcome perspective of the industrial innovation in research management.

Findings: This paper investigated the industrial innovation since the latter has not been defined clearly from a knowledge perspective. For the definition, the model of industrial innovation in research management is designed.

Research limitations: This paper formulated the contribution of industrial innovation to develop knowledge and implementation of the research management.

Social implications: Academics in a vocational college can generate potential innovation in the industry.

Practical implications: The industrial innovation in the research management model was applied to adjust the learning materials in accordance with the continuous innovative changes in the industry. The framework model was based on a case study involving a polytechnic and the industry in East Java, Indonesia.

Originality: This paper contributes for developing a knowledge-based model on industrial innovation in research management.

Keywords: *Industrial Innovation, Research Management, Knowledge*

INTRODUCTION

Economic development comes with pollution, social tension, and so on. A learning model should be undertaken in small doses in order for the people to adapt gradually in which economic development (Newman, 2016). Investment in education has been seen by many scholars as the key for creating sustainable and stable development (Haggard, 2000; Staub & Stern, 2002; Stiglitz, 2003). Upgrading human resources has always been a key factor for the development of economic globalization (Newman, 2016).

The knowledge of soft skill and hard skill are deemed important to study for college graduates from universities

and especially vocational colleges in Indonesia. The personal abilities of lecturers have been highlighted as important factors for determining quality of vocational colleges. If the vocational lecturers are not able to adapt technology in industries, then the vocational lecturers will not improve the quality of graduates (Suharto, 2011). The increase of research volume of the information and communication technology projects of universities require the efforts to increase the competitiveness and the research ideas need to synergize with the industry (RistekDikti, 2016).

The problems exist while academics of universities effort to keep up with technological developments in the industry. The probit regressions confirm the descriptive findings and shown in table 1.

Table 1: Probability of Academic and Industrial Role to Innovate

	Idea generation	R&D, Engineering design
Research projects with academic	0.072 (**)	0.063 (**)
Product imitations	0.029	0.033 (*)
Market novelties	0.106 (***)	0.047 (*)
Process Innovations	0.016	0.009

Notes: the table reports marginal effects of probit regressions with robust standard errors: * p <0.10, ** p <0.05, *** p <0.01

Source: creative industry survey austria 2008 (Müller et al., 2009)

The technical skills relevant for supporting to innovation in R&D and engineering design activities, but technical skills were not relevant for supporting to generate ideas or product design (Müller et al., 2009). The research projects with academia sector have not offered the significant contribution to R&D, engineering design, and idea generation. The product imitations, market innovation and process innovations sectors have offered the significant contribution to R&D, engineering design and idea generation (see table 1).

The industrial processes should be studied as a continuous improvement. The industrial processes start from the ideas of product, product development, production process, and distribution of consumers. Feedback information was collected from the customer then developing ideas to create the new products or improve the old products and the current production processes (Gaspersz, 1998). Thus, the industrial processes have the important parts such as process innovation and it offer the significant contribution to R&D innovation, engineering design and idea generation.

Academics in the higher educations must produce the proposals of the industrial research partnerships. An incentive is something that motivates the higher educations who develop science and technology utilized with the Industry. The incentives were given in the form of funds and incentives were provided by the ministries of research, technology, and higher education of Indonesian government (RistekDikti, 2016). This paper presents the findings of the accepted proposals and the research proposals between higher educations and industries. The selection results of accepted proposals in 2015 shown in table 2.

Table 2: The Selection Results of Accepted Proposals in 2015

Higher education	Quantity (accepted proposal)	Percent (%)
Polytechnic	1	2,9
Institute	9	25,7
University	25	71,4

Source: Litabmas Ditjen Dikti, letter No.1794/ E5.2/PL/2015, 03 August 2015

The selection results of accepted proposals were produced by polytechnic still smaller when they were compared with institutes and universities (see table 2), although the incentives were given in the form of funds to the higher educations who develop science and technology utilized with the Industry.

Around the world, the technology industry is growing. If the higher education adapt with new technology in the industry, then the higher education will get benefits. The higher education will get a knowledge-based development for teaching.

Hard skills are the most important inputs to industrial innovation (Leiponen, 2005), and skilled and talented people are a key element for a firm's potential to absorb external knowledge (Cohen & Levinthal, 1990). The creative industries in the industrial innovation is to link the academia and the business world. On the one hand, the creative industries are an important employer of graduates who want to apply their knowledge and creativity acquired during their studies. On the other hand employees in the creative industries regularly have close ties to their lecturers (Müller et al., 2009).

An industry perspective (the private sectors), the innovation performance of the industry not always correlate positively with one chain of innovation, but the innovation chain consists several industries (Xu & Ding, 2014) and academics in universities (Müller, 2009).

A vocational colleges perspective (the public sectors), an unique public sector competency is required such as interpersonal motivational skills (Sean, 2016). The vocational colleges force to continuously adapt to technology rises in industries and use several kinds of relationships (Toni & Nonino, 2010), they are as follows: (1) the vocational colleges make a consultation relationship which it gives a problem-solving in the industry, (2) the vocational colleges make an access relationship which it allows to access a knowledge in the industry.

A government perspective, government involvement would lead to a close relationship between the government and businesses. In a good scenario, government involvement would foster a healthy co-operative relationship between the public and the private sectors (Newman, 2016).

A knowledge perspective, the organisations do not need to view knowledge management in isolation or a standalone initiative, and linking of knowledge management with innovation culture is a sure way to improve business performances (Nagesh, 2016). Knowledge management strategies are continuously adapted and corrected on the basis of a “dialog” between a rational contribution of reasoning and a perception of reality influenced by practical views (Ettore Bolisani, Constantin Bratianu, 2017).

Thus, an industry perspective (the private sectors), a vocational colleges perspective (the public sectors), a government perspective, and knowledge management strategies can inspire a new agenda for synergy between public, private and government sectors in order to influence knowledge outcome.

The structure of this article was based on the following framework: first, authors reviewed the different kinds of literature on industrial innovation and research management for exploring the definition in the industry as a knowledge outcome. Second, authors explore the industrial innovation in research management literature to produce the applied research between industry and vocational colleges according to government regulations. Third, authors propose a definition of industrial innovation in research management as knowledge outcome.

LITERATURE REVIEW

This paper propose the definition of industrial innovation in research management as a result of synergy between polytechnic, industry and government. This article has e-research platform, content-based research management, and basic functions of management process are planning, organizing, actuating, and controlling.

Industrial Innovation

The vocational colleges have the research activities in the industrial innovation as research management so the industry and government were a primary key for applied research (Marjanovic, 2009). Another researchers suggest that an applied research was determined by the chain innovation. The chain innovation was generated by offering contracts to public procurement and selected supplier (Xu & Ding, 2014).

Triple Helix was described as the university-industrial-government relations (Leydesdorff, 2012; Etzkowitz and Leydesdorff, 2000). Triple Helix was described as model for studying the knowledge-based economics. Triple Helix model was called “Triangle” (Sábato, 1975) as a program for technological development and endogenous innovation (Etzkowitz & Leydesdorff, 1995; Lowe, 1982).

In globalization era, Triple Helix includes two conclusions (Leydesdorff, 2012), they are: (1) medium-tech industry is more important for synergy than high-tech, and (2) the service sector tends to uncouple from the geographical location because a knowledge-intensive service is versatile and not geographically constrained.

Several researchers argue that applied research was conducted between two departments. Some researchers have different opinions, that applied research can be done between three departments. This paper explore a knowledge-based model on industrial innovation in research management as a result of synergy between polytechnic, industry and government.

Research Management

Evaluation can be defined as “a systematic and objective process designed to assess the relevance, efficiency, and effectiveness of policies, programmes and projects”. A strong reason for conducting research evaluations as inputs in the research management process was better understanding and learning from past experience for the research process (Marjanovic, 2009). The right specification of industrial innovation in research management is needed by vocational lecturers for developing knowledge more efficiently and effectively.

Industrial innovation in research management needs an e-research platform to give main benefits such as the cooperation development between research centers in higher education and industry (Popescu, Brenda & Beju, 2011). The e-research platform must be adapted and developed to the existing technologies evolution.

Based on previous research, in order to improve the individual research performance by using 9 (nine) steps from the model of researcher’s competency standard. However, this model is still going on and it can’t be stand alone (Lasambouwa, Sutjiredjekib, & Nuryatic, 2015).

Management Functions

The research management needs databases and it contains tables to store informations such as industry, lectures and research projects. The main window is used to access the

research management by opening on the activities menu (Popescu, Brenda & Beju, 2011). The research management menu can access the pages related by using functions of management process, they are planning, organizing, actuating, and controlling (Terry, 2010).

Knowledge Management & Industrial Innovation

Dobni and others have recommended further study of the innovation culture's effect on performance, as this area lacks sufficient empirical research in the literature (Dobni, 2008; Nagesh, 2016). Also, the literature suggests that the academic and industry practitioner's interest has increased on the effects of innovation culture on organisation performance (Clayton & Raynor, 2003; Govindarajan & Trimble, 2005; Hamel, 2002; Nagesh, 2016).

Julia Naranjo also advocated that even though much of the importance attached to culture as it is emerging as a key stimulant for innovation. However, only a few studies directly pointed to a strong link between knowledge management and innovation culture, and this aspect also lacks empirical research, and the available few research studies have targeted and analyzed particular aspects of cultural characteristics (Julia Naranjo, et al. 2011; Nagesh, 2016).

Impact on Knowledge

Knowledge curriculums of universities can be developed by adapting to the science and technology development in the industry, and it was called an imperative strategic (Mgijima, 2014).

RESEARCH METHODOLOGY

Tri-Angular

The information and knowledge partnership can develop the technology and scientific curriculums of higher education. Tri-Angular model was one of the information and knowledge partnership. Tri-Angular model has an impact on the social and economic development, the public sector and the scientific technological solutions (Vutsova, Ignatova, 2013).

The applied research has implemented in Tri-Angular model for partnership between higher education and industry to produce the applied research according to government regulations. The applied research implementation is shown in fig. 1.

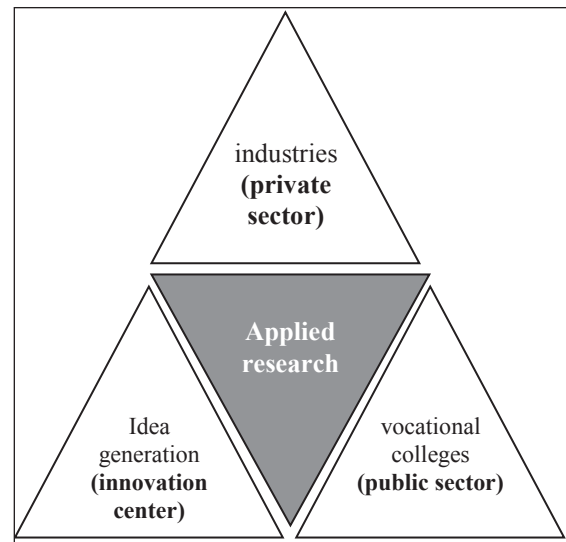


Fig. 1: Applied Research Implementation in Tri-Angular model

The applied research implementation in Tri-Angular model for technology transfer can be described as follows:

- The interaction between the vocational colleges (the public sector) and industries (the private sector), exchange of experience and strategic decisions by the vocational colleges (the public sector), also ensuring links between the vocational colleges (the public sector) and industries (the private sector) environments.
- Cross-company projects with the support of the government and the potential of research teams and laboratories.
- Vocational college's research projects financed by the government and under a mandatory condition for use in industrial (the private sector).

Model Validation

Tri-Angular model was done by presenting the applied research implementation to three people, they a expert system (industry), expert regulation material (the central research in polytechnic) and users (lecturer).

Correlation Analysis

The data survey has 10 indicator variables. Significant values of the indicator variables validity obtained from testing results by using SPSS 16 and values of the indicator variables validity will be compared with 5% of critical R person criteria. If the significant value got more than 0,05 on indicator, then this instrument will be called invalid. If the significant value got smaller than 0,05 on indicator, then this instrument will be called valid.

Scale Reliability and Validity Analysis

The data survey has 10 indicator variables. Significant values of the indicator variables validity obtained from testing results by using SPSS 16 and values of the indicator variables validity will be compared with 0.5 of reliability at r table. If significant relationship values were smaller than 0.5 on indicator, then these instruments does not have the relationship with other instruments, while significant values were more than 0.5 on indicator, then these instruments have a positive and significant relationship with other instruments.

Questionnaire

Questionnaire method was used to know what were respondent's expectation and questionnaires given to respondents directly (Sugiono, 2014).

Questionnaire method was used to measure respondent's opinions and perceptions of people by asking respondents (Sugiyono, 2014). Questionnaire data were obtained and scored by using Likert Scale to formulate the validity and reliability of applied research in Tri-Angular model.

FINDINGS AND ANALYSIS

Industrial Who have Product Development

Universities adapt to the science and technology development in the industry for developing knowledge, and it was called an imperative strategic (Mgijima, 2014). Industrial partners who have a product research and development as shown in table 3.

PT. Hartono Istana Teknologi and PT. PLN have an appropriate engineering field for an applied research partnership. The vocational colleges can make a partnership with PT. Hartono Istana Teknologi and PT. PLN (see table 3).

After obtaining an industrial partnership, the vocational colleges will use a research cooperation strategy approach to identify the needs of knowledge development in the industry. The knowledge will be developed by the knowledge management strategies, knowledge are continuously adapted and corrected on the basis of a "dialog" between a rational contribution of reasoning and a perception of reality influenced by practical views (Ettore Bolisani, Constantin Bratianu, 2017). This stage was implemented as agendas for the focus group discussion with two industrial partners, they are PT. Hartono Istana Teknologi and PT. PLN.

Table 3: Industrial Partners and Its Product of Research and Development

Industry Name	Research and development fields	Research partners opportunities
PT. Hartono Istana Teknologi (Polytron)	audio, video, home appliance, mobile phone ⁽¹⁾	product development
PT. Adi Karya	infrastructure investment provider ⁽²⁾	no capital investment
PT. PLN	boiler, turbine and generator ⁽³⁾	operator generator
PT. POS Indonesia	postal services operator ⁽⁴⁾	no delivery service
PT. Coca Cola	human resource ⁽⁵⁾	human resources
PT. Pertamina	mineral resource ⁽⁶⁾	none

Source:

(1) <https://www.polytron.co.id/index>

(2) PT. Adi Karya, 2012: 23

(3) PT. PLN, 2015: 47

(4) PT. POS Indonesia, 2013: 104

(5) <https://www.coca-colabtting.co.id/ina/ourcompany/index>

(6) LKIP - PT. Pertamina, 2016: 18

Table 4: The Needs of Knowledge-Based Industries

Industry	Vocational skills	Aspect	Information
PT. Hartono Istana Teknologi	knowledge development work includes such activities as (1) invents any new of product and it can be patented, (2) renewal of a product, and (3) improvements of existing products.	professional competence	the innovation cooperation does not exist
PT. Perusahaan Listrik Negara	(1) capable for simulating the data systems, (2) understanding the total losses from distributed generators, (3) knowing an impact of distributed switching	pedagogic competence	cooperation in the internship program

1. *The Imperative Strategic Planning in the Focus Group Discussion*

Based on the implementation of the focus group discussion with two industrial partners, the needs of knowledge-based industries as shown in table 4.

PT. Hartono Istana Teknologi has a field of product innovation that can support product innovation that can support the growth of knowledge-based industries in research management (see table 4).

2. *The Agreement between the Vocational College and the Industry*

a. Memorandum of understanding (MoU) was drafted by the vocational college to the industry. MoU's content includes such agreement as (1) objectives, (2) benefits, (3) scope, (4) references.

b. The government regulations were used as follow:

1). The ministries of research, technology, and higher education of Indonesian government, the number of letter : 341/M/Kp/V/2015, subject : "technological incentives program for applied research utilized in the industry".

2). The Indonesian minister of industrial, the number of letter : 3 in 2014, 4th chapter on the human resources development; 16th article and 4th paragraph, subject: "the human resources development should be conducted with the research and development in the higher educations".

c. Industry send an invitation letter to the vocational college for signing memorandum of understanding.

3. *The Industrial Innovation in Research Management*

The three main components of the knowledge management approach were utilised, with a particular focus on the interrelationship between the three Cs as follows: (1) content, which was mainly enabled through technical infrastructure, (2) communication, which allowed for knowledge creation and sharing; and (3) consumer, which was active participation and interaction to build commitment for creating online relationships (Rachel Barker, 2015). The implementation between the three Cs as follows:

- **Technical infrastructure.**

The web server database was created using PhpMyAdmin and contained several tables to store data.

- **Knowledge creation and sharing.**

The applications was designed to connect domain name to hosting account or research management server. The explanation of the knowledge creation in research management as follows:

(1) Industry registered the project as product development to entry ideas. Administrator in the vocational college accept and share the project.

(2) Academics in the vocational college submit the research proposals.

(3) Industry downloads a research proposal from the approved proposals.

(4) Academics in the vocational college have responsibility to do and report the approved proposal as the knowledge creation.

(5) Industry has responsibility to monitor and receive the final results of research as knowledge sharing.

(6) Academics in the vocational college maintain the scientific documents as knowledge outcome.

The knowledge creation in research management and sharing diagram between the vocational college and the industry is shown in figure 2.

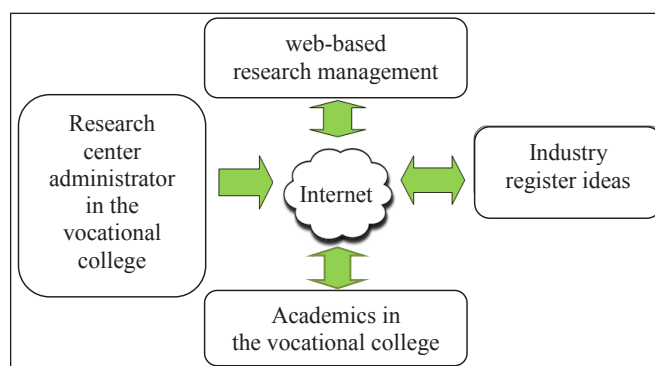


Fig. 2: The Knowledge Creation in Research Management and Sharing Diagram

- **Active participation and interaction.**

The industrial innovation in research management model is shown in fig. 3. The explanation of model as follows:

(1) Academics send the email of identities to administrator in the vocational college. The identities are profile of researcher in the vocational college.

(2) Industrial staff registered the project as product development to entry ideas.

(3) Administrator in the vocational college store data, such as profile of researcher and industrial projects, to database.

(4) Administrator in the vocational college send the email of username and password to researcher and industrial staff.

(5) Academics submit the research proposals by planning menu.

(6) Industrial staff download the research proposals by organizing menu.

(7) Academics have responsibility to do and report the approved proposal as the knowledge creation by actuating menu.

(8) Industry has responsibility to monitor and receive the final results of research as knowledge sharing by controlling menu.

(9) Academics have the scientific documents for publication.

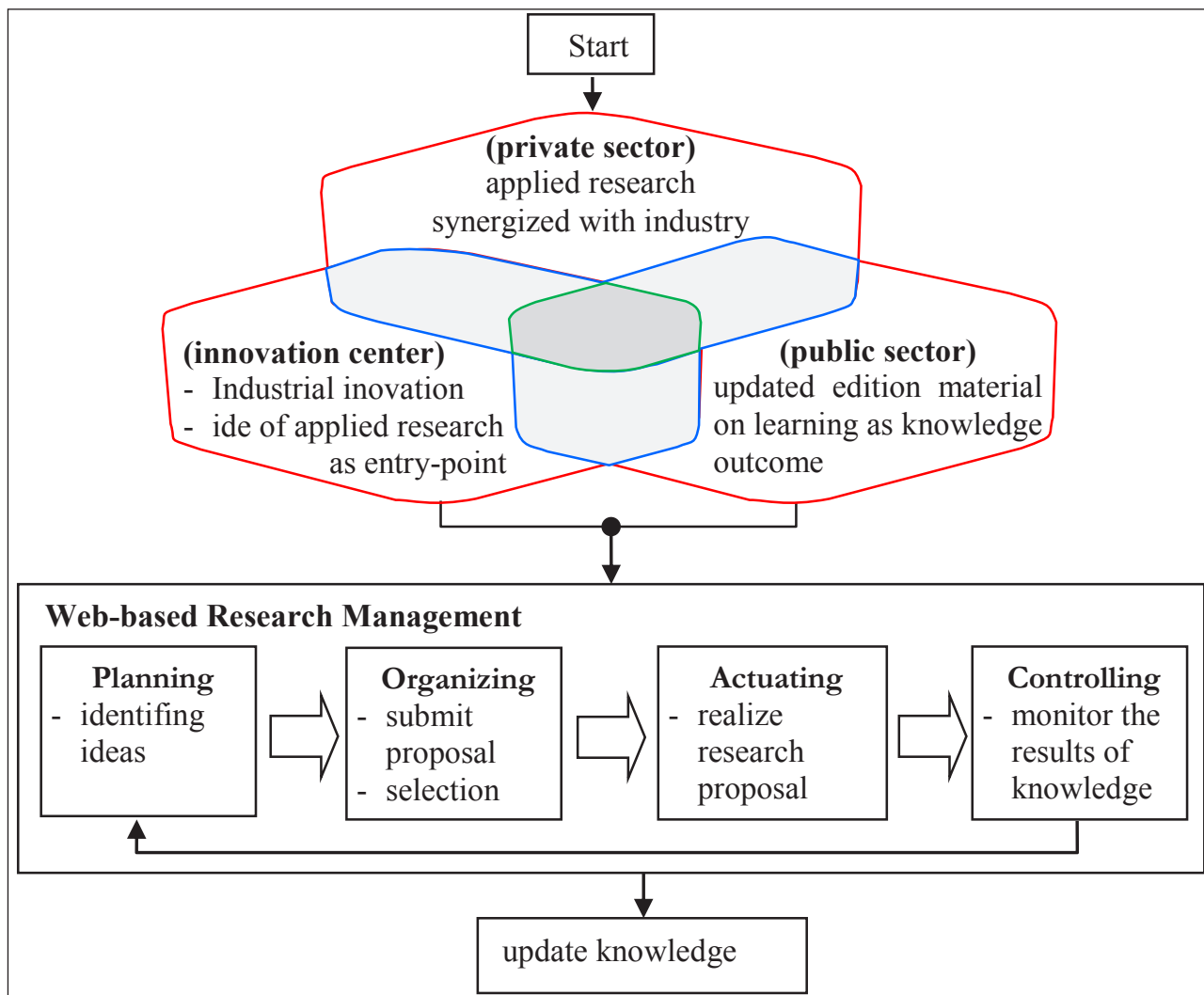


Fig. 3: The Model of Industrial Innovation in Research Management

Data Analysis

The data survey informs about 10 indicator variables and the information according to the question. The questioner spread through 12 persons during the validation agenda for the focus group discussion. The persons were as follows:

- Human resource and development staff from PT. Hartono Istana Technology was called expert systems.
- Innovation center or the research and community service center staff were called expert material and

chairman of industrial relations unit in Polytechnic state Semarang as expert judgment.

- Vocational lecturers of academic in polytechnic state Semarang were called users.

The purpose of polytechnic was established for synergizing with Industry, so polytechnic and industry are having a same of attitudes to employment. It is called a homogeneous population (Sugiyono, 2004). This paper spread the questionnaire and contains 10 question. The questions in questionnaire sheet are shown in table 5.

Table 5: The Questions in Questionnaire

No	Assessment of models and indicators
1.	do industrial always give some of research ideas to lecturer?
2.	do ideas from industry have an understanding as the sustainable industry based?
3.	do lecturers research accordance to industry based have an understanding as planning function?
4.	does Industry select the solutioned proposals have an understanding as organizing function?
5.	do lecturers act for their applied research have an understanding as actuating function?
6.	does Industry accept and supervise the results of lecturer's proposal have an understanding as controlling function?
7.	do lecturers carry out the applied research with industry can be used as materials for teaching?
8.	do lecturers produce the industry innovation have an understanding as community service?

No	Assessment of models and indicators
9.	do the applied contents in the web-based can be accessed as the information media and easily?
10.	can lecturers publish the articles of of potential industry innovation?

Random samples should be taken from a homogenous population (Sugiyono, 2004). The samples of the homogenous population as follows: (a) 4 persons from industry as the expert system, (b) 4 persons from the innovation center as the expert material, and (c) 4 persons from academic or lecturers as users.

Data Analysis

Based on the data survey informs about 10 indicator variables and the questioner spread through 12 persons. Data Analysis was obtained by using SPSS 16.0 and the data survey as shown on fig. 4.

	aca-1	innova-1	ind-1	ind-2	ind-3	innova-2	innova-3	aca-2	innova-4	ind-4	aca-3	aca-4
Indicator-1	3	5	4	3	4	3	3	3	4	4	3	4
Indicator-2	5	5	4	4	4	4	4	4	4	4	4	4
Indicator-3	5	4	4	5	4	4	4	4	3	4	4	4
Indicator-4	4	4	5	5	4	4	4	4	3	4	4	4
Indicator-5	4	4	5	4	4	4	4	4	4	3	4	4
Indicator-6	4	4	5	5	4	4	4	4	3	4	4	4
Indicator-7	5	5	5	5	3	4	4	4	4	3	4	3
Indicator-8	4	4	5	4	4	4	4	4	4	3	4	4
Indicator-9	5	5	4	4	4	4	4	4	4	4	4	4
Indicator-10	5	4	4	4	4	4	4	4	4	3	4	4

Note: aca = academica, innova = innovation center, ind = industry

Fig. 4: The Data Survey Informs about 10 Indicator Variables and 12 Questionnaire

1. Correlation Analysis

Data survey on fig. 4 was processed with the correlation and validity analysis. The values of the indicator variables were compared with 5% of critical R person criteria by using SPSS 16.0.

The significant value was more than 0,050 probability level on indicator-1, therefore this instrument was invalid. The significant values were smaller than 0.050 probability level on other indicators. All Indicators significant and valid for research instruments except the first indicator.

2. Reliability Analysis

Data survey in fig. 4 was processed with the reliability and validity analysis. Base on the guidance of the successful research for determining size of sample (Roscoe, 1975), a simple experimental is presented in small sample size between 10 to 20 samples.

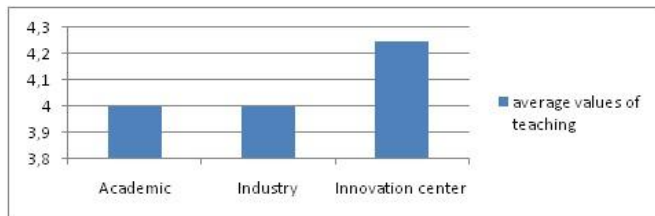
The values of the reliability testing were compared with the reliability at r Table, according to a number of the expert were n = 12 and number of questions were DB = 10 ~ 13. Number of reliability was obtained at r Table by using the correlation coefficient of interpretation value, number of reliability was r = 0,4 ~ 0,6 or it was called "Medium" category interpretation (Arikunto, 2010). The values of the indicator variables scale reliability have obtained from testing results by using SPSS 16 and values of the indicator variables scale reliability have compared with 0.5 probability level at r table.

Significant relationship values were smaller than 0.5 probability level on indicator-1 so this instrument does not have the relationship with other instruments, the significant values were more than 0.5 probability level on indicator-2, 3, 4, 5, 6, 7, 8, 9 and 10 so these instruments significant and have a positive relationship with other instruments.

Knowledge Outcome

Teaching knowledge

Evaluation model of industrial innovation in research management as knowledge output especially in the research field through the questionnaire on indicator-7, as follows: “do lecturers carry out the applied research with industry can be used as materials for teaching?” (see table 5). Data survey in figure 4 was processed with the average values analysis for the indicator-7 question and data survey is shown in fig. 5.



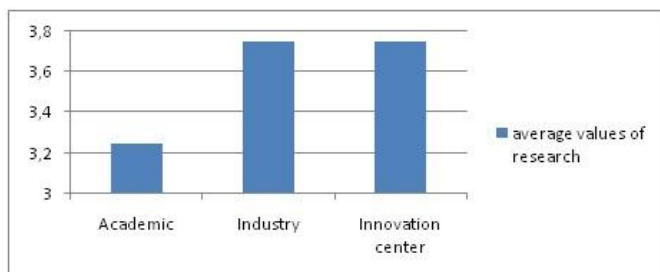
Description:
 0,5 ≤ n ≤ 1,5 = no material, 1,5 ≤ n ≤ 2,5 = little material,
 2,5 ≤ n ≤ 3,5 = less material, 3,5 ≤ n ≤ 4,5 = a good material,
 4,5 ≤ n ≤ 5,5 = many materials

Fig. 5. Evaluation of Teaching Knowledge

Based on data survey from spreading the questioner spread through 12 persons, there are good materials from the development of innovation in the industry (see fig. 5). Academics in vocational college can work with the Industry for updating the teaching materials.

Research Knowledge

Evaluation model of industrial innovation in research management as knowledge output especially in the research field through the questionnaire on indicator-1, as follows: “do industrial always give some of research ideas to lecturer?” (see table 5). Data survey in figure 4 was processed with the average values analysis for the indicator-1 question and data survey is shown in fig. 6.



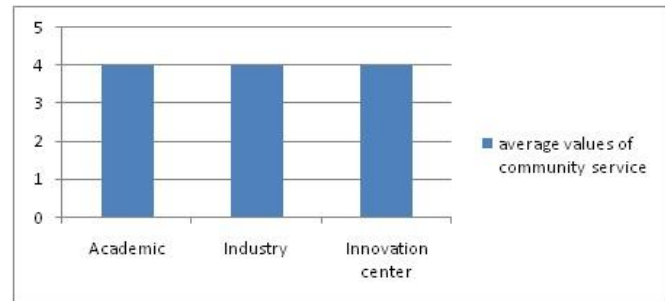
Description:
 0,5 ≤ n ≤ 1,5 = no idea, 1,5 ≤ n ≤ 2,5 = little idea,
 2,5 ≤ n ≤ 3,5 = less idea, 3,5 ≤ n ≤ 4,5 = a good idea,
 4,5 ≤ n ≤ 5,5 = many ideas

Fig. 6: Evaluation of Research Knowledge

Based on data survey from spreading the questioner spread through 12 persons, it is a good idea in the industry, but it was less idea in academics from the development of innovation (see in fig. 6). Academics at vocational college need a memorandum of understanding with industry for entering the applied research ideas of product development in the Industry.

Community Service Knowledge

Evaluation of industry innovation in research management model as knowledge output especially in the research field through the questionnaire with the indicator-8 question: “do lecturers produce the industry innovation have an understanding as community service?” (see table 5). Data survey in fig. 4 was processed with the average values analysis for the indicator-8 question and data survey is shown in fig. 7.



Description:
 0,5 ≤ n ≤ 1,5 = no innovation, 1,5 ≤ n ≤ 2,5 = little innovation,
 2,5 ≤ n ≤ 3,5 = less innovation, 3,5 ≤ n ≤ 4,5 = a good innovation,
 4,5 ≤ n ≤ 5,5 = many innovations

Fig. 7. Evaluation of Community Service

Based on data survey from spreading questioner to 12 persons, there is a good innovation from the development of innovation in the industry (see figure 7). Academics in vocational college can generate potential innovation in the industry.

Comparison to an Existing Model

This paper proposes a new model of developing lecturer’s knowledge. The model can be done by using the research management to manage ideas and applied research proposal. In same study, the researcher’s competency mapped in order to personal effectiveness (Lasambouwa, Sutjiredjekib, & Nuryatic, 2015). The comparison between a new model and the map of researcher’s competency are shown in tabel 6.

Table 6: Comparison to an Existing Model

No	Map of Researcher's Competency (*)	Model of Developing Lecturer's Knowledge
1.	Select a research topic	Planning, (a) determining title of project or applied research from product development in Industry, (b) writing the applied research proposal. Update knowledge
2.	Conduct literature review	
3.	Proposal writing	
4.	Define appropriate research methodology	Organizing, (a) industry analyzes incoming proposal, (b) industry review solution, (c) industry give fund.
5.	Manage research funding	
6.	Research implementation	Actuating, lecturer implement a product design in industry
7.	Research report writing	Controlling, industry reject or accept final product
8.	Academic publication	Academic publication
9.	Adhering to research ethics	

The data of comparison analysis shows that new model of developing lecturer's knowledge has several advantages, they are:

1. new model divided in 5 steps, so a new model more simple than an existing model.
2. industry give ideas and knowledge outcome.
3. output innovation will be implemented in industry certainly.

The data of comparison analysis shows that new model of developing lecturer's knowledge has several weakness, they are:

1. A new model must be supported by the link and match concept in industry (MoU).
2. A new model needs for identifying the potential industry innovators.

CONCLUSIONS

Summary

This paper manages the applied research of industrial innovation in research management as knowledge-outcome between polytechnic and Industry as a partnership. This paper explores the industrial innovation in knowledge-based industries in research management between three departments, they are university, industry, and government. This study is validated through a case analysis using: (1) correlation, scale reliability and validity analysis, (2) teaching, research and community service as knowledge outcome, and (3) comparison to an existing model.

Based on data survey from spreading questioner to 12 persons, academics in the vocational college need to synergize with the industry to increase the competitiveness and the research ideas for updating the teaching materials. The vocational college need a memorandum of understanding with industry for getting the ideas of applied research such activities as (1) invents any new of product, (2) renewal of a product, and (3) improvements of existing products.

The model of industrial innovation in research management can update academic college's teaching materials as knowledge outcome. Academics in the vocational college can generate potential innovation in the industry.

Limitations of the Study

The model of industrial innovation in research management must be supported by memorandum of understanding (Mou) in research partnership between the vocational college and Industrial. If vocational college does not make a MoU in research partnership then the model will be ineffective.

Future Scope

The next study considers the outcome-based implementation of industrial innovation in service partnership between vocational college and Industry.

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