Technology Transfer Model through Industrial Collaboration for Product Development and Technopreneurship in Polytechnic Education

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Abstract

Technology transfer is the process of skill, knowledge and technologies transferring to ensure that scientific and technological development exploited for improving new products, processes, applications, materials or services, while technopreneur (techno-entrepreneurs) use technology to come out with new or innovative products through a process of commercialization. For both of these, POLMAN Bandung has a unique approach in manufacturing education through industrial partnerships to increase added value and benefits, especially in the practice on skills mastery through production approach (production based education) which has been designed to transferring knowledge and technology to the students by solving industrial cases. The students will have experiences through their involvement in manufacturing of industrial product development where a lot of application technology can be done which are needed by the market. This approach is providing an opportunity to have an experience in applying technology as a new technopreneur development. Polytechnic education has opportunities to gain the capacity in developing industrial products, while the industry can utilize it without any additional investment. This model is kind of technology transfer in education process for several results, especially in product and technology development, so the education institution could be as a center of technology for the industries.

Keywords
Technology Transfer, Production Based Education, Experiences Learning, Technopreneur

1. Introduction

Since its establishment, POLMAN Bandung has provied the process of learning of technologies to the students in advance technology where at that time the industry was not interested (may be it was not fit to their need), but to prepare the future industrial work force required the transfer of appropriate technologies to students that will encourage the development of technology utilization in industry. It will not only for technology but also for attitude and culture as well. To achive that goal of technology transfer, the process should be started from urgent demand (needs) on certain technology that can be immediately applied in industry. So to accelerate the tranfer process it required the ability of recipient (transferee) to absorb and adapt then apply and on the other side the transfer of technology is always tailored to the need of local recipient which has focused for the purpose of increasing the value added (profits and benefits) (Li-Hua 2005).

Before 1980s, many technology transfer activities carried out to developed countries for searching economic growth as well as natural resources in colonial era of houndreds or thousand years ago. Then in early 1980 began the transfer technology in local or domestic which has been absorbed mostly by local player through education and training activities.

Began in the 1990s a lot of industrial research and development were collaborated between university and industry to find the best solution for industrial problem in looking for added value and competitive advantage through mastery of the latest technology beyond the competitor (K Woods et al. 2003).

This paper will discuss the use of technology transfer model for developing new technopreneur through experience learning which is the student involve in industrial product development as a collaboration activities between higher education and industry.

2. Methodology

Transfer of technology become so popular during the development of developing countries where much of the developed technologies are adopted and adapted (*adopt and adapt*) to develop local capacity to manage its resources in order to excel and get the economic value added for economic growth through increasing *competitive advantage*. Some of the literature describes the notion of technology transfer (T^2) which is summarized in the table below.

Tabel 1: Summary of *Technology Transfer* Definition

Scholar	***Viewpoint***
Roger (1972)	*The process by which an organization adopts an innovation made by another organization*
UNCTAD (1973)	*Technology transfer is that which takes place between advance countries and developing countries. In order to expand new manufacturing equipment and existing manufacturing equipment, technology transfer refers to the act of transferring the needed technical knowledge that has been designed and managed*
Rodrigues (1985)	*The application of new technology to a new use or user*
Derakshani (1987)	*A country's acquisition, development and use of technical knowledge*
Yu (1990)	*Technology transfer is defined in the work regulation of the United Nations, as the transfer of systematic knowledge for the manufacture of the product or provision of services*
Jasinski (1999)	*Technology transfer exists in the main forms are (1) Sales/purchase of results of the R&D work, (2) Turnover of licenses, patents. Utility models, know-how, (3) Sales/purchase of production techniques means of automation, etc (4) Technological advisory/consulting, (5) Technical staff training and (6) Exchange of technological information. Further to simplify technology transfer into embodied technology transfer (the flow of knowledge embodied in new products, materials, tools, machines and similar equipment), and disembodied technology transfer (other forms of flow of technical knowledge).*
Andrzej (2005)	*an inflow of technical knowledge to the market where it is sold and bought*
Wikipedia (2009)	*Technology transfer is the process of sharing of skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services.*

From these many explanations of technology transfer, the Wikipedia literature description and forms of technology transfer from Jasinki (1999) are explained quite comprehensive overview, whereas transfer technology method is often countered in the practice from time to time since known in 1980s. The other explanations mention that the transfer technology is part of tacit knowledge (especially for technical knowledge), namely the hidden knowledge that cannot be understood without explanation how to transfer which could used for certain purpose.

Transfer of knowledge is the key of technology transfer, because the technology cannot be transferred if there is no knowledge (technical knowledge) about something that will be transferred, so that the knowledge transfer should always be carried out and developed to achieve the transfer objectives (Hendrix and Li-Hua 2008). Thus it is necessary to the knowledge management mainly to the tacit knowledge, because it need to be changed first in a structured and scientific explanation before transferred to other parties as needed

In the figure below is shown how the relationship between technology and knowledge and transferring process to the other parties who are needed (Hendrix and Li-Hua 2008).

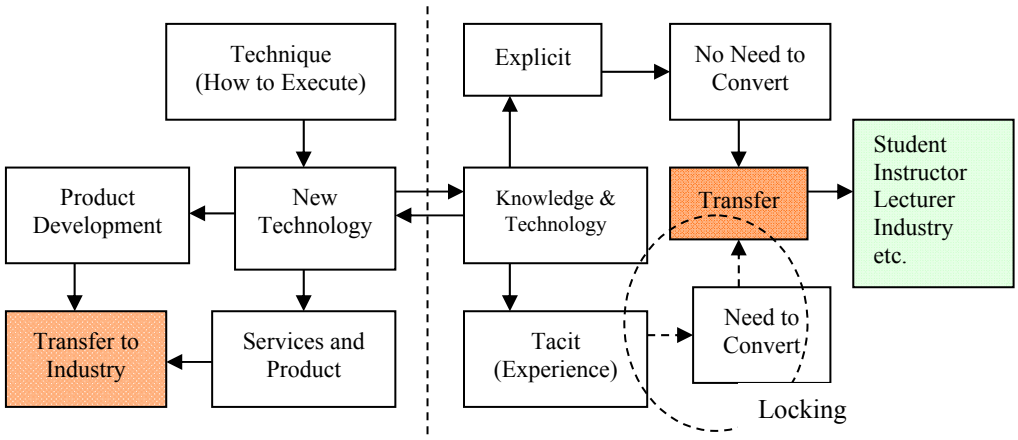

Figure 1: *Technology & Knowledge Transfer*

2.1 Challenging and Beneficiary of Technology Transfer

One of the beneficiary of technology transfer is changging at the industry on current globalation era which is technology transfer bring a big world market as an open market. That why the domestic market will get an impact from this situation and get beneficiary for creating an competitive new product or services, whereas it will be improving a productivity in industry and economic growth in general (macro) as well.

For take advantage and also to answer the technological growth challenging (in macro economic) through technology transfer, the University of Applied Science should be able to approach the industry and understand the industry "language" in order to provide and receive technologies on the field study of technology. In developing countries the technology and knowledge transfer occurs primarily among many industries and universities. With the existence of this technology transfer activities, there is a mutually beneficial relationship between industry and universities.

2.2 Transfer of Technology Methodology

Based on that several literatures (Hendrix and Li-Hua 2008), (Chun-Chu Liu 2007), (Li-Hua 2005) and (K Woods et al 2003), technology transfer method can be done such as *Foreign Direct Investment* (FDI), *Joint Venture* (JV), *Licensing Agreement* (LA), *Technological Advisory/Consultant* (*Technical Assistance*) (TA), *Technical Staff Training and Education* (TT), *Sales/Purchase Equipment or Machineries* (S/P), *Intellectual Property Right* (IPR), and *Unlocking Tacit Technical Knowledge* (UTK).

In this paper will be elaborated Joint Venture and Unlocking Tacit Technical Knowledge as majority POLMAN Bandung done besides giving technical training & education and technical assistant as well.

3. Design and Implementation

POLMAN Bandung has been done the technology transfer activities to the medium and small scale industries such as in the below table.

Table 2: POLMAN Bandung Technology Transfer Activities

A. COUCHING CLINIC, supervising SME's through 3rd party fund
1. Voucer Program, Funding P2M-DIKTI, Ministry of National Education. The program has strated in early 1994 in Industrial Central of Foundry, Ceper, Middle Java.
2. DAPATI Program, Funding DEPPERINDAG (Industrial and Trade Department). The program is conducted in 1996 to 1998 to the local industry (comando knife manufacturing & door handle mfg.)
3. Technology Transfer Program-DIKTI , supporting fund from DIKTI in year 2007 for gear flame hardening technology for SMEs in Bandung arround

Table 2: POLMAN Bandung Technology Transfer Activities (continue)

4. Program Community Development, Apperentice program in foundry industri (1996-1998), Coconut hask Processing (2001-2002) and establising a TESDC (2007-Now)
B. INDUSTRIAL TRAINING, Foundry Technology (1995-2012) and Manufacturing Technology (1990-2012) for several Big Industries
C. PRODUCT DEVELOPMENT
1. Research Collaboration, Vulcano electrical power generator (2008-2012)
2. Industrial Collaboration (Joint Venture), in Casting Component Manufacturing partnership with PT. Semen Padang (starting in year 1992), Precision Part Manufacturing partnership with Norma BV, Netherland (2006-2009), Loading System & Watertreatment Manufacturing partership with Lufapak, GmbH, German (2007-Now).

The above activities are forms of technology transfer activities that have been carried out on excursions research and community service; the activities are mostly implemented trough collaboration and cooperation with industry, while at the education (academic activities) itself actually POLMAN Bandung has done also the transfer of technology to the students through the learning process especially in the practice program. In the practice program, the student learn how to solve an industrial problem together with a lecturer, where it has given gradually as much as possible to produce products that can be used by industry. Thus, indirectly also do transfer of technology to industries through the products or services of the educational or leraning process.

These activities of technology transfer can be tabulation based on form of technology transfer refer to the resume of chapter 2.2 above and its can be seen on the following table.

Table 3 : Kind of Activities and Technology Transfer Method Relation Matrix

Kind of Activities	**Transfer of Technology Method**								TLP (PBE)
	FDI	JV	LA	TA	TT	S/P	IPR	UTK	
1. Voucher Program-DIKTI					■			■	
2. DAPATI Program-Depperin					■			■	
3. Technology Transfer – DIKTI				■					☺
4. Community Development-DIKTI				■					☺
5. Industrial Training					■				
6. Research Collaboration		■					■		☺ ☺
7. Partnership with PT. Semen Padang		■						■	☺ ☺
8. Partnership with Norma BV, Netherland		■							☺ ☺
9. Partnership with Lufapak GmbH, German		■						■	☺ ☺

Note ☺: low student involvement ☺☺: high student involvement, TLP: Teaching & Learning Process

The concept of production based education system (PBE system) provide a solution of technology transfe to students and teachers in general from college to the world of industry, there are product development activities can be obtain as media of learning. It can be concluded that the form of cooperation with industry in collaborative product development have a large impact on the learning process system which uses the concept of PBE system.

4. Results

After the 34-year-old, POLMAN Bandung has suffered decades of technology transfer in accordance with the stages of its strategic plan, it can be concluded that the area of cooperation with industry in the form of product and systems development, resulting in the transfer of technology based on industrial needed. The Collaboration with industry in product development needs of the industry provide space for the transfer of technology through the concept of the learning process PBE system as the POLMAN Bandung character.

The effectiveness of this technopreneursip are develops high quality professionals in production areas, increase the sustainability factor of the institute by empowering resources and support the targeted industrial development, integrate the mission of education institution relevant to the future industrial needs.

5. Conclusion

The important thing in industrial collaboration is how the education institution can give a real contribution by solving the actual industrial problem. That why it has to developed as an opportunity for transfering the technology and building technopreneurship through producing product/services as a learning media.

This technopreneurship program has been resulted some points that are match to the several entrepreneurial criteria such as:

- *Experiential Learning*, Students get experiences from structuring practical work as a problem case study, involving in production activities and trying to handle a project.
- *Innovative and Creative Problem Solving*, The industrial order as a "case study" actually is a problem, so the lecturer and student have to find the solution whereas innovation needed.
- *Positive Impact*, It gives impact for soft and hard skill of student simultanously
- *Significant*, The program has started in early semester and plus last semester in business incubator can be develop for forging the student as a real technopreneur
- *Sustainable*, The program will sustain because there is always create a new entrepreneur since from the first semester.

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Biography

Mohammad Nurdin is Lecturer, and Director of Technical & Entrepreneurial Skill Development Center in POLMAN Bandung, West Java, Indonesia. He is graduate Master of Business Administration in school of Business and Management of ITB, hold engineering degree from UNJANI-Bandung in Industrial Technology and Management, Diploma Technician from PMS – ITB (now POLMAN Bandung) in Tool Making and supported by industrial experience (on the job training) for three years in Winterthur-Switzerland. His experience in education starting as instructor in production unit of Foundry Department and Lecturer in several subjects such as Production Management, Industrial Management, Entrepreneurship, Engineering Economy and Production Planning and Control. His work experience starting from Production Supervisor (1989 – 1992) Production Planner (1992-1996), Head of Industrial Services (1996-2003), Assistant Director for Production & Business Partnership and Coordinator for Strategic Business Unit (2003-2013). He has consultancy projects with MARA Malaysia in implementing Production Based Education for KKTM-Melaka (2013-2014).