Development of Educational Programs for Global-PLM (Product Lifecycle Management) Producer through Action Project Group Activities by Industry-University Cooperation

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Abstract. In recent years, the product lifecycle management (PLM) strategy has been highly important to create a significant competitive advantage for global firms. Our industry-university project group has been investigating and researching global product strategy for several years. The results of the action project group activities indicated that the new education curriculum for cultivating the ''Global-PLM Producer'' was well designed as preparation of research and development of the adult education programs for next 2017. This research reports on the definition of competency required for the "Global-PLM Producer", PBL and active learning education programs through action project group activities.

Keywords: PLM (product lifecycle management), product strategy, and educational program

1. INTRODUCTION

In recent years, product lifecycle management (PLM) strategy has been highly important to create a significant competitive advantage of global firms. Thus, numerous studies have been conducted on this topic mainly focusing on utilization of ICT. For example, organizational change and knowledge management in PLM implementation (Garetti et al., 2005), measuring the impact of PLM (Tomovic et al.,2010), PLM implementation guidelines, relevance and application (Bokinge et al., 2012) have already been discussed.

The Business Innovation project group in the Human Innovation Research Center (HiRC) of Aoyama Gakuin University in Japan has been engaged in joint research activities with several universities and corporations related to manufacturing and ICT software industries for eight years. The main objectives of this project group have been to research and develop a new framework for global PLM strategy (Tamaki, 2011), and "Global-PLM producer"

educational programs for undergraduates and adult education (Tamaki et al., 2015).

The main purpose of this article is to report three issues. The first issue is to describe history of project group activities carried out by university-industry collaboration from 2012 to 2015. The second issue is to define competency required for the "Global-PLM Producer". The third issue is to report on development of "Global-PLM producer" educational programs by using PBL (project based learning) and active learning methods.

2. PROJECT GROUP ACTIVITIES

In order to respond to the recent severe business environment, training through industry-university cooperation of specialists engaged in the global business of each company is indispensable. For this, we carried out research and development on a Global-PLM producer educational program. Particularly in the manufacturing industry, ICT system, and service industries, the significance to provide this educational program will increase for next-generation managers and engineers who will play the role of promoting global PLM projects in the future.

2.1 History of Project Group Activities

A university-industry collaboration action project was carried out in preparation for development of Global-PLM producer educational programs from 2012 to 2015 as shown in Figure 1. The four periods of this project are as follows:
- The first period from October, 2012 to March, 2013
- The second period from April, 2013 to September, 2013
- The third period from October, 2013 to March, 2014
- The fourth period from April, 2014 to March, 2015

The first period from October, 2012 to March, 2013

Investigation of advanced industry-university collaborative research on PLM:
- the PLM research center at Purdue University in U.S.A
- the future research project of "Street Scooter Electric Vehicle" at RWTH Aachen University in Germany

The second period from April, 2013 to September, 2013

Investigation of the PLM expert educational program at the KAIST:
- the "PLM expert educational program" had been performed at the Korean Advanced Research Institute of Technology (KAIST)
Advanced industry-university collaborative research on PLM in overseas and domestic companies and research institutions (Continue to following periods)

The third period from October, 2013 to March, 2014

Action project activities for developing our Global-PLM producer educational programs:
- to define core competency required for education of the future Global-PLM producer
- to set the policy for curriculum design

The fourth period from April, 2014 to March, 2015

Action project activities for developing our Global-PLM educational programs (cont.):
- application of new practical education method to adult education program
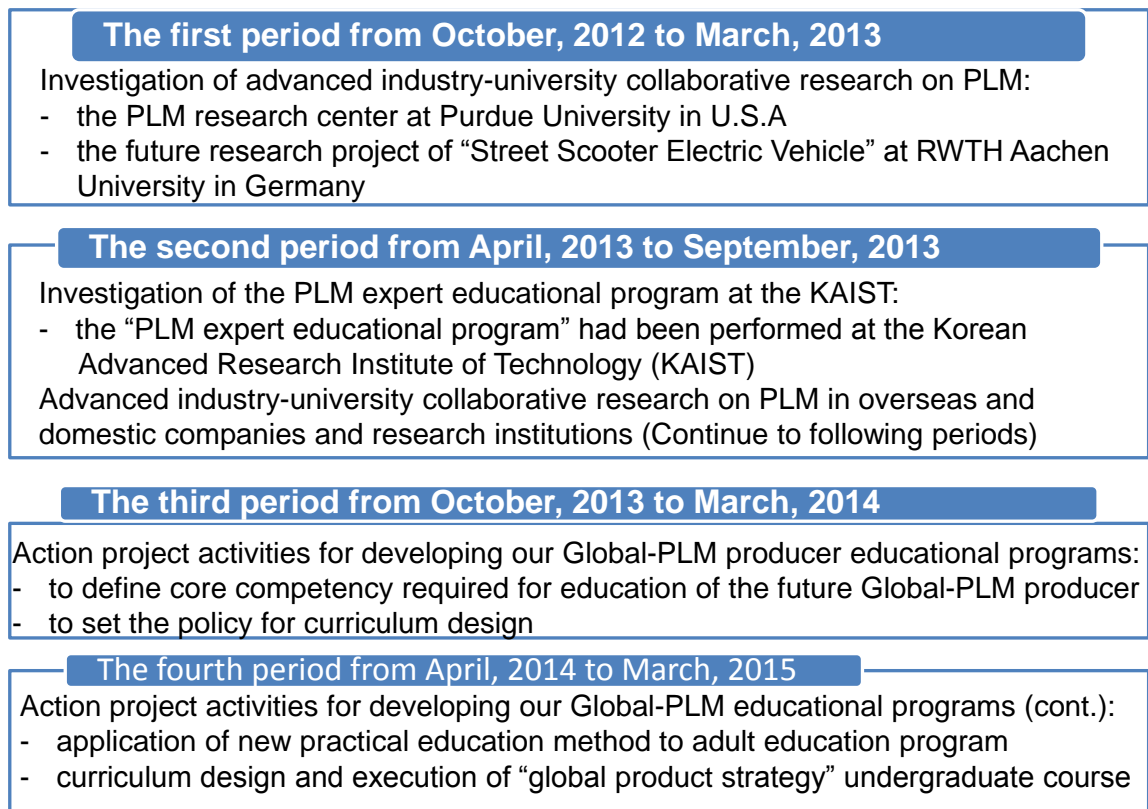- curriculum design and execution of "global product strategy" undergraduate course

Figure 1: Roadmap for industry-university action projects group activities from first period to fourth period

2.2 Investigations of PLM Research and Educational Program at Other Advanced Institutes

During the first and second periods, investigations of advanced industry-university collaborative research on PLM in overseas and domestic companies and research institutions were performed. For example, the PLM research center at Purdue University in U.S.A and RWTH Aachen University in Germany research project of "Street Scooter Electric Vehicle" were observed.

An investigation of the PLM expert educational program at the Korean Advanced Research Institute of Technology (KAIST) was also performed. This academic domain of the educational program focused on the limited application areas of how to utilize PLM software for product development and design.

During third and fourth periods, the action project activities for developing our Global-PLM producer educational programs had treated with three research issues. First issue was to define competency required for cultivating the future Global-PLM as shown in later Figure 2.

Second issue was to set the policy for curriculum design of new Global-PLM producer educational programs. The KAIST educational program at focused on the partial "product architecture strategy" during "PL (product lifecycle) Phase" illustrated in later Figure 3.

The third issue was to apply the new practically PBL and active learning methods for the PLM producer educational program during the fourth period.

3. DEFINITION OF COMPETENCY FOR GLOBAL-PLM PRODUCER

A "competency" can be defined as "the ability to properly respond requests and solve issues, in certain contexts, by utilizing harmonized combination of multiple human resources" (Prahalad et al., 1990). For example, competency is developed through the process of continuous improvements over a period of time rather than a single large change. To succeed in glocal business environment, it is more important and required to build core competency.

As shown in Figure 2, the definition of the whole "competency" for cultivating the future Global-PLM producer is illustrated by a matrix composed by six PL (product lifecycle) phases and four BA (business administration) levels.

(1) Six PL (product lifecycle) Phases:

As previously mentioned the policy for curriculum design of the Global-PLM producer educational program, six "PL (product lifecycle) phases (mentioned in later Figure 3)" were treated for Group 1/ Group 2/ Group 3 project activities by using the PBL and active learning methods.
1) Phase1; Product strategy
2) Phase2; Business model
3) Phase 3; Global market sensing and the new product plan
4) Phase 4; Product architecture strategy (mechanism, electronics, and software)
5) Phase 5; SCM (supply chain management), manufacturing, and QC (quality control),
6) Phase 6; Global marketing channels, sales, and maintenance service.

(2) Four BA (business administration) Level

These four hierarchical "BA (business administration) Levels" were prepared to decide the specific abilities to properly manage the internal environment and the external environment surrounding companies.
1) Level 1: "Glocal business environment", depend on the specific abilities related to Phase 1: Product strategy,
2) Level 2: "Business creation", depend on the specific abilities related to Phase 2: Business model,
3) Level 3: "Customer creation", depend on the specific abilities related to Phase 3: Global market sensing and Phase 6: Global marketing channel, sale, and maintenance, and
4) Level 4: "Product development and operational management", depend on the specific abilities related to Phase 4: Product architecture strategy and Phase 5: SCM, manufacturing, and QC.

The whole "competency" was defined as educational goals based on cultivation Global-PLM producer. Each scope of "competency" sub-units in charge of respective Group 1/ Group 2/ Group3 (mentioned in later Figure 3) are illustrated in this Figure 2. Global-PLM producer should be required not only the ability to adjust respective expert members between Group1, Group2, Group3, but furthermore the ability to supervise the whole competency".

Figure 2 table:

	PL Phase 1: Product strategy	PL Phase 2: Business model	PL Phase 3: Global market sensing	PL Phase 4: Product architecture strategy	PL Phase 5: SCM, manufacturing, and QC	PL Phase6: Global marketing channel, sale, and Maintenance
Level 1: Global business environment	- Product line-up strategy - Platform strategy - Product line strategy - Lifecycle management - Variation management		**Group1 competency sub-units covered with Phase 1/2 and Level 1/2**			
Level 2: Business creation		- Analysis of global business environment - Decision of the entry country - New business concept - Global business model - Ccompetitive strategy				
Level 3: Customer creation			- Marketing research - Market segment - Positioning - Customer behavior analysis - New product planning - 4P-4C-4S - Brand marketing	**Group2 competency sub-units covered with Phase 3/6 and Level 3**		- Global logistics strategy - Local market cultivation - Local distribution channel pioneering - Local market promotion - Local service marketing - Local sales store business management
Level 4: Product development, and Operational management		**Group3 competency sub-units covered with Phase 4/5 and Level 4**		- Technological benchmark - Product specifications and constrained condition - Concept development - System architecture design - Integrated design between mechanics, electric control, and software - Integrated PLM business process model	- Global framework building of production and SCM strategy - Mass production preparation planning - Supplier registration and management - Manufacturing process planning	

Figure 2: Educational goals corresponding to whole "competency" required for cultivating Global-PLM producer

4. EDUCATIONAL PROGRAMS THROUGH ACTION PROJECT GROUP

As shown in Figure 3, research and development of Global-PLM producer educational programs through action project group activities was implemented from the following three standpoints of six PL phases, group work activities, and team building between Group1, Group2, Group3 for the PBL and active learning.

(1) Six PL (product lifecycle) Phases:

As previously mentioned the policy for curriculum design of the Global-PLM producer educational programs, six PL (product lifecycle) phases were treated.

The previously described KAIST educational program focused on the partial "product architecture strategy" during "PL (product lifecycle) Phase" of product architecture strategy illustrated in Figure 3. However, our curriculum policy was to expand the whole range of "PL Phases", which covered product strategy, business model, glocal market sensing, product architecture strategy, SCM (supply chain management), manufacturing, QC (quality control), and
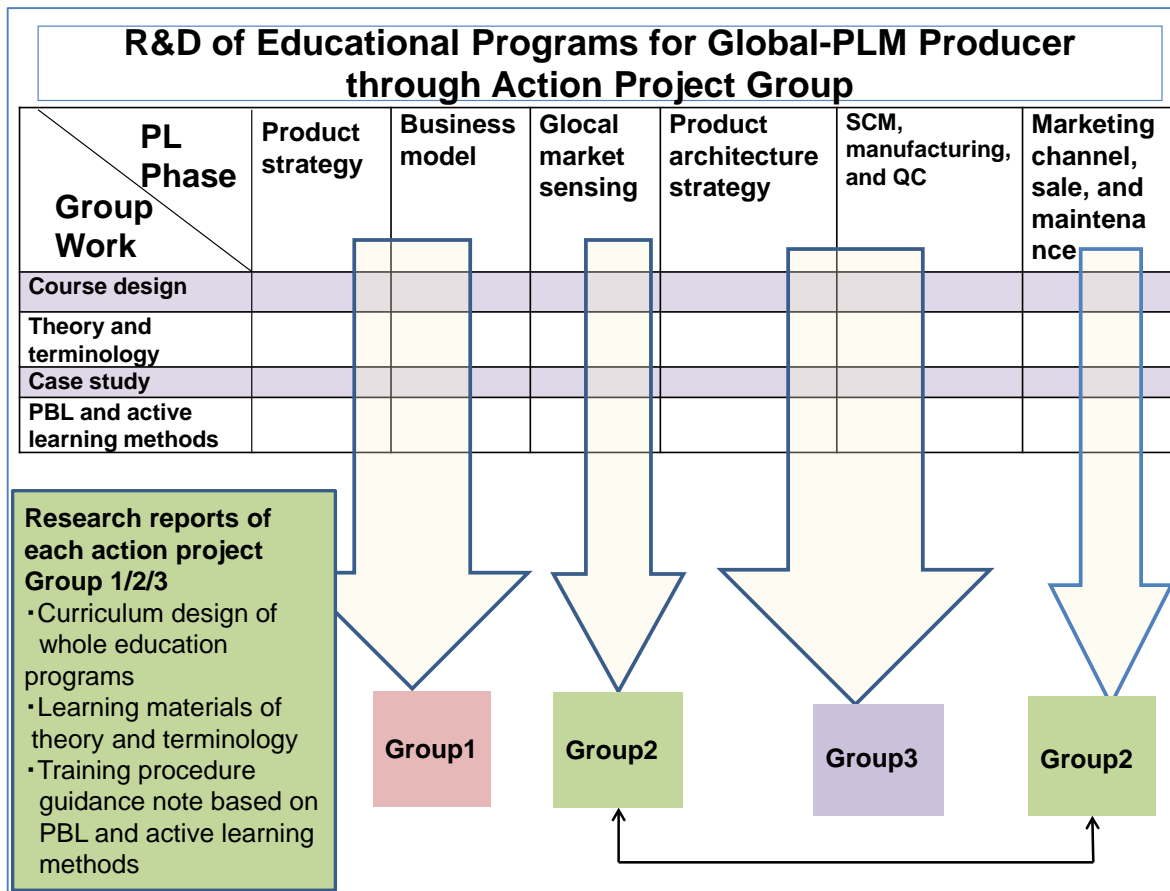
R&D of Educational Programs for Global-PLM Producer through Action Project Group

PL Phase / Group Work	Product strategy	Business model	Glocal market sensing	Product architecture strategy	SCM, manufacturing, and QC	Marketing channel, sale, and maintenance
Course design						
Theory and terminology						
Case study						
PBL and active learning methods						

Research reports of each action project Group 1/2/3
・Curriculum design of whole education programs
・Learning materials of theory and terminology
・Training procedure guidance note based on PBL and active learning methods

Group1 Group2 Group3 Group2

Figure 3: Product lifecycle phases, group works, and team building in PBL and active learning methods for developing Global-PLM producer educational programs

glocal marketing channel, sale, and maintenance service.

(2) Four Group1/ Group2/ Group3 work activities for developing educational programs:

Each specific phase was discussed from the viewpoint of the four group works below by each group1/ group2/ group3.
1) Course design of each group1/ group2/ group3 academic area considering about curriculum design of whole education programs,
2) Learning materials of theory and terminology,
3) Case study for especially PBL, and
4) Training procedure guidance note based on PBL and active learning methods.

Project-based learning (PBL) focuses on relatively long-term, integrated units of instruction where learners focus on complex projects consisting of multiple cases (Jonassen et al., 1999). They debate ideas, plan and conduct experiments, and communicate their findings. Project-based learning integrates courses at a curricular level, requiring learners to self-direct their learning while solving numerous cases across a curriculum. Case-, project-, and problem-based learning represent an approximate continuum of complexity, but all share the same assumptions about active, constructive, and authentic learning.

The virtual case study for the PBL, which proposed a new-product-planning project for a next-generation "Drive Recorder Service System" in consideration of safety and security applied into "Indonesia car markets", was created.

(3) Team building between Group1, Group2, Group3 for the PBL and active learning methods:

The project members were separated into three

groups (Group1, Group2, and Group3) and each individual group worked on editing the training procedure guidance notes based on PBL and active learning methods.

Members divided into each group tackled the group work practice of the new virtual PLM project. Each group treated the same overseas area (Indonesia) with a different business focus: Group1 worked on product strategy and business model/, Group2 global market sensing and marketing channel, sale, and maintenance/, and Group3 product architecture strategy and SCM, manufacturing, QC, respectively.

5. CONCLUSION

The whole "competency" was defined as educational goals based on cultivation Global-PLM producer. Respective Group 1/ Group 2/ Group3 was in charge of Each scope of "competency" sub-units.

In the second period in 2013, project group members had decided to apply PBL (project-based learning) and active learning methods for Global-PSLM producer educational programs. We are currently continuing project group activities in the fourth project period in 2016, and editing research reports which will include curriculum design of whole education programs, learning materials of theory and terminology, and training procedure guidance note based on PBL and active learning methods.

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REFERENCES

Bokinge, M. and Malmqvist, J (2012) PLM implement ation guidelines-relevance and application in practic e: a discussion of findings from a retrospective cas e study, I*nternational Journal of Product Lifecycle Management*, Vol.6, No.1, pp.79-98.

Garetti, M., Terzi, S., Bertacci, N., and Brianza, M. (2005) Organizational change and knowledge management in PLM implementation, *International   J ournal of Product Lifecycle Management*, Vol. 1, No.1, pp. 43-51.

Jonassen, D. (1999) Designing Constructivist Learning Environments, *INSTRUCTIONAL-DESIGN TEHORIE S AND MODELS (Volume Ⅱ)* Edited by Reigeluth, C. M., Lawrence Erlbaum Associates, INC.

Prahalad, C. K., & Hamel, G. (1990) The Core Competence of the Corporation, *Harvard Bu siness Review*, 68(3), 79-91. p.84

Tomovic, C.L., Ncube, L.B., Walton, A., and Grieves, M (2010) Development of Product Lifecycle Management metrics: measuring the impact of PLM, *International Journal of Manufacturing Technology and Management*, Vol. 19, No.3/4, pp.167-179.

Tamaki, K. (2011) Management Process of Product Strategy Integrated with Platform Strategy and Product Line Strategy,"*Journal of Strategic   M anagement Studies*, Vol. 2, pp. 3-10.

Tamaki, K., Park, Y., and Goto, S (2015) A Professional Training Program Design for Global M anufacturing Strategy: Investigations and Action Pro ject Group Activities through Industry-University C ooperation, *International Journal of Business   in formation Systems*, Vol. 18, No. 4, pp.451-468