DISCUSSION PAPER SERIES

2013-05

Improving R&D capability in auto parts manufacturers through VA/VE experience

Motohiro Kurokawa

November 8, 2013

Improving R&D capability in auto parts manufacturers through VA/VE experience[1]

Motohiro Kurokawa[2]

1. Introduction

Automotive industry of Thailand has been developed and expanded since 1960th, when Japanese car producers started to invest, it has already counting over 50 years of history, production amount finally reached to 2.45 million in 2012. During the period, QCD level of local parts producers in the industry was successfully improved by their own effort and support from assemblers.

In addition to self-efforts of private sector, the Japanese government has been assisting their improvement from various aspects, in recent case from FY 2006 to 2010, there was a 5-year development assistance program, namely, Thailand Automotive Human Resource Development Program (TAHRDP), was implemented by the government. Major purpose is to strengthen automotive human resource in skilled labor level, accordingly, it is consisted with four main pillars, those are;

1. Introduction of Toyota Production System (TPS),
2. Skill development for mold & die engineer and skilled labor,
3. Skill development and workmanship training for production technology
and
4. Introduction of skill certification system.

The project has successfully terminated and resulted to train sufficient amount of workforce with upgraded skill & knowledge. After all, in response to continuous request from the Thai government and the Thai automotive industry society, Japanese government has determined to launch another 5-year program, from latter half of FY 2011 to 2015, and renamed it to Thailand Automotive Human Resource Development Institute (TAHRDIP). In discussion for project development, Thai parties demanded to contain advanced stage of training rather than QCD level, government designed new program with involvement of "R&D capability development program", as new assistance menu for engineers. Unlike manufacturing training, incubating of R&D human resource is quite challenging,

since technology transfer in R&D level has just launched among private firms, and development assistance for R&D capability development has not introduced well, except few cases.

So, in this study, through analyses of current business environment and potential of Thai auto-parts manufacturers, strategies to develop R&D capability in the Thai automotive industry are tried to figure out. Then, tailor-made program provided for TAHRDIP, which has just started to implement in 2012, is reconfirmed.

This paper is structured with 6 parts and Chapter 2 will define R&D capability and way to develop is discussed. Along with it, present situation of the Thai automotive industry will be described too. Chapter 3 will emphasize importance to introduce value analysis and value engineering (VA/VE) for stepping early stage to enhance R&D capability. Effects to utilize VE method to improve their R&D capability is mainly explained. In the fourth chapter, collected information through observation of VE training course in TAHRDIP are analized, and Chapter 5 will demonstrate indicators to scale R&D capability, which is adaptable for evaluation, program development or benchmarking study, and the final chapter will conclude discussions.

2. Definition of R&D capability and its process to develop

In this chapter, R&D capability in automotive industry is defined and essential knowledge for parts producers and process to develop those will be discussed. Those information is usable to acquire current situation of the Thai auto parts producers.

As in chart 2.1., typical R&D process for automotive OEM, “Concept make” is an origin and through processes like, “Product planning”, “Product engineering”, and “Process engineering” are responsible to fix specification, and after confirmation process through testing and modifications, mass production is finally launched. Here, crucial parts to understand is that experiences, such are, learning from testing, accumulating past experience for design review, having production knowledge and process change, and learning QA information of ongoing products, are accumulated and fully utilized for development activities. According to survey conducted in Takahashi and Kurokawa (2007) and Kurokawa

(2008), local parts producers are not eager to accumulate such experience to enhance basic knowledge for R&D, which make them difficult to be "Drawings approved" producers. For example, it is often found among local parts producers that updates of drawing are not recorded in good condition, trial (testing) results for production launch is not logged well, or QA information and sample inspection results for current products are not treated as information resources for farther production. Considering enormous efforts historically carried out by Japanese parts producers, currently involved into development process of OEM, local parts producers are required to adjust above situations in daily production activities. Advocating the importance of those experience should be a part of responsible for R&D capability development program.

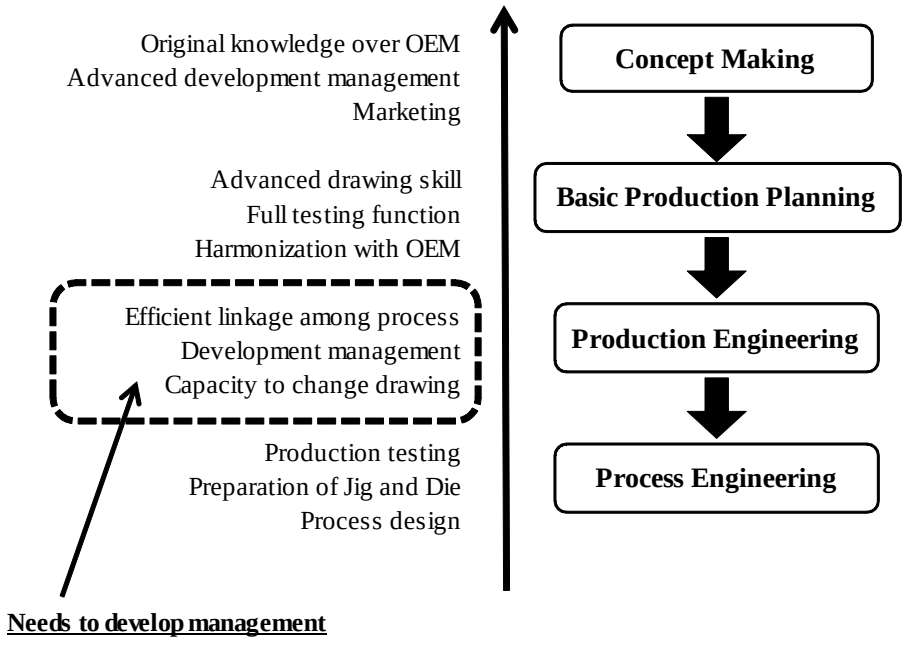

Chart 2.1. Essentilal needs to participate OEM development process, by level

Source: Takahashi and Kurokawa (2007)

Chart 2.1. also explains essential needs for parts producers to participate development process of assemblers, required knowledge are precisely shown in line with participation level. Starting from process design, jig and die

preparation, after all, to be a “drawings approved” producer, advanced knowledge and responsibility are gradually required. According to present position of local parts producers, they would like to cope with the second level, which is to participate from production engineering. In this regards, items depend on managerial types of knowledge are strongly demanded as key items. In addition to agendas mentioned above, it can be reconfirmed again that such managerial type of knowledge should be organized to improve development capability. In Thai firms, things often found like,

1. They are hardly hold proper staff for R&D,
2. They do not launch independent section for R&D,
3. They do not pay much attention to collect information systematically,

and they are easily telling us that they do not take it important to strengthen management system[3].

Chart 2.2. is one of outputs from Kurokawa (2008), three main problems which prevent parts producers from developing R&D capability are analyzed. As discussed in the chart, main problems are found in purchasing, testing and drawing, considering source of problems, as provisions, improvement of management system will task them to solve those. In this point of view, same issue could be raised and proposed, it accordance with the facts in site level.

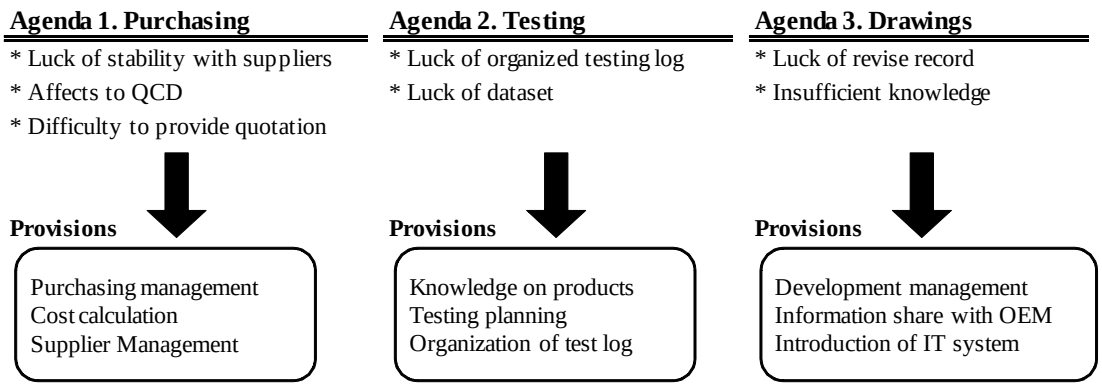

Chart 2.2. Importance of managerial skill

Source: Kurokawa (2008)

When development of management-type knowledge is effective to upgrade them to enhance R&D capability, introducing VA/VE is one of realistic approach to fill the gap. Because VA/VE strongly demands data collection and its results of analyses, also recommend to log many information to realize valuable engineering activities. In this matter, as a training program for R&D, putting VA/VE training into the central part can be customized model for Thai automotive industry. Chart 2.3. is assisting the idea, it briefly order methodologies to modify products as development activities.

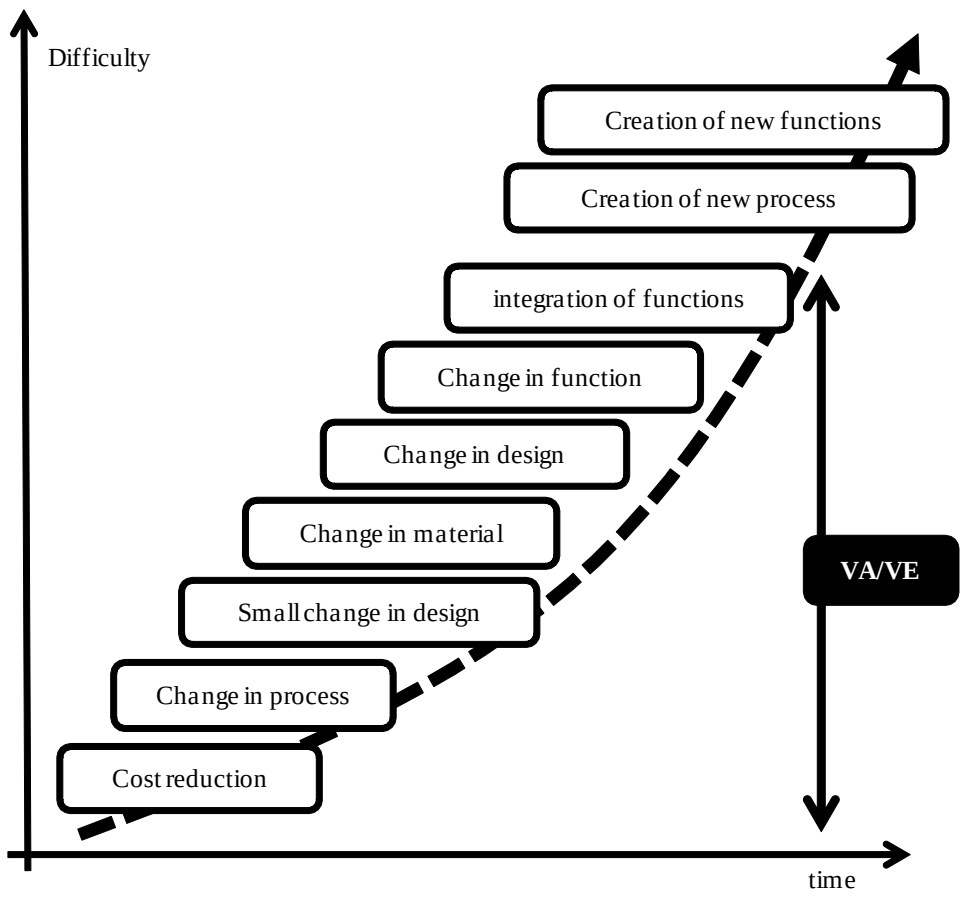

Chart 2.3. Sequence to develop R&D capability

Source: by author

Except two methods shown on top, other minor modifications can not be

understood as development activity in strict definition, rather than that, those are defined as VA/VE. If local parts producers will build up their capability from the bottom line of the sequence, challenging VA/VE is a relevant plan to have realistic perspectives to conduct R&D in the long run. By accumulating experiences from VA/VE, they could enhance managerial knowledge, it partially solve current problems and provide basis to stack R&D knowledge in their organization.

3. Effects to introduce VA/VE

In the last chapter, effectiveness of introducing VA/VE is once examined by confirming problems ongoing in Thailand, this section once emphasize strong point of VA/VE in terms of building managerial knowledge.

Chart 3.1. shows three importance contents of VA/VE, those are 1. Definition of functions, 2. Evaluation of functions, and 3. Creation of alternative value, which is a general methodology to carry out VA/VE for manufacturers.

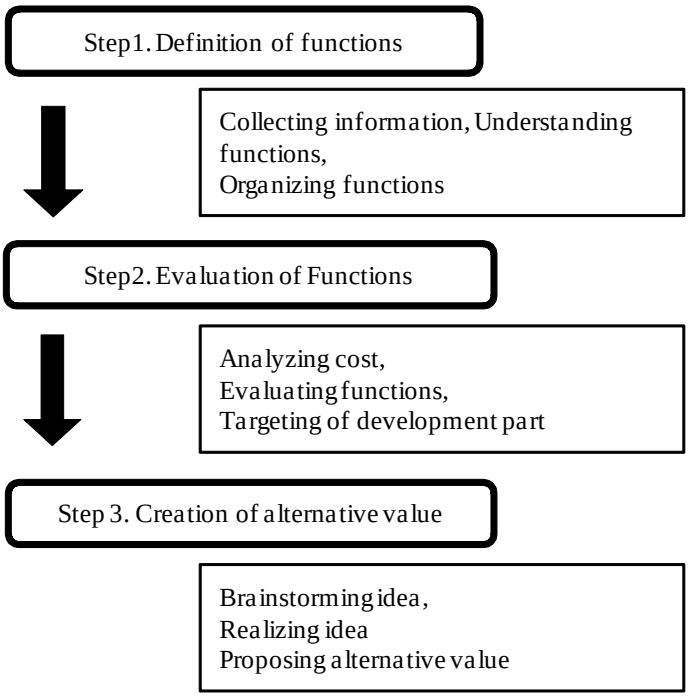

Chart 3.1. Composition of VA/VE

Source: Ueno (2011)

In each step, engineers are forced to investigate products very deep, and products have to be analyzed with objective framework. This task automatically depend on data collection and information management, luck of log management in testing, drawing and trial will be collected through VA/VE activities. Such systematic treatment of development experiences turn to be platform and seeds for future R&D activities. Step 1. is named "Definition of function", which is to separate parts composing products, function of each parts will be reviewed. In this step, engineer will try to judge needs of each parts and related functions. In Step2., it is an "Evaluation of functions", functions brought by each parts are evaluated from two aspects, both value added and markets. In those steps, engineer is naturally think of validities in each parts level, knowledge on products will be improved. In the final step, "Creation of alternative value" will be practiced based on information and results of analyses, maintained in previous steps. Thus, VA/VE, sophisticated method to product data, will support Thai firms to organize management system applicable for development activities.

Reviewing current concern to the Thai automotive industry, there are three important issues to discuss. One is how to keep competitiveness to emerging countries surrounding Thailand, those are Vietnam, Indonesia, Myanmar and Laos. Even low income countries have not been holding automotive industry significantly, it is said that investment of OEM will be appeared in near future. In terms that Thai has the longest history amongst, having different level of capability could be an advantage for them, but there is a possibility that low-tech production will be pulled just by cheaper labor cost in surrounding country, Thailand still need to increase its productivity.

Secondly, they have to catch up with increasing production volume. It is quite nice condition that automotive production has been increasing rapidly in recent years, but parts producer is meeting needs to increase their capacity for sufficient delivery. Increasing capacity by expansion is the easiest way, but due to shortage of labor force, which is laid as the third problem, will make parts producer difficult to take such a strategy. Here, importance of improving productivity through QCD improvement is again a crucial matter.

The third problem is a requirement to enhance development capability. It is difficult to improve development knowledge without holding certain QCD

capabilities, but shown in Chart 3.1., VA/VE will help them to improve both of those simultaneously, because VA/VE is again an early stage of development and sometimes lead to change in production process for cost reduction. In this point, VA/VE also contribute QCD improvement.

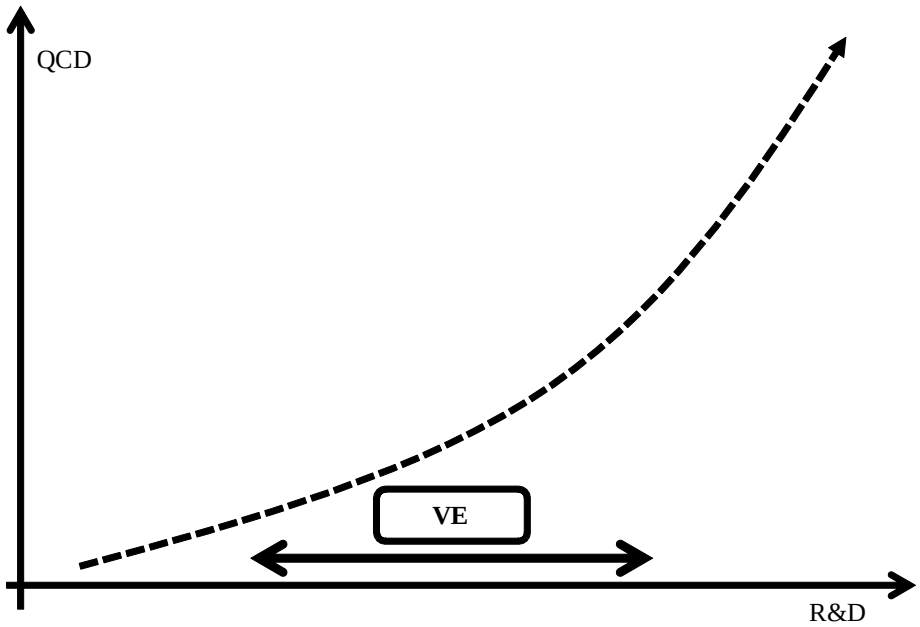

Chart 3.1. Correlation between QCD and R&D

Source: by author

It is said that any firm can hardly enhance development capability without improving their QCD, but development capability and QCD, on the other hand, have correlative relation. If situation permits, parts producers should prioritize improving QCD, then gradually try to improve development capability. But, it is also a possible idea to introduce VA/VE as a basis of R&D activity, parts producers can improve both QCD and development capability,

As seen in the last chapter, VA/VE require advanced knowledge on QCD to define function and calculate values. This fact straightly explains the fact that VA/VE activities would strengthen QCD level. And VA/VE involves elementary level of development activities as Step 3, creation of alternative idea, it means that trying VA/VE is a good practice to experience development process.

VA/VE can take a role to bridge QCD and R&D by filling the gap which local parts producers have been holding presently. According to field information, among local business owners, there are some misunderstandings occurring to describe the image of R&D, they are apt to think R&D is a creative and different from manufacturing activities. But, Clark and Fujimoto (1991) is telling, firm also have to take care, cost efficiency, process management and routine jobs for possible development activities. VA/VE, doing pre-development activity in a systematic way, will task them to understand development process as non-creative activities, which is unlike academic research without practical efforts in manufacturing.

Having said that, introduction of VA/VE is effective and reasonable solution to decline problems of parts producers.

4. Observation of VE training

In this chapter, results of observation of VA/VE training actually implemented under the umbrella of TAHRDIP.[4] The period of the training was 7 months, started in August, 2012 and completed in February 2013. Training period has separated into two phase, first two months was a basic course. In this two-month for basic course, among parts producers, 7 trainees (as candidates for trainer in expansion phase) from 5 firms have participated, and trained 6 hours/day and 3 days/week. In addition to 7 trainees, 2 trainee has also joined to be a master trainer. They were sent from OEM and existence of master trainer is necessary to keep sustainability of the training course after the end of TAHRDIP.[5]

Curriculum was fixed as following Table 4.1., nearly half of the total time was spared for VA/VE to understand general methodology in three steps in the last chapter. In VA/VE lectures, by using half of the time, trainees have educated under workshop style and experienced to adopt V/VE tools in actual level. They have assigned to analyze small trash box used in a car. Along with VA/VE method, trainees were firstly started to collect information of current products in the market and functions by parts were figured out. Secondly, they have estimated costs by functions and through use of analytical framework of VA/VE table, target to modify was found. In the last stage of workshop, new products were presented by each working team.

Table 4.1. Subjects of training

Basic lecture (9h)	Function of parts (24h)	Automotive engineering (27h)	VA/VE (54h)
Orientation	Quality, performance	Energy	Orientation
R&D general	Operability	Electrical system	Process
Required conditions for components	Maintenance	Environment	Definition of functions
	Safety	Gasoline emission	Systematic diagram
	Products Liability	Diesel emission	Evaluation of function
	Intellectual property	Exhaust system	Consideration of improvement
	Brain storming	Homologation	Creation of alternative idea
	TNI visit	Reliability engineering	
		Power train	

Source: by Author

Reviewing the first phase, there were some problems confirmed through observation and interview survey. Firstly, TPA, vocational school for technological training, has been a counter part of this training course, but sufficient commitment was not reconfirmed from them. It has not made clear that how much they are observing course works, without having necessary communication with instructor, it could be hard to organize training course in the future. In this point, sustainability in the expansion phase taught by incubated Thai trainers is somewhat questionable. Secondly, distinguished trainees sent by each firms themselves are becoming the source of concerns. Explained in table 4.1., this course work was basically designed to incubate R&D engineer in the future, so general lectures for automotive engineering were additionally involved, but those did not fit to capacities of trainees, there was a request that

this training course should be concentrated on VA/VE related subjects.

In the next phase, duration for another 4 months, only 2 trainees were selected among them, based on their own firms, in-house workshop education was intensively conducted by adopting their real product as case studies. This workshop must be beneficial in two ways, one is that trainee can experience VA/VE in his professional area, enhanced knowledge is directly usable for daily business. The other benefit is that the results of workshop could bring about real business profit, which is like former TPS course ever achieved in TAHRDP. But, outputs of those two workshops has just shown in the final presentation, suggestion has not approved and adopted immediately by firms. If their idea could clearly bring benefit to those two firms, the training course could be more appearing and brought secondary outcome.

Listing other problems of in-house workshops, "VA/VE workshop team" was not ranked as high position in their organization structure, trainee could not intervene and deal with all production lines and parts by strong authority. As a result, trainee had to consider VE idea limited to parts that his previous division was in charge. Same as TPS, VE activity must be proceeded with corporate-wide approach and the workshop team should be ranked next to top management. Program has failed to provide such environment for workshop tem, it has restricted trainee's activity and output of workshop was uncompleted .

5. Evaluation framework to scale R&D potentials

As a final part of this study, indicator to analyze R&D capability is tried to concrete, since it is usable to reconfirm growth of trainee after implementation and adoptable to provide advanced course after learning in VA/VE training. Table 5.1. shows 7 indicators to analyze R&D capabilities by firm level. In our previous studies have ever defined components of R&D capabilities, those are mostly consisted with technological items. In this study, to emphasize the importance of management knowledge for development, following 3 indicators out of 7 are directly investigating conditions of organizational management, those are R&D related organization, QA/design data management and R&D training system. If firm makes effort to set up sufficient organization, those indicators are easily raised. But, strong commitment from top management with additional

investment should be shown, it sometimes cause larger impact to improve R&D function, rather than improving technological skill.

In this regards, considering management side and organization form, firms can develop their capability, when it will along with this framework.

Table 5.1. Evaluation framework for R&D capability

functions	Level 1	Level 2	Level 3	Level 4	Level 5
VA/VE	Cost reduction	Process change	Material change	Design change	Functional change
R&D related organization	QA section for testing capacity only	ad hoc team for new product launch	Independent organization with testing capacity	Independent organization with design capacity	Independent organization with research capacity
Process Design	100% by customer	20% by own (can make some changes)	50% by own	75% by own (need customer certification)	100% by own
QA/design data Management	Documents not properly stored	Documents stored but rarely used	Documents stored in good order and difficult to seek	Documents integrated in electronic data	Data systemically managed and traceable
Testing Capability	100% by customers	20% by own	50% by own	75% by own	100% done
Drawing	All drawings supplied	Drawings supplied but detailed drawing prepared	Drawings supplied and modify it	Drawings approved	Drawings approved with original knowledge
R&D Training System	None	External system	Original system	Off-JT operated by independent division	Proper trainer available

Source: by author and VA/VE training development group

6. Conclusion

This study tried to reconfirm and discuss current agendas of local auto parts producers to enhance R&D capability, putting main focus to improve their managerial knowledge is focal point to reform. And findings from site observation explained the impact to adopt VA/VE training, after theoretical discussion to reconfirm accountability and usability to conduct VA/VE as pre-development activities. Oppositely, problems occurring in training site are listed.

As a result, it is noted that development program settling VA/VE training as a core subject meets the potential needs and current capability, trainees could upgrade their Kaizen and cost reduction knowledge up to VA/VE knowledge by the specialized training. Having proper VA/VE methodology will help them to accumulate VA/VE experience strategically, the knowledge will partially consist their future R&D capabilities usable for "Drawings approved" works or new product development. Additionally, 7 indicators to scale R&D capability can be used for benchmarking, firm-level study to adopt this methods will be planned in farther study.

References

Caffyn, Sarah (1997) Extending Continuous Improvement to the New Product Development, *R&D Management*, Vol.27, No.3, pp.253-267.

Ichiro Ueno, You Ueno, Masayasu Tanaka and Yoshio Nakagami (2011) *Value Engineering Handbook,* Society of Japanese Value Engineering

Motohiro Kurokawa (2008) Development of the "Monozukuri" Capability in the Thai Automotive Industry, Strategies of Local Auto-parts Producers to cope with "Drawings Approved", *Annual report of Japan Academy of international Business Studies*, Vol.14, pp.113-124

Prajogo, Daniel I. and Amrik S. Sohal (2006) The Integration of TQM and Technology/R&D Management in Determining Quality and Innovation Performance, *Omega*, Vol.34, No.3, pp.296-312.

Yoshi Takahashi and Motohiro Kurokawa (2007) Effects to improve QCD management to develop R&D capability in LDCs, *Annual report of Japan Academy of international Business Studies*, Vol.14, pp.69-81

Yoshi Takahashi, Motohiro Kurokawa and Kriengkrai Techakanont (2009) Learning and Behavioral Change through Participation in Thai Automotive Industry Skill Certification System, *Abstract Journal for the 8th International conference of the Asia Chapter in Bahrain, Academy of Human Resource Development*

---

[1] This is a revised version of two papers presented in "International Workshop, Economic Integration in Asia" held in February, 2012 and "2nd International Workshop on Assistance

for Developing Manufacturing Human Resources: Cases of Thai and Malaysian Supporting Industries" held in March, 2013

[2] Associate Professor, Faculty of Regional Policy, Takasaki City University of Economics, Japan, kurokawa@tcue.ac.jp

[3] In this paper, the ward 'management' does not simply mean financial matter, but includes "coordinating things", "organizing things" and "controlling things" in a company.

[4] In this second 5-year, name of program has changed from TAHRDP to TAHRDIP, since the Thai government is slightly projecting to establish new organization to handle those implemented training course, "I" as "Institute" is added.

[5] All course of TAHRDIP is a trainer's training, from the second phase, Thai teaches Thai is expected.

高崎経済大学地域政策学会
370-0801 群馬県高崎市上並榎町１３００
027-344-6244
c-gakkai@tcue.ac.jp
http://www1.tcue.ac.jp/home1/c-gakkai/dp/dp13-05