Technology and Human Resource Management Methodology in “Kaikaku” (Corporate Innovation) Program

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Abstract

In a corporate innovation program, the alignment of required technologies and available human resources is the key part of the corporate reengineering. In this paper, the authors disclose successful implication of “Pinch Technology” to the technology and human resource management based on the study of rationale for the generic task assignment problem. Additionally, the authors propose a strategic planning procedure for the said management.

Current Situation of ICT Business in Japan

Each IT vendor has restructured its organization and allocated corporate resources to achieve system integration business programs and created its own fulfilling contents, scale and quality as a system integrator. In order to manage corporate human resources, Nihon Unisys maps engineer’s skill level on Career Framework proposed by Information-Technology Promotion Agency, Japan [1] as shown in Table 1. In this table, eleven job categories and seven achievement levels for his/her career are specified by analyzing difficulties of practical IT service processes carried out by engineers.

Every year, Nihon Unisys surveys the achievement level of each engineer and confirms the corporate human capital portfolio as shown in Figure 1 where each box size shows number of engineers and the shape and place of each box show career paths from the bottom to the top in this figure. By applying human capital profiling, Nihon Unisys successfully reengineered its business field from Mainframe-System-based Integrator to Open-System Integrator.

In recent days, however, emerging cloud computing and off-shore development have quickly shifted the ICT vendor’s business paradigm from the system integrator to the service producer that requires different types of engineering skills.

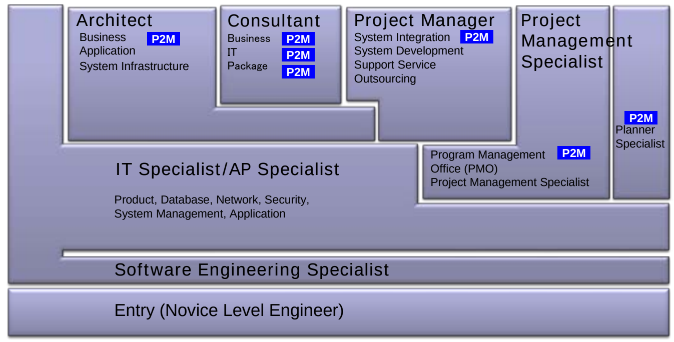

Figure 1 Sample of Corporate Human Capital Portfolio

Problem Formulations in a Corporate Innovation Program

S. Ohara discloses an advanced version of P2M (Project & Program Management) as a paradigm of “Kaikaku” Project Management (KPM)[2]. In his concept shown in Figure 2, KPM is a general term for the mutual relation of the 3 K’s, “Kakusin” (innovation), “Kaihatsu” (development) and “Kaizen” (improvement). It is necessary for KPM to support the enterprise strategic operation and to sustain changes of organizational capability against the external environmental changes.

Figure 3a shows a typical value chain of the 3S (Scheme, System and Service) project model for the development of corporate values. In the value chain, the scheme model project defines the ground design of overall program so as to form systems required for value creation. Further, the service model project achieves actual values based on these systems.

After a certain period of steady operation, the business phase i should be transferred to the next phase i+1, because the initial values to be promised in the first scheme of the

Table 1 Career Framework of IT Engineers [1]

Job Categories	Speciality Fields	Level 7	Level 6	Level 5	Level 4	Level 3	Level 2	Level 1
Marketing	Marketing management	■	■	■				
	Sales channel strategy		■	■	■			
	Market communication		■	■	■	■		
Sales	Consulting by visiting customers	■	■	■	■	■	■	■
	Product sales by visiting customer		■	■	■	■	■	■
	Sales via media			■	■	■	■	■
Consultation	BT(Business Transformation)	■	■	■	■	■		
	IT	■	■	■	■	■		
	Application of a package			■	■	■		
IT Architect	Application architecture	■	■	■	■			
	Integration architecture	■	■	■	■			
	Infrastructure architecture	■	■	■	■			
Project Management	Systems development	■	■	■	■	■		
	IT outsourcing	■	■					
	Network service		■	■	■			
	Software product development	■	■	■	■	■		
IT Specialist	Platform		■	■	■	■	■	■
	Systems management		■	■	■	■	■	■
	Database		■	■	■	■	■	■
	Network		■	■	■	■	■	■
	Distributed computing		■	■	■	■	■	■
	Security		■	■	■	■	■	■
Application Specialist	Business application system		■	■	■	■	■	■
	Business application package		■	■	■	■	■	■
Software Development	Basic software		■	■	■	■	■	■
	Middleware		■	■	■	■	■	■
	Application software		■	■	■	■	■	■
Customer Service	Hardware			■	■	■	■	■
	Software			■	■	■	■	■
	Facility management		■	■	■	■		
IT Service Management	Operation management	■	■	■	■	■		
	System management		■	■	■	■	■	■
	Operation				■	■	■	■
	Service desk				■	■	■	■
Education	Planning the training		■	■	■			
	Instructions		■	■	■	■		

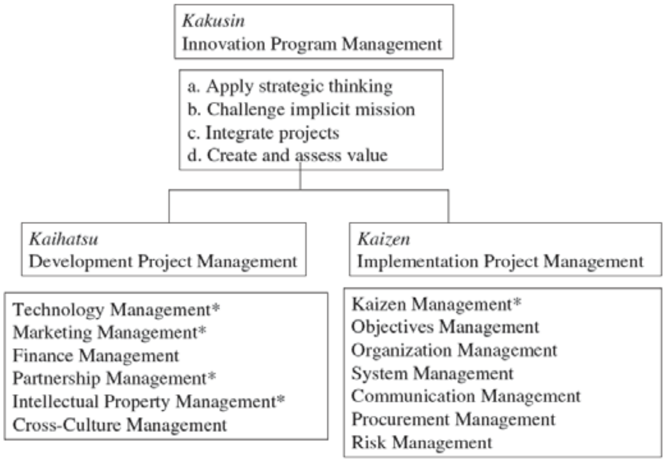

Figure 2 KPM Framework [2]

phase i may be worn out under a competitive business environment. (Figure 3b)

In the business transformation from phase i to i+1 shown in Figure 3b, the following three options can be listed.

Option 1: Link to Next Service-Model Project

This operation improvement (Kaizen) option means improvements in corporate software mostly based on human eagerness's effort. This Kaizen usually needs quite precise and detailed practice, limited value up may be expected.

Option 2: Link to Next System-Model Project

This system improvement (Kaizen) option reforms and/or revamps corporate hardware, such as production systems, service systems, IT systems, internal organizations, and outside corroborations. This reformation is carried out in the form of trade-off between costs and earned values.

Option 3: Link to Next Scheme-Model Project

This business innovation option (Kaikaku) is essential for the total innovation from "AS-IS" stage to "TO-BE" stage. There are three factors for succeeding at this high risk and high return project as follows:

1) Profiling of Current Corporate Situation and Target Innovation
2) Visualization of Project Scheme, System and Service
3) Optimal Allocation of Corporate Resource and Optimal Arrangement of External Collaboration

It is determined that the above mentioned paradigm shift in the ICT vendor is formulated as a certain KPM.

Brief Introduction of "Pinch Technology"

In chemical, petroleum refining and other process industries, energy utilization system synthesis has been researched because of its importance in an area of system

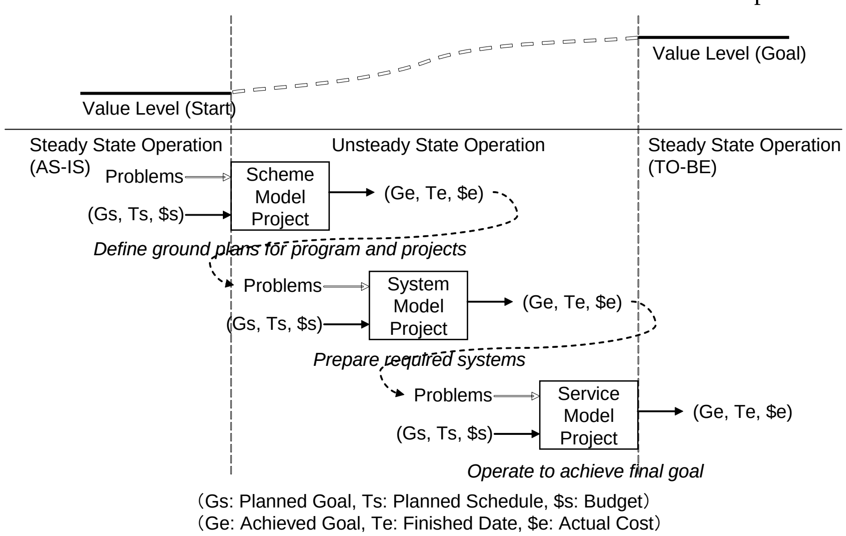

Figure 3a Application of 3S (Scheme, System and Service) Model for Value Creation [3]

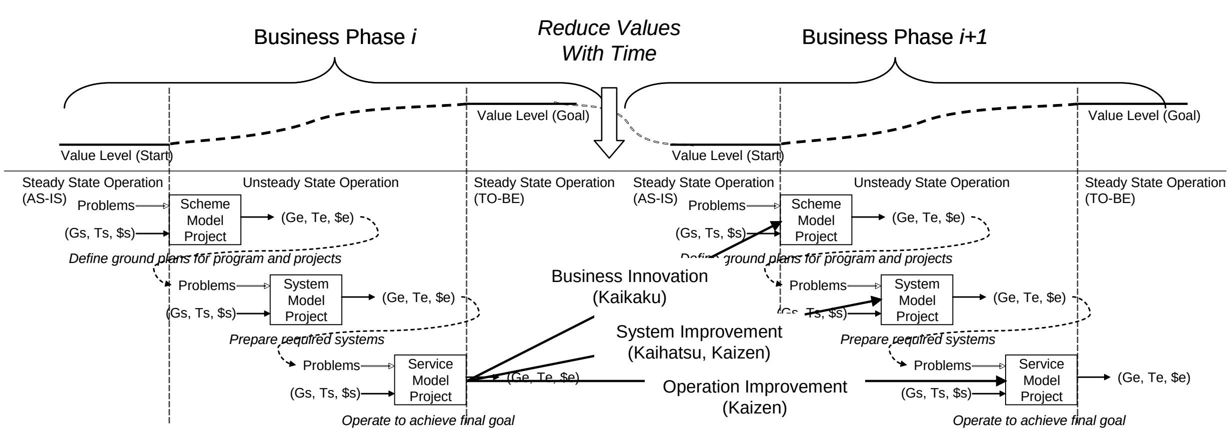

Figure 3b Business Transition based on 3S Model with KPM Concept [3]

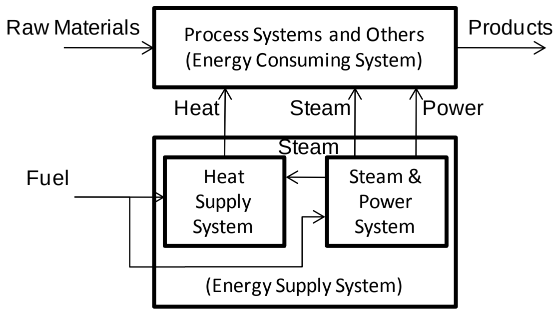

Figure 4 A Simplified Schematic of Chemical Plant

synthesis in the wake of the needs for industrial energy conservation. As shown in Figure 4, from the viewpoint of energy exchange, a chemical plant is composed from two subsystems, i.e., an energy consuming system and energy supply system.

The energy supply system can be decomposed further into a heat supply system and a steam-power system. In a total system, energy conservation can be defined to minimize fuel consumption in the energy supply system corresponding to any energy demand from the energy consuming system. In order to reduce the fuel consumption, heat exchangers between heat sources and heat sinks are installed in the energy consuming system.

So called "Pinch Technology"[4] was introduced in 1980s and has been widely utilized to allocate available energy resources and synthesis heat exchanger networks based on a composite temperature-enthalpy diagram (T-Q Diagram). The left drawing of Figure 5 shows a sample of the composite temperature-enthalpy diagram (T-Q Diagram) that shows two heat source streams and one heat sink stream, which are specified in Table 1. Two heat source streams are integrated into one composite curve. As shown in the right drawing of Figure 5, the heat exchanger networks with the same composite curve can be synthesized from this T-Q Diagram.

By combining all T-Q Diagrams of the heat sources, single heat source composite curve, and single heat sink composite curve are created (Figure 6). The smaller gap between the heat source and heat sink composite curve shows the better energy utilization. This diagram visualizes the available heat recovering duty (Q_R), the required extra heating duty (QH) and the extra cooling duty (Q_C). The smallest gap between two curves is called "Pinch Point" and the temperature gap at this point is called "Approach Temperature (ΔT) ". By shifting the heat sink composite curve to the left, ΔT becomes smaller and finally comes into zero. At this final point, the maximum hear recovery and the minimum extra heating and cooling are achieved simultaneously, though the heat transfer area is infinite because of ΔT=0 in the following thermodynamic equation.

$$A = Q_R/(U\Delta T) \qquad \text{(Eq.1)}$$

where A: Heat Transfer Area, Q_R: Heat Recovery Duty, U: Overall Heat Transfer Coefficient, ΔT: Temperature Difference between Hot and Cold Medium.

The "Pinch Point" indicates a critical point at which no driving force is charged, and the "Pinch Technology" implies

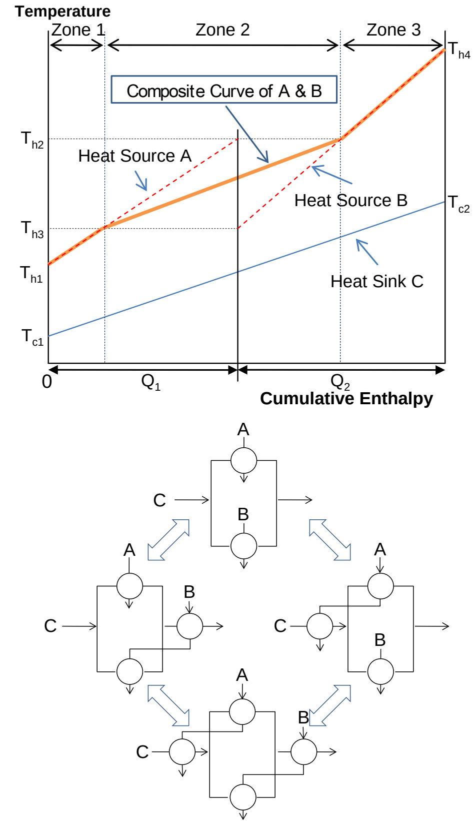

Figure 5 Composite Temperature-Enthalpy Diagram and Equivalent Heat Exchanger Networks

Table 2 Temperature and Heat Duty of Each Stream

Stream	Inlet Temperature	Outlet Temperature	Heat Duty
Heat Source A	T_{h2}	T_{h1}	Q_1
Heat Source B	T_{h4}	T_{h3}	Q_2
Heat Sink C	T_{c1}	T_{c2}	Q_1+Q_2

to solve resources allocation problems according to the quality gradient.

Analogy of "Pinch Technology" in Project Management

Work Breakdown Structure (WBS) is the key part of the project work plan.[5] It defines the task to be performed and settles a basis matter for controlling the project costs, schedule and responsibility. The matrix organizations provide an efficient project execution environment with emphasis on the functionality of each discipline. Under the corporate specific matrix organization, all project tasks in WBS are assigned to each discipline through work packages. The success of project depends on a balance between the quality of deliverables and functional expertise of the discipline.

The concept of "Pinch Technology" has far-researching implications for solving the resources allocation problems according to the optimal matching between quality-difference candidates. Corporate resource profiling and technology management, therefore, can be translated on the analogy of "Pinch Technology" as shown in Figure 7 and Table 3.

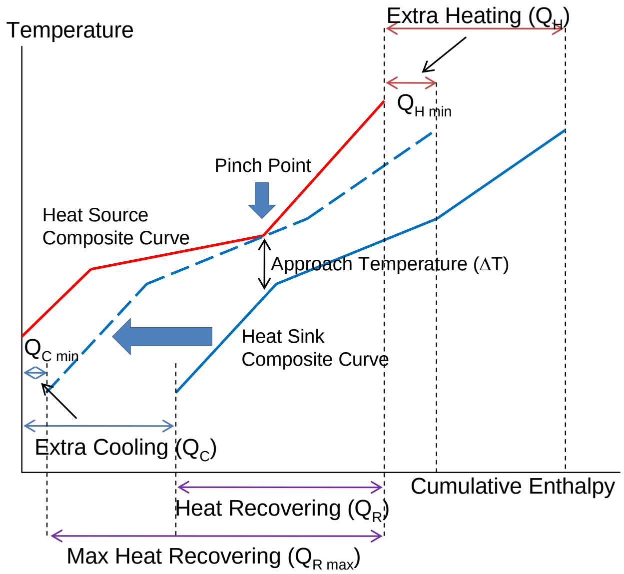

Figure 6 Heat Recovering Synthesis in Pinch Technology using T-Q Diagram

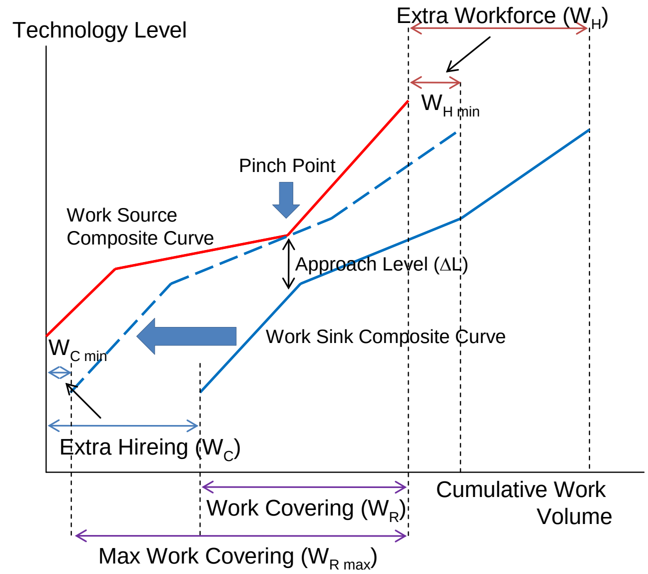

Figure 7 Task Assignment Synthesis using Technology and Work Volume Diagram (T-Wv Diagram)

In this implication, the followings are assumed:

1) Enterprise Project Management [6]

Every corporate resource involves the innovation program on the enterprise-wide level. Not only primary activities but also supporting activities in the Michael Porter's value chain somehow contributes to the innovation project under the enterprise project management concept.

2) Human Resource [7]

Each human resource (an engineer in the technological innovation) has his/her own technology level that can be estimated from the career framework shown in Table 1. His/her technology level at the start of the task is higher than the end of the task, because his/her superior technology state becomes more ordinary state .

3) Project Task [7]

In each project task, from a certain technology level of inputs (such as documents, specifications, drawings, etc.), a promised technology level of outputs can be obtained by engineering efforts of human resources.

4) Work Volume, Work Performance [8]

The volume of the task is measured by man-hours consumed. Therefore, the following assumptions are made for the work performance.

a) A task in the work package can be divided into a multiple of graded sub-tasks, and work volumes (Man-Hour bases) are specified by the graded sub-tasks.

b) The work efficiencies of the graded sub-tasks can be defined for corresponding engineer's classes, respectively. There exist differences in the work efficiencies depending on whether the engineer's class is adequate or inadequate for the assigned sub-task.

c) The execution time of the task can be formulated by the following equation.

$$Te = W_V/(\varepsilon \Delta L) \qquad \text{(Eq.2)}$$

where Te: Execution Time, Wv: Work Volume, ε: Overall Work Efficiency, ΔL: Technology Level Difference between Work source (= engineers) and Work sink (= project tasks).

In using software tools and information technologies, ε can be increased while the execution time is reduced. If ΔL becomes zero, an infinite execution time is necessary. Therefore the optimal ΔL should be reviewed with the condition of realistic technology-work volume profile.

Table 3 Analogy of "Pinch Technology" in Technology and Human Resource Allocation Problem

In Chemical Engineering	In Innovation Project
Heat Exchanger	Project Task
Temperature	Technology Level
Heat Duty	Work Volume
Heat Source	Engineers
Heat Sink	Project Tasks
Extra Heating	Extra Workforce
Extra Cooling	Extra Hiring
Heat Recovering	Work Covering
Approach Temperature	Approach Technology Level

Strategic Management of Technology and Human Resource for the Innovation Program

Due to the space limitation, the summary of the above-mentioned methodology is depicted in Figure 8 by the form of procedure for simultaneous management of technologies and human resources.

Step 1: The current business portfolio is correctly captured with core technologies, core personnel and core vendors.

Step 2: All corporate resources are functionally summarized as Organization Breakdown Structure (OBS) where each human resource placed at the bottom of OBS is described with his/her technology level and available working times during the project period.

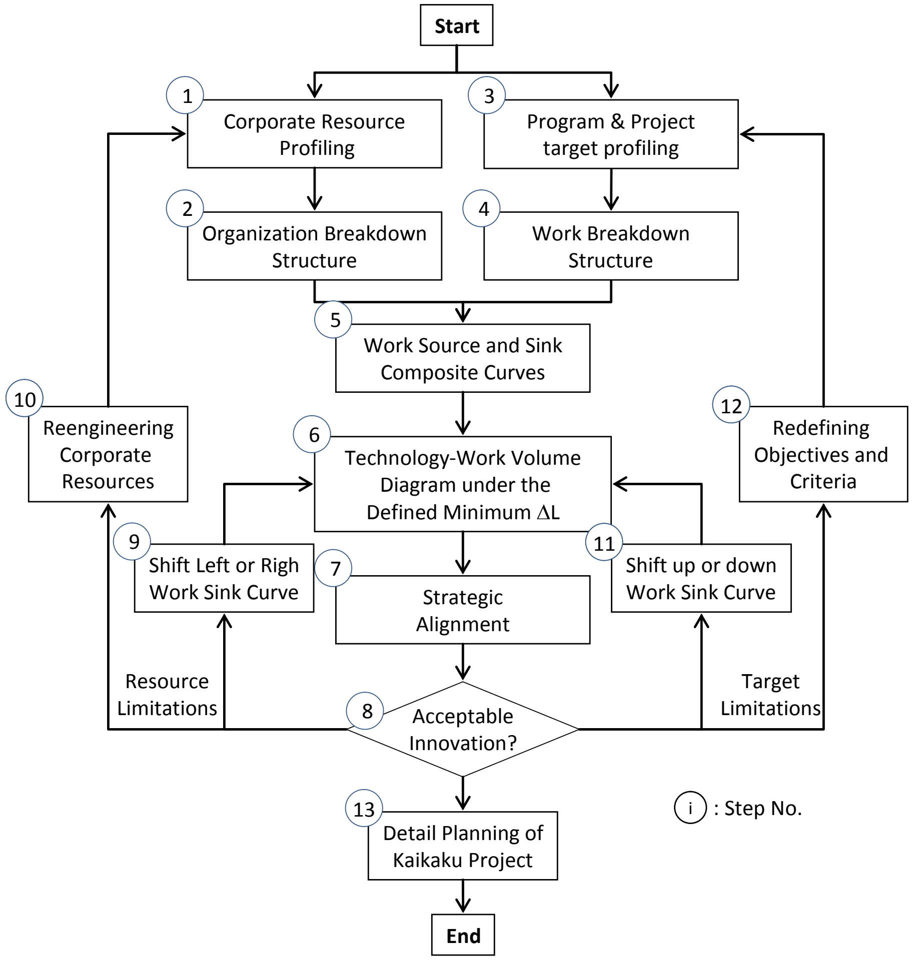

Figure 8 Technology and Human Resource Management Procedure

Step 3: The target of innovation program is clearly defined by the program and project profiling based on the 3S model.

Step 4: All tasks to be performed for achieving the target innovation are described with WBS where each task placed at the bottom of WBS is described with its technology level and required work volumes during the project.

Step 5: The work source composite curve and the work sink composite curve are generated from above OBS and WBS.

Step 6: Both the composite curves are combined in the T-Wv Diagram which the minimum ΔL is maintained.

Step 7: In order to align every task into the strategic direction of the Kaizen project, the strategic decision is made, referring to Table 4.

Step 8: The strategic alignment is made in reality, Step 9, 10, 11, 12 until the acceptable innovative plan is specified.

Step 13: After reaching the acceptable plan, detailed execution plans are prepared for the farther evaluation.

Concluding Remarks

In this paper, the authors have applied the concept of the "Pinch Technology" to attain the corporate resource profiling and technology managements in "Kaikaku" (corporate innovation) program. The success of implication is based on the rationale of essential conclusion of task assignment problem formulation and solution. Additionally, the authors proposed the strategic management methodology where strategic alignment of project objectives, project tasks and project workforces are taken into consideration.

This paper is the first paper, as far as we know, that attempts to apply "Pinch Technology" to a corporate level of resource management. The following studies should be taken to adapt, extend and enhance the concept into the real problems during "AS-IS" to "TO-BE" transition. .

1. How manage the reformation process from "AS-IS" to "TO-BE" phase, while "AS-IS" projects are earning profit?
2. How educate extra workforces who are not adequate in "TO-BE" project, while they are doing "AS-IS" projects?
3. How manage external workforces, though they are indispensable to reach "TO-BE" stage?

Though the concept is not fully established and more research is necessary, the authors attempt to disclose our present status of the research so as to stimulate members of the engineering management community to pay attention to this new and challenging research area.

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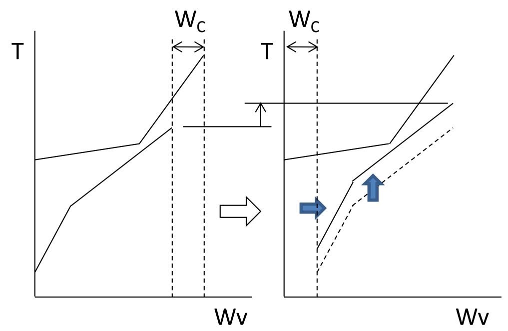
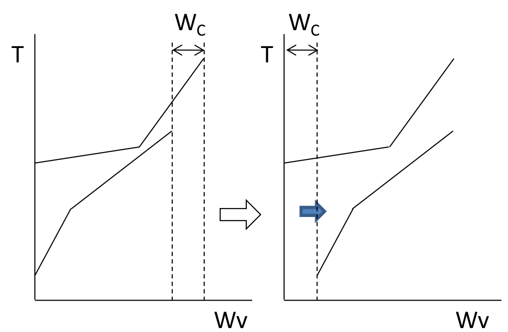
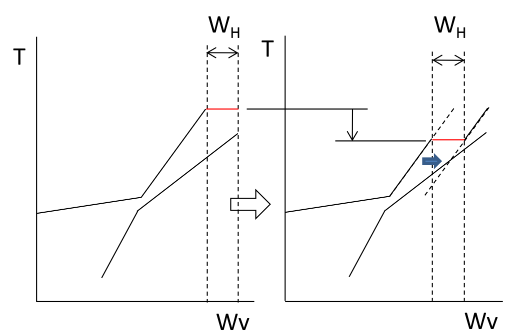
Table 4 Strategic Decisions in Task Assignment

Operation on the T-Wv Diagram	Strategic Plan
Achieve Higher Target with Current Workforce 	Plan 1: In order to effectively use the extra hiring WC who has the higher technology, the sink curve is shifted to left and up direction. More advancement can be expected than the original plan. Plan 2: Another project can be planned by using WC's higher technology.
Achieve Agility in Project Execution 	Plan 1: In order to shorted project schedule, the extra hiring WC who has the higher technology and performance is engaged by shifting the sink curve to left direction.
Hire External Workforce in Proper Technology Level 	Plan 1: Higher class of external workforce shown in WH is cost effective. In order to find out a proper level of external workforce, the upper side of the work source curve is shifted to left to cover higher level of tasks. Plan 2: The WH part of tasks is given up and the project target is lowered.

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