Human Resource Management in Small-scale Project

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Abstract**—**The number of small-scale projects has recently increased despite the numerous difficulties in managing them due to limited resources, including members' limited skill and knowledge, short duration, and small budget. Small-scale project management also suffers from a lack of concern about customer satisfaction. This study concludes that a key factor of management, QCDCs, is not applied effectively in small-scale management. Therefore, this study examines methods for reducing small-scale projects' costs and delivery time and developed a method for measuring each member's performance through task analysis. This measurement also evaluates the characteristics of each project member. The project performance and progress measurement method was based on H-EVM. In small-scale projects, it is especially important to assign the most appropriate member to each task in order to manage limited human resources. The concept of H-EVM thus became a fundamental approach for developing EVM to manage the quantitative project progress by considering the differences between employee capabilities and the ambiguity of labour cost.

Keywords**—** QCDCs, EVM, H-EVM, Small-scale project

I. INTRODUCTION

The number of small-scale projects has recently increased despite the numerous difficulties in managing them due to limited resources, including members' limited skill and knowledge, short duration, and small budget.

The Ministry of Health, Labour and Welfare (2000) asserted that the most essential requirement in improving IT human resources is appropriate personnel management. The study found an effective approach essential to human resource management.

Inogawa (2005) found that small projects markedly differ from large ones in their project scope, time management, human resource management, and project risk management, which should be adapted to suitably manage small-scale projects, which include the following (Table1):

Table (1) Comparison of project management knowledge areas in small-scale and large-scale projec

Project Management Knowledge Areas	*Result found in small-scale management*
Integration Management	*Same as large-scale Project*
Scope Management	*Be characteristic*
Time Management	*Be characteristic*
Cost Management	*Same as large-scale Project*
Quality Management	*Same as large-scale Project*
Human Resource Management	*Be characteristic*
Communication Management	*Almost same*
Risk Management	*Be characteristic*
Procurement Management	*Same as large-scale Project*

Scope management – Considering small project duration limitations, stakeholders must make quick decisions. The required documentation must be collected.

Time management – A brief and simple work plan allowing time for members' other roles must be outlined.

Human resource management – One weakness of small-scale projects is a limited number of team members, and individual members must work in several areas. Consequently, the optimal utilization of each member's time, knowledge, capacities, and motivation are essential for small-scale projects.

Communication management – Although small-scale projects have few team members, they require an effective communication mechanism for sharing all changes among the stakeholders.

Risk management – No difference exists in risk management related to project scale. However, because of the need for rapid decision-making, it is preferable to

prepare four techniques for risk response, according to PM Guide (2004): (1) Avoid, (2) Pass, (3) Reduce, (4) Acceptance.

II. PURPOSE

This study suggests a method for assigning the most appropriate member to each task by measuring each member's performance through task analysis developed using human resource-based earned value management (H-EVM). First, we review the problem of a small-scale IT project's human resource management. We then measure the performance of each member, using H-EVM to effectively assign the most appropriate member to each task.

III. METHOD

Itagaki (2007) proposed that two problems remain in human resource management (HRM): (1) different capability levels and (2) labour cost ambiguity. H-EVM was developed to solve these quantitative problems. H-EVM became a fundamental approach for developing earned value management (EVM), and it comprises six measures (Fig. 3).

Itagaki (2007), He also suggested that there is not only integral ability index, but also ability index for task is necessarily required to assign work to member.

Therefore, The literature suggests that the concept of H-EVM thus became a fundamental approach for developing EVM to manage the quantitative project progress by considering the differences between employee capabilities and the ambiguity of labour cost.

H-EVM
(Human Resource Management based on Earned Value Management)

H-EVM was created by the fundamental concept of EVM (Earn value Management). It is considered 3 indexes as below.

- ✧ PV (Planned Value) is the total cost of the work scheduled /Planned at reporting date.
- ✧ AC (Actual Value) is the total cost taken to complete the work at a reporting date.
- ✧ EV (Earned Value) is the total cost of the work completed/performed at a repotting date.

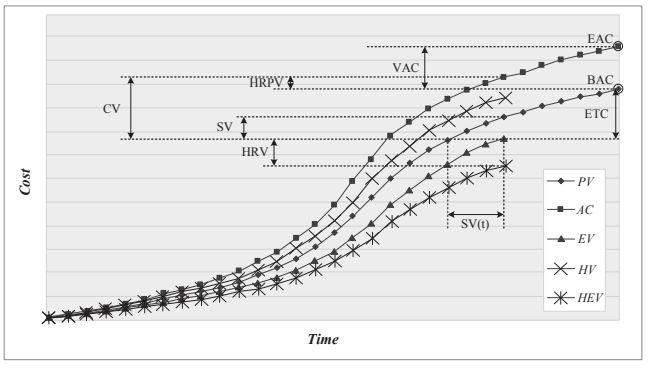

Fig.1 Depicts the other two line (HV and H-EVM), Added by comparing the other value of EVM

In addition, when comparing these two new indicators to all fundamental EVM indicators, one can find a solution to problems caused by human factors such as high cost, delivery delay, and low-quality product.

Considering aspect of Human resource management, it is also able to estimate how ability variable of these human resource affect human resource assignment and human resource cost. We conclude that the two problem found in small-scale project is able to solved by H-EVM

Table(2) Primary data of H-EVM

Human Resource based Earned Value Management	
HV ***(Human Value)***	$HV = HV_{(f)} \square AC$
HEV ***(Human Earned Value)***	$HEV = HV_{(f)} \times EV$

Table(2) showed that H-EVM consists of 2 fundamental indicator which is ***HV (Human Value)*** and ***HEV (Human earned Value)*** as below

Human Value (HV)

First, (Human value (HV) is calculated in relation to actual cost (AC), which is a fundamental indicator of EVM. One can manage the differences between human resource capabilities and ambiguity of labour cost which is often problematic.

- ◆ Actual Human resource cost which considered by ability of each employee
- ◆ Be able to manage the difference between ability and Human resource cost by comparison with AC

Example of HV

Human resource cost of AB employee is 1000 yen
The result of HV, which calculated by equation in fig.4, is *1.20*

A regular human resource cost is 1000 yen, and expected that be able to produce 30 products ($task_t$) per hour

Accordingly, Ability of AB employee for $task_t$ is predicted *30×1.20=36* In case of AB employee working for a hour, *1000yen (per hour) ×1.20=1200yen*

It is evaluated that he has greater ability than value of human resource cost. In experiment using the value of AI which evaluated by the process of questionnaire survey through effective human resource arrangement system, expressed by Fig.2

Fig.2 effective human resource arrangement system

Second, Human earned value (HEV) is calculated in relation to earned value (EV). One can also manage the difference between activity level and the skill of a human resource assigned to a task.

Example of HEV

Payment by the hour of AB member is 1000 yen, expected that making 30 products in a hour

Value of product is 1,000/ 30 = 33.3 yen

HV of AB member is 1.20
EV of AB member is 36 products/hr

Accordingly,

HEV = 1.20 *(36×33.3・・・)=1,440 yen

Table3. reports the following more fundamental indicators that can be calculated from H-EVM.

HRPI *(Human resource Performance Index)*	$HRPI = \frac{HEV}{EV}$
HRPPI *(Human Resource Procurement Performance Index)*	$HRPPI = \frac{HV}{AC}$
HRV *(Human Resource Variance)*	$HRV = HEV - EV$
HRPV *(Human Resource Procurement Variance)*	$HRPV = HV - AC$

(1) Human resource performance index (HRPI)

HRPI≧1.0 indicates that assign an appropriate human resource to a proper work
HRPI<1.0 indicates that assign inappropriate with work

(2) Human resource procurement performance index (HRPPI)

HRPPI≧1.0 indicates that be able to assign an appropriate human resource with appropriate cost
HRPPI<1.0 indicates that not be able to assign an appropriate human resource with appropriate cost

(3) Human resource variance (HRV)

HRV≧0 indicates that assign high-performing human resource who appropriated with task
HRV<0 indicates that assign human resource who is inappropriate human resource who have no enough ability for task

(4) Human resource procurement variance (HRPV)

HRPV≧0 indicates that be able to assign human resource who have appropriate ability with cost.
HRPV<0 indicates that not be able to assign an human resource who have appropriate ability with cost

In addition, Chida(2008) argued that measurement of technical skill standard compared by task is a need for human resource management in IT industry.
Therefore, It is important that how to understand member's ability index for task. It will expressed following

by equation of Productivity performance index (PPIt) as below

$$PPIt_a = \frac{\sum_{i=1}^{n} EVt_{ai}}{\sum_{i=1}^{n} ACt_{ai}} \quad \text{.....(1)}$$

$PPIt_a$: PPI of Human resource by task
EVt_{ai}: EV value of WP_{ai} by task
ACt_{ai} : AC value of WP_{ai} by task

Task	EV	AC
WP1	**5.0**	**4.0**
WP2	**4.0**	**3.5**
WP3	**4.0**	**4.0**

Example PPI of A member

Table (4) the value of EV and AC based on task

$$PPI = \frac{\sum EV}{\sum AC} = \frac{(5.0 + 4.0 + 4.0)}{(4.0 + 3.5 + 4.0)} = 1.13$$

However, PPI equation as above is lack of consideration about degree of difficulty of task. For instance, the measured value of PPIt may be larger than actual value, when assigning low performing employee to low-level task.Also, this equation of PPIt based on operating speed in productivity which is not mentionable about other ability or other knowledge area.

Therefore, AIt (Ablity Index for task) was created and based on ITSS (IT skill standard) expressed as below

Project Management Knowledge Areas	*Score*
Integration Management	*7*
Scope Management	*6*
Time Management	*8*
Cost Management	*6*
Quality Management	*7*
Human Resource Management	*9*
Communication Management	*8*
Risk Management	*8*

Table (3) Score based on ITSS

AIt(Ability Index for Task)

$$AIt_{hat} = W_a \times W_{at} \times S_{hat} \quad \text{.....(2)}$$

AIt_{hat}: Ability index for task based on activity $_a$
W_a: Weight of activity $_a$
W_{at}: Weight of task $_t$ based on activity $_a$
S_{hat}: A raw score of employee $_h$ for task $_e$ evaluated by the process of interview ,writing examination or questionnaire survey

Equation of AIt (Ability Index for Task) as above is more preferable than PPIt as calculation the value of Performance Index for Task. Because it is considered both integral ability index and degree of task difficulty.

However, there is still different unit in two equations, and there is also the different values of the productivity performance index (PPI) and ability index (AI) as a result of experiments measuring members' performance and abilities, underlying unit of these two values was changed into the same unit by standardization, and became a new value, **Human value for task (HVt)**, which used as a human resource capability index, expressed in the following equation.

Human value for task (HVt)

$$HV_{aj} = \frac{PPI_{aj} + aAI_{aj}}{2} \quad \text{.....(3)}$$

HVt_{hat}: HVt of $emplyee_h$ for $task_t$ based on activity $_a$
$PPIt_a$: PPIt of $emplyee_h$ for $task_t$ based on activity $_a$

$aAIt_{hat}$: The valued adjusted by both a standard deviation and the arithmetical mean of PPIt and AIt of $employee_h$ for task $_t$

Example of value of HVt for task

Table 6. The value of HVt for task

アクティビティ	タスク	人的資源A	人的資源B	人的資源C	人的資源D
1.システム開発の準備	1-1 システム化構想の策定支援	1.13	0.93	0.93	1.09
	1-2 開発作業のライフサイクルモデルの決定	1.00	1.03	0.95	0.99
	1-3 開発環境の準備	0.98	0.94	0.99	1.10
	1-4 開発プロセス実施計画の作成	0.99	1.00	0.98	1.05
:	:	:	:	:	:
	統合(HV)	1.10	0.90	0.97	1.05

Activity: System development Preparation

Task 1.1 Plan Support
Task 1.2 Decision of life cycle of work
Task 1.3 Preparation of work
Task 1.4 Making process plan

According to value of HVt following by Fig.4, Arrangement of Human resource will be more effective. It will be able to assign the most appropriate member to appropriate task in order to manage limited human resources, expressed by Table (7) which is make more effective result of work and make more motivation of work of each members.

Table (7). HVt Value after assignment

アクティビティ	タスク	HR	HVt	AHV
1.システム開発の準備	1-1.システム化構想の策定支援	人的資源A	1.13	
	1-2.開発作業のライフサイクルモデルの決定	人的資源B	1.03	4.24
	1-3.開発環境の準備	人的資源D	1.10	(1.08)
	1-4.開発プロセス実施計画の作成	人的資源C	0.98	

After assignment an appropriate member to an appropriate work, the total value of work result will be larger.

IV. CONCLUSION

Managing small-scale projects presents numerous difficulties, especially because of limited resources such as members' limited skill and knowledge, short duration, and small budget, the last being a very influential factor in effectively managing projects.

However, project management in software development projects is particularly ineffective because of lack of concern about these limits of both the software provider and customer. This situation creates higher risk in the future.

Consequently, this study proposed two methods for addressing these problems of small-scale projects: (1) effective human resource management, and (2) effective human resource management using H-EVM and HVt.

The study focused particularly on HVt, the calculation of which considers the value of skill standards. However, each employee's individual ability index is also accepted if they come from a different task area or different industry, Itagaki (2007)

This study also demonstrated that that the management strategy for duration limit, which is an influential factor in small-scale projects, is essential during the entire course of the project.

Through effective human resource management by focusing on each employee's individual characteristics, companies can achieve higher motivation and better performance.

Furthermore, by using effective management via H-EVM, companies can both track the current situation or problem and shorten lead-time in resolving the problem.

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