Life Cycle Value and Its Evaluation

HISAYA YOKOTA, CVS, P. E. JP, CMC
President and Chief Executive Officer
Functional Approach Institute Company Limited, Tokyo, Japan

Biography

Hisaya Yokota is a Certified Value Specialist both by the SAVE International, USA and by the Society of Japanese Value Engineering and also is a Professional Engineer, Japan (P. E. Jp), certified by the Institution of Professional Engineers, Japan. He has been a leading VM Consultant over the past 20 years, having promoted the application of Design-phased VE to public works projects for the Ministry of Land, Infrastructure, Transport and Tourism, the Urban Renaissance Agency, Prefectures, Cities, Towns, and Villages, etc. He has conducted approximately 90 Design-phased VE Studies, creating a total savings of about 200 billion JPY in cost reductions. In 2010, after having worked as Director of the Value Engineering Center at Pacific Consultants Company Limited, he started the Functional Approach Institute Company Limited in Tokyo where as President and Chief Executive Officer, he offers business management strategies, project consulting services, and VM education.

Abstract

Value is a concept inevitable for the improvement of products and services. Since its inception in 1947, value methodology (VM) has been utilized to improve the value of products/services. However, the author felt that there were many cases where value was not properly understood and utilized – especially, value in the life cycle of products/services. In 2006 the author decided to spread VM to non-manufacturing/construction fields and over the past twelve years he has studied the concept of value and has helped make its application more widespread. Considering value's original concept and international VM experts' opinions along with his VM achievements and experience, he has established value in the life cycle of products/services. Through diagramming the conventional value concept, this paper will propose the necessity and effect of Life Cycle Value (LCV) and its basic formula; introduce the Function-Performance-Attribution () Technique with three worksheets, which is used to evaluate LCV for VM activities; and provide LCV studies by the use of this technique with a view to variation and change in LCV.

Keywords: value methodology (VM), Life Cycle Cost, Life Cycle Value (LCV), Potential Function, Potential Value, Performance Rate, Performance Value, Attribution Rate, Attribution Value, variation, change, FPA Technique, FPA Sheet, LCV Calculation Sheet, LCV Change Analysis Sheet

Introduction

Since VM was created by Lawrence D. Miles in 1947, more than 70 years have passed. VM is still being applied worldwide and has proven extremely effective. During the course of this period, this superb methodology has been handed down to many experts with its proper understanding and its continual improvement. From now on, too, one will need to thoroughly understand the essence of VM and develop its timely techniques in order to hand VM down to many generations to come. The author will begin by describing the reason why VM has been widely accepted over the past 70 years.

Why has VM been accepted over 70 years?

The author considers that long-lasting VM application, even for the past 70 years, lies in its very concept of value-based improvement. The concept of VM is of its own that no other improvement method has. VM aims at better products and services by improving their value, which can be gained from their costs and functions. VM by no means merely seeks either lower prices or higher functions of products/services: their higher value means their users'/customers' higher satisfaction. Value can be calculated with a simple

formula V = F/C, where F represents Function or 'output' produced by products and services; and C represents Cost or 'input' with which they can be obtained.

Thus far, a great many VM experts have been developing VM techniques to improve value of various products/services. In doing so, they have satisfied their users/customers. The author does believe that this is the reason why VM is still being widely applied even after its inception 70 years ago.

How should VM be accepted in another 70 years?

In order for VM to still be utilized in the future, the author thinks that one should evolve its techniques while maintaining its principles.

VM application to the service field

This is the era in which VM should be spread to the service field. However, services, which customers experience through their servers and locations, differ prominently from products in the following four characteristics: intangibility, perishability, simultaneity, and heterogeneity (Figure 1). One will be required to have a flexible interpretation to apply value concept further to the service field. That is, one will need to apply the 'value of products' to the 'value of services'.

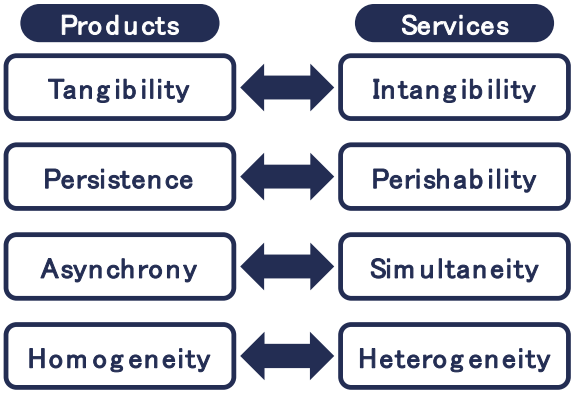

Figure 1: Characteristics of services

Evaluation of value in life cycle

Life cycle, in this context, is defined as the journey of products/services from their planning until their disposal. Costs generated through their life cycle is defined as Life Cycle Costs. The value of products/services should be considered not at a time of their production or sales but from their planning until their disposal. For example, the Life Cycle Costs of products/services should be accumulated each time they are generated. With the accumulation of such costs, product/service value becomes lower on the grounds that their functions are constant. Meanwhile, change in functions of products/services should also be considered through their life cycle. With their deterioration and consumption, functions of products/services become lower. Conversely, the exchange/addition of parts may lead to improvement in functions of products/services. Users/customers of products/services tend to judge the products'/services' value in matters of costs and functions in their life cycle.

Proposing Life Cycle Value

As described above, the value of products/services should be considered through their life cycle. Their functions and costs should also be calculated and accumulated through their life cycle. In order to extend the VM application in the future, life cycle of products/services should be taken into account as their timely value concept.

Basic formula of Life Cycle Value

The author proposes a Life Cycle Value (LCV) formula, in which the conventional value is set as 'before use' of products/services; and after-influence on value 'in use' and 'after use' of them are also taken into account (Figure 2). The right side of this formula is a multiplication of three numerical numbers. Each number has a specific meaning and will be explained in the following three sections.

Potential Value before use

The first numerical number is F/C, which has been accepted as the conventional value. In this stage, products/services are finished but before use, and each product/service has its own constant value. The author sets this value as a potential LCV and names it Potential Value.

Performance Value in use

The second numerical number is P/F, which is the ratio of performance to Potential Value. P represents the performance of a product/service for its users/customers. Each product/service has a different performance for its users/customers. The author sets this as the performance of LCV and names it Performance Rate; and Potential Value multiplied with Performance Rate is named Performance Value.

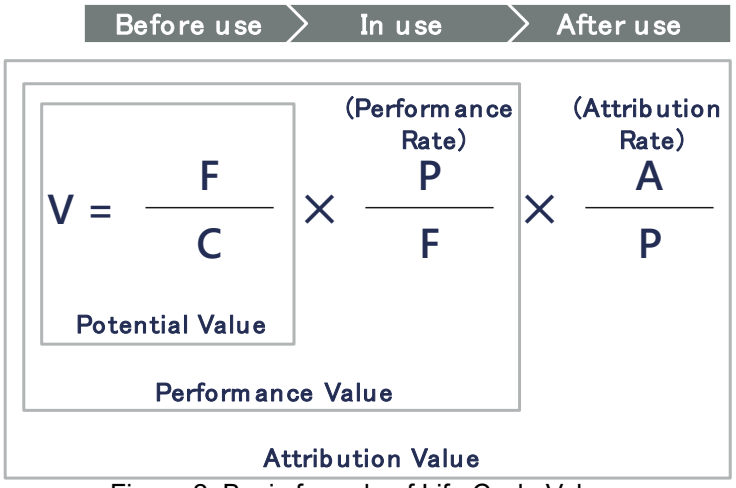

Figure 2: Basic formula of Life Cycle Value

Attribution Value after use

The third numerical number is A/P, which is the ratio of attribution to Performance Value. A represents the attribution of user/customer satisfaction to Performance Value. Whether a product's/service's performance will be attributed to its user/customer satisfaction depends on its users/customers. The author sets this as the attribution of LCV and names it Attribution Rate; Performance Value multiplied with Attribution Rate is named Attribution Value.

Value in three stages of life cycle

The LCV formula makes it possible to evaluate the value of a product/service in each of the three stages of its life cycle – before its use, in its use, and after its use. In reality, however, there are many cases where a product's/service's Potential Value alone is evaluated at the time of its production as a finished product/service. In these cases, its Performance/Attribution Value is neglected. Such neglect may lead to a risk of producing over-performing products/services, which satisfy only their providers.

Therefore, the author suggests defining each of the three stages of a product/service and clarifying its value in each stage. This will contribute greatly to properly evaluating a product/service. As value in each stage is named with familiar work-related words, one can easily use it daily at work (Figure 3).

Before use	In use	After use
Function	Necessary function	Necessary function surely achieved
Function	Performance	Attribution
Skill	Competence	Effect
Design	Operation	Worth
Occupational ability	Duty	Accomplishment
Ability	Role	Effect
Function	Capability	Efficacy
Expectation	Practical	Actual condition
Ideal	Reality	Reaction
Practice	Real part	Grade
Potential ability	Performance capability	Attribution capability
Products	Use	Achievement
Cuisine	Meal	Digestion
Televise	Watch	Excitement
Teach	Memorize	Use
Learn	Use	Useful
Charm	Merit	Virtue

Figure 3: Value in three stages

Cases with LCV application

People tend to judge the Potential Value of products/services prior to using them. However, there are many products/services which can provide higher user/customer satisfaction with the use of LCV. The following are three cases in which LCV is applied.

LCV in products

The 'digital timer' is a product in which an alarm sound goes off when the set time has come. This product has the function <<Measure time>>. To improve the product's function <<Measure time>> means to extend the set time to a maximum. Product A is a digital timer which can set a time up to 99 hours 59 minutes 59 second. That is, this product has its Potential Function of setting a time up to about 100 hours. Under the same price, it certainly has a higher Potential Value than Product B, which can set a time up to one hour. If its user sets the timer up to about one hour, however, Product A cannot exploit its Potential Performance. With its low Performance Rate, Product A has no higher LCV than Product B. This is a case where a product's value cannot be evaluated with their specifications alone (Figure 4).

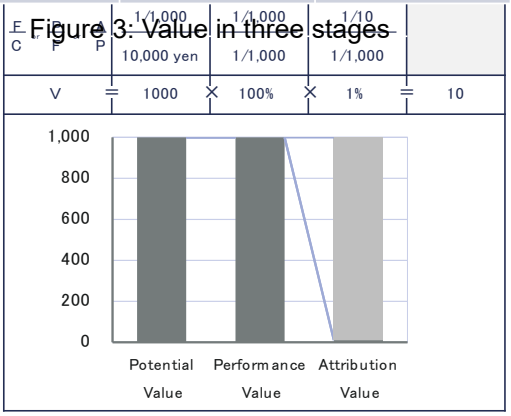

Figure 4: LCV in a digital timer

Another example is the 'wrist watch with stopwatch'. This product has the function <<Enhance measuring-accuracy>> as well as the function <<Measure time>>. To improve this product's function <<Enhance measuring-accuracy >> means to make its time-measuring unit smaller. Product C is a wrist watch with stopwatch, which can measure up to one millisecond. That is, this product has the Potential Function of measuring one millisecond. Under the same price, it has a higher Potential Value than Product D, which can measure up to one decisecond. However, the stopwatch of Product C can be operated only by hand. Therefore, Product C's reliability on its one millisecond time-measuring unit is low and its attribution is questionable. Due to a low Attribution Rate of its stopwatch, Product C has no higher LCV than Product D. This is another case where a product's' value cannot be evaluated with their specifications alone (Figure 5).

LCV in services

The ‘counter service’ is a service provided for customers through interpersonal communication. For example, it is given that there is an inquiry counter which has the function <<Provide information>>, which is accessed when a customer triggers the function <<Hear inquiries>> and after the subsequent function <<Solve troubles>>. The counter was designed to respond to ten inquiries per day. On Day E, it received ten inquiries: however, due to lack of communication with some demanding customers, it was able to solve only five issues. On Day F, the counter received five inquiries but was able to solve all the five issues through smooth communication with the customers. On Days E and F, the counter had the same value, as each of the five inquiries were well answered. This is a case where the value of a counter service cannot be judged only by the number of inquiries that it has received (Figure 6).

LCV in human resources

‘ Human resources development’ is an activity which enhances employees’ skills. Companies invest their employees to enhance their work abilities and have the employees work for better results.

Labor costs for employees differ, depending on what value their companies emphasize: their costs to Potential Value lead to ‘competency-based pay’; their costs to Performance Value ‘job-based pay’; and their costs to Attribution Value ‘performance-based pay’. For example, there are two employees at one company, Employee G and Employee H. Employee G acquired ideal competency through the company’s one-day training. His/her skills were rated as 100 points on the scale of up to 100 points. At that point, Employee G had higher value than Employee H whose skills were rated as 50 points. However, Employee G had no chance to exploit his/her skills at work and never varied from their normal duties. Employee G performing at 50% of his/her competency was enough to do work. Before long, he/she started to do work poorly. In the end, only 50% of his/her work resulted with satisfaction. Meanwhile, Employee H had to exploit 100% of his/her skills to do the same work, all of which was finished satisfactorily. As a result, Attribution Value of Employee G became 25 and that of Employee H 50. This is a case where the value of human resources cannot be judged purely by their potential skills (Figure 7).

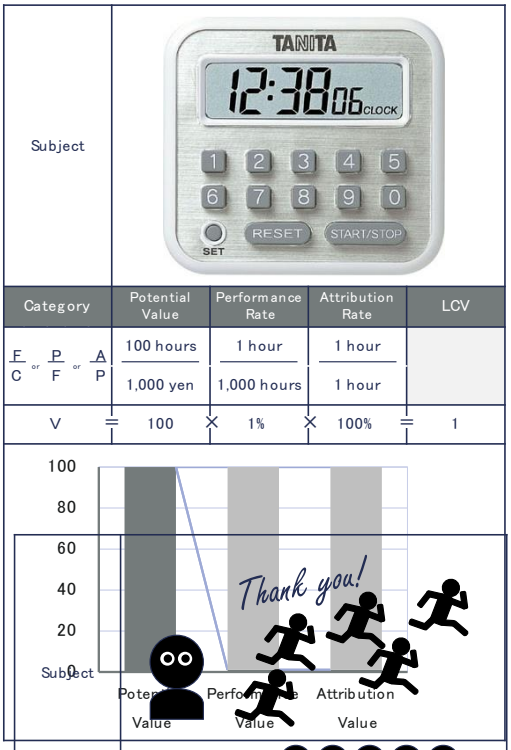

Figure 5: LCV in a wrist w[illegible]

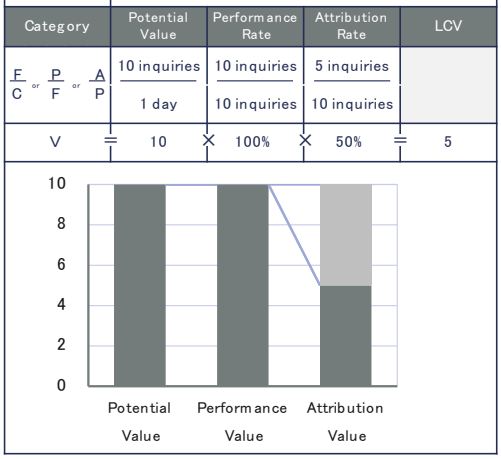

Figure 6: LCV in a counter service

Attention to variation and change in value

As described in the aforementioned LCV cases, product/service value should not be evaluated by their Potential Value alone. Their Performance/Attribution Value should also be evaluated in order to securely satisfy their users/customers.

Variation in value

A service is defined as an ‘intangible’ thing, which, by its nature, ‘simultaneously’ serves its customers under their very nose in a way which arranges each customer’s ‘heterogeneous’ needs, and ‘perishes’ as soon as it has been provided its customers: it is irreproducible and irreversible. Herein, one should pay attention to ‘variations’ in the value of services. That is, the Performance Value of services changes for better or worse due to variations in their servers and customers. Even if their Performance Value has been achieved desirably, the Attribution Value of services differs according to individual ‘variations’ of their customers. For this reason, the author suggests applying the concept of LCV in order to evaluate the value of services, as LCV can respond to their value variations. The author thinks that servers cannot satisfy their customers only through their ‘follow-the-manual’ training. One needs to create ways to improve the Performance/Attribution Rates of services.

Change in value through time

Products are a ‘tangible’ thing, which can be produced in high quality out of the presence of its users – e.g., at factory. However, repeated use of products may wear down their parts or exhaust/deteriorate their materials. Herein, one should pay attention to ‘change in products’ value through time’. That is, the Performance Value of products changes through their repeated use after their purchase. In many cases, a product’s Performance Value becomes lower as time progresses; but that of few products, such as leather items, may become higher after their repeated use. For this reason, the author suggests applying the concept of LCV in order to determine the value of ‘products with repeated use’, as LCV can respond to their value change over time. In a case where the Performance Value of such products goes below the standard of their users’ demand, maintenance costs for expendables replenishment or parts exchange occur. LCV makes it possible to treat the occurrence of the products’ maintenance costs as change in costs through their life cycle (Life Cycle Cost).

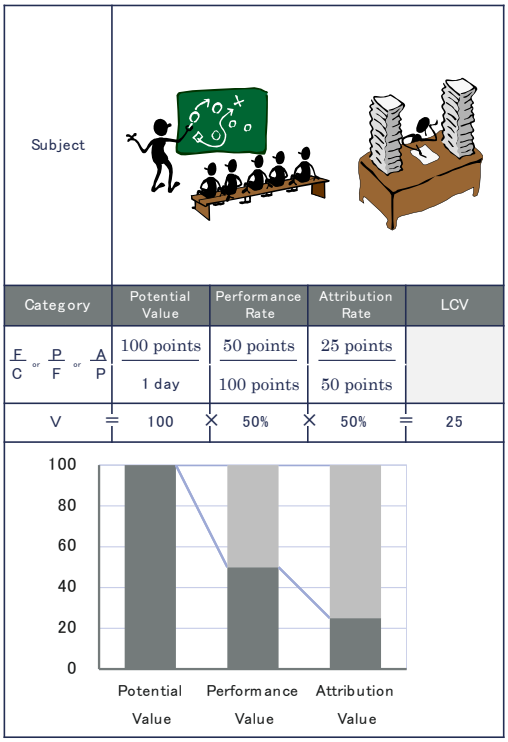

Figure 7: LCV in an employee

Value and user/customer satisfaction

Variations and time-related changes in product/service value are closely related to their users'/customers' satisfaction (Figure 8). Before purchasing a product/service, users/customers can check their Potential Value but cannot check their Performance/Attribution Rates. In other words, product/service value may increase if users'/customers' interests and expectations towards their Performance/Attribution Rates are enhanced. With their enhanced interests and expectations, users/customers make purchases. In comparison, after their purchase, 'interest' changes to 'effect' and 'expectation' changes to 'actual condition' in and after the product's/service's usage. In a case where users/customers feel that the Performance/Attribution Rates of products/services are beyond their interests and expectations, the products'/services' value increases. With this value increase, users/customers may make repeated purchases or referrals of the products/services that they purchased. One can determine the design or providing method of products/services, depending on where the peak of their users'/customers' satisfaction is set.

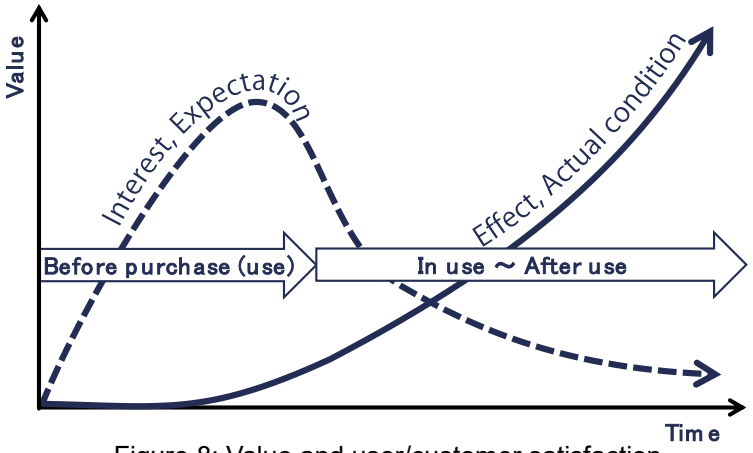

Figure 8: Value and user/customer satisfaction

Evaluation of LCV

To apply LCV to VM activities, this chapter will show the procedure of LCV evaluation, which includes the timing of its evaluation and necessary techniques.

Timing of LCV evaluation in VM job plan

In the VM job plan, generally, Value is calculated by quantifying Cost and Function in the function evaluation phase: this is to evaluate the degree of value of each function area and the potential for value improvement for the following alternative development phase. To evaluate LCV, its Potential Function is evaluated by following the standard procedure; however, LCV should be calculated to evaluate the Performance/Attribution Value. Each value influences differently on potential for improvement. After evaluating each function, one needs to quantify its achievements. This is the FPA Technique (Function-Performance-Attribution), as the author names it. To select subject areas, LCV should be calculated with the FPA Technique (Figure 9).

VM job plan		Options
Function definition	Information gathering on functional themes	
	Definition of function	
	Diagramming of function	
Function evaluation	Cost analysis by function area	
	Evaluation of function	FPA Technique
	Selection of function area	Calculation of LCV
Alternative development	Idea generation	
	Evaluation of ideas	
	Development of ideas	
	Evaluation of alternatives	Calculation of LCV

Figure 9: VM job plan with added techniques

FPA worksheets to evaluate performance and attribution

The author will describe worksheets that he actually uses at his VA workshops. The first worksheet is named the FPA Sheet (Function-Performance-Attribution). The FPA Sheet can be used to evaluate the achievements of both the current functions and 'should-be' functions of products/services. This worksheet can be used with two steps to follow. The first step is to set and quantify indexes to evaluate the achievements of functions in each function area in the same way as the conventional VM. The second step is to evaluate the performance of the functions. To do so, variations in value, as described in the section:

Change in value through time, should be taken into account: variations include time-based, user/customer-based, and provider-based ones. It is recommended to calculate the median and average of each of these figures. In the VM planning phase, it is helpful to conduct a risk analysis and consider its risk diversification.

Let us take one project as an example (Figure 10). The author evaluated the actual performance (performance) of a product's/service's numbers assumed in the project's planning phase. Real numbers can be calculated with rates and put directly in their appropriate columns. Similarly, the author evaluated the attribution of performed functions. In speaking of the function area <<Expect customers>>, 20,000 peoples were assumed as potential users/customers in the planning phase, but the product's/service's Performance Rate of 75% led to 15,000 people and, further, its Attribution Rate of 50% 7,500 people.

Function area		Evaluation index	Function (F)	Performance (P)		Attribution (A)		Comments
			Real number	Rate	Real number	Rate	Real number	
			①	②	③=①×②	④	⑤=③×④	
F1	Capture market	Population in marketing area (unit: 10,000 people)	20.0	100%	20.0	100%	20.0	
F2	Expect customers	Expected customer number (unit: 10,000 people)	2.0	75%	1.5	50%	0.75	
F3	Increase sales	Sales (unit: 100 million yen)	3.0	67%	2.0	50%	1.0	
F4	Reduce expenses	Reductions total (unit: 100 million yen)	0.2	50%	0.1	100%	0.1	
F5	Develop employees	Average skill (unit: point)	85	88%	75	67%	50	
F6	Enhance efficiency	Weekly activity (PPW)	60	67%	40	80%	32	
F7	Raise visibility	Visibility in marketing area (%)	33	67%	22	50%	11	

Figure 10: Example of FPA Technique application

LCV Calculation Sheet to calculate LCV

To calculate the degree of value, the numbers evaluated by the FPA Technique should be put in a sheet named the LCV Calculation Sheet (Figure 11). With this sheet, Potential Value, Performance Value, and Attribution Value can easily be gained. Furthermore, the percentage of Attribution Value to Potential Value is defined as LCV Decrease Rate and should be put in the rightmost column. In a case where there is a function area with significantly low LCV, the product/service may have over-specified in its potential or it may have some problems in its performance or attribution. By selecting subject areas with consideration of these evaluations, project members can stimulate their creativity and generate ideas for value improvement.

Function area		Life Cycle Cost (C)	Function evaluation number			Degree of value			LVC Decrease Rate
			Potential (F)	Performance (P)	Attribution (A)	Potential Value	Performance Value	Attribution Value	
		①	②	③	④	⑤=②/①	⑥=③/①	⑦=④/①	⑧=⑦/⑤
F1	Capture market	0.30	20.0	20.0	20.0	66.7	66.7	66.7	100%
F2	Expect customers	0.25	2.0	1.5	0.75	8.0	6.0	3.0	38% ✓
F3	Increase sales	0.10	3.0	2.0	1.0	30	20	10	33% ✓
F4	Reduce expenses	0.05	0.2	0.1	0.1	4.0	2.0	2.0	50%
F5	Develop employees	0.05	85	75	50	1,700	1,500	1,000	59%
F6	Enhance efficiency	0.05	60	40	32	1,200	800	640	54%
F7	Raise visibility	0.20	33	22	11	165	110	55	33% ✓

Figure 11: LCV Calculation Sheet

LCV Change Analysis Sheet to visualize change in LCV

With the use of both the FPA Sheet and the LCV Calculation Sheet, value in the three stages (potential, performance, and attribution) can easily be differentiated. By applying these worksheets to VM activities, project members and other people concerned can increase their awareness of the project and discuss it more effectively. However, if this mere series of numbers, which represent change in the life cycle of a product/service as described in the section: *Change in value through time*, are visualized, the LCV concept can be put in more use. Therefore, the author uses an approach chart named the LCV Change Analysis Sheet at many VM workshops in order to visualize changes in LCV among products/services (Figure 12). In setting evaluation points in the life cycle of products/services, this sheet can evaluate value at each point and make a graph of it, where its horizontal axis represents Life Cycle Cost and its vertical axis represents Attribution. Lines connecting the origin with each point represent each value: as the slope of a line becomes steeper, its Attribution Value will become higher. This LCV Change Analysis Sheet makes it possible to quickly locate where issues, such as low-level service and customer defection, occur.

	①	②	③	④	⑤	⑥	⑦	⑧
	New	After 3 months	After 6 months	Maintenance	After 9 months	After 12 months	After 15 months	Disposal
C	10,000 yen	12,000 yen	14,000 yen	19,000 yen	21,000 yen	23,000 yen	25,000 yen	26,000 yen
A	100 points	90 points	80 points	95 points	85 points	75 points	65 points	0 points
V	10.0	7.5	5.7	5.0	4.0	3.3	2.6	0

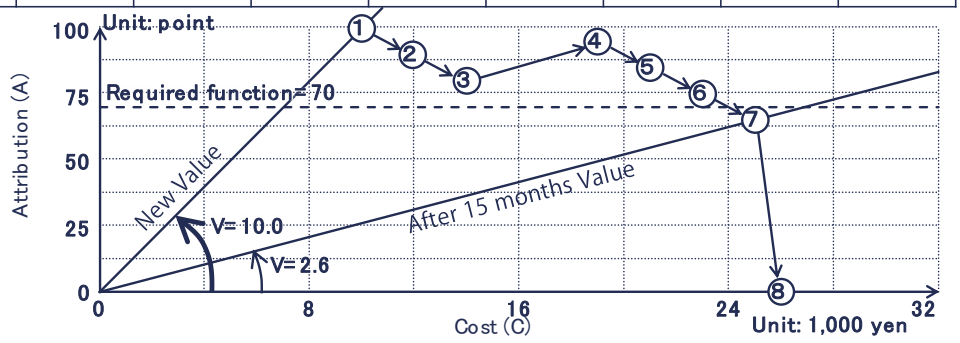

Figure 12: LCV Change Analysis Sheet

Conclusion

This paper could diagram evaluations of change in value of products/services, which inevitably occurs through their life cycle. The service and retail fields, in particular, will become more diverse over time. The LCV concept and its basic formula would be of significant use to responding timely to this diversification. Related to LCV, the FPA Technique and its three worksheets could be introduced with their usage and their value variation/change analysis for VM activities. These would serve as an intellectual stimulant to future VM experts as a step towards better VM activities. The author does hope that VM will become applied to virtually every industry in order to greatly contribute to value improvement in each industry. To this end, he intends to continue studying VM and developing its techniques in collaboration with domestic and international VM experts.

References

- Hisaya Yokota, 2015, “Four Characteristics, Four Points, and Four Techniques of Service VE”, SAVE International