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Study on the Maturity Assessment Model and Application of Highway's Standardization Management

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Abstract

In order to solve the problem of highway standardization management ability description, evaluation and improvement, in this paper, a highway standardization management maturity evaluation model has firstly been put forward. Moreover, the influence highway qualitative factors of implementing the standardized management have analyzed and its evaluation index system has constructed. Furthermore, based on the practice of highway in Henan province, a standard management level has been made quantitative analysis and corresponding countermeasures and suggestions.

Keywords*: highway, standardization management, maturity*

1. Introduction

There is still not form a unified definition about highway standardization management at home and abroad. A concept comparison comparatively recognized in the highway industry is that "in order to get the best management order and management efficiency in highway management practice, we should implement national on standardization work laws, regulations, policies, guidelines, and establish and improve a standardization system with technical standards as the main core, with management standard for the support, with working standard for the protection." [1] Highway standardization management is a systematic project which is regarded as a project in the process of making the best management efficiency goal. Therefore, in highway standardization management implementation process, the project management capability maturity model provides such a kind of methods and tools about how to describe evaluation, comparison and improve their management ability.

Project Management Institute, referred to as PMI, defined the project management capability maturity model as "It is a method to assess organization through management single project and combined project to carry out his combination of strategic goals ability, and still a tool of helping organizations to improve market competitive power." Project management for the capability maturity model provides the user with a rich knowledge to understand the project management and its maturity and other related aspects, gives the criteria as self assessment tool to determine the organizational current project management status and weak links, and then guides organizations to develop improvement plans for improving the current situation. The model is not a simple mathematical analysis or chart, but a set of scientific system and method and a process of leading a group's project management ability from junior to senior and making the success rate of project implementation continued to improve [2]. This paper introduced the project management capability maturity model into the assessment of highway standardization management ability, constructing highway standardization management maturity model to qualitative analysis influence highway standardization management factors, quantitatively calculated its maturity and relatively weak links to offer advice for local highway supervision unit formulating standardization management policy.

2. Highway Standardization Management Maturity Evaluation Model Construction

2.1. Highway Standardization Management Maturity Evaluation Dimension

Common project management capability maturity model is generally consists of two or more than two dimension. For the dimensions, highway standardization management maturity model can be divided into 3D: category five maturity, standardization management technology

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layer, and organization concept layer. These three dimensions are the foundation of highway standardization management maturity assessment, as shown in Figure 1.

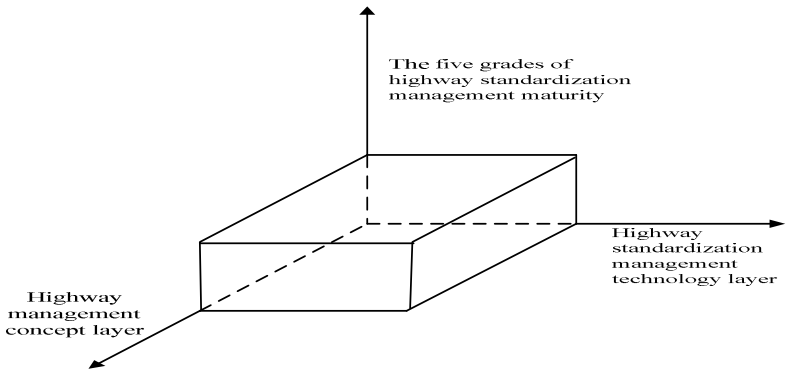

Figure 1. Highway standardization management maturity assessment structure

The specific content of the three dimensions as follows:

(1) The five grades of highway standardization management maturity

Highway standardization management maturity levels defined as grade 1 to grade 5, in which grade 1 represents minimum maturity level and grade 5 represents the highest. Grade 1: the initial level, grade 2: the growth levels, grade 3: the standard level, grade 4: the comprehensive level, grade 5: the optimizing level. The five grades of specific content will be discussed in the next quarter.

(2) Highway standardization management technology layer

Highway project standardized management technology layer means that various related norms of the highway engineering construction and operation management (such as: procedures, rules, regulations, standards, etc), are contextualized and then some related departments will take action accordingly.

(3) Highway management concept layer

Highway management concept layer includes the support of highway enterprise senior management and the degree emphasis on standardized management of corporate culture and organization.

2.2. Highway Standardization Management Level of Maturity and Features

Rank is a primary issue which the capability maturity model should solve [3]. At present, there have been a part of the project management capability maturity model hierarchies situation such as shown in table 1.

Table 1. Project management maturity model classification table

grade / model	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
CMM	initial	repeatable	defined	administrable	optimizing
PMS-PM3	initial process	structured process and standards	organizational standards and institutionalized processes	administrable process	optimizing process
(PM)2	confusion level	planned level	managed level	integrated level	sustainable level
K-PMMM	general terms	general process	single method	benchmarking	continuously improvement
OPM3	standardized	measurable	controllable	continuously improvement	--
KM-PM3	exploration level	arousal level	competent level	best method level	--

As we can see, in addition to OPM3 and KM-PM3, other project management maturity models all have five levels. In most models, its lowest level shows management confusion, and its higher level mostly advocates benchmarking concepts and methods. However, the highest level reflects continuously improving process with continuous optimization.

Comprehensive above maturity model hierarchies, highway standardization management maturity model also set to grade 5, from grade 1 to grade 5 level rises gradually, gradually incline to mature, all levels of maturity name as shown in Figure 2.

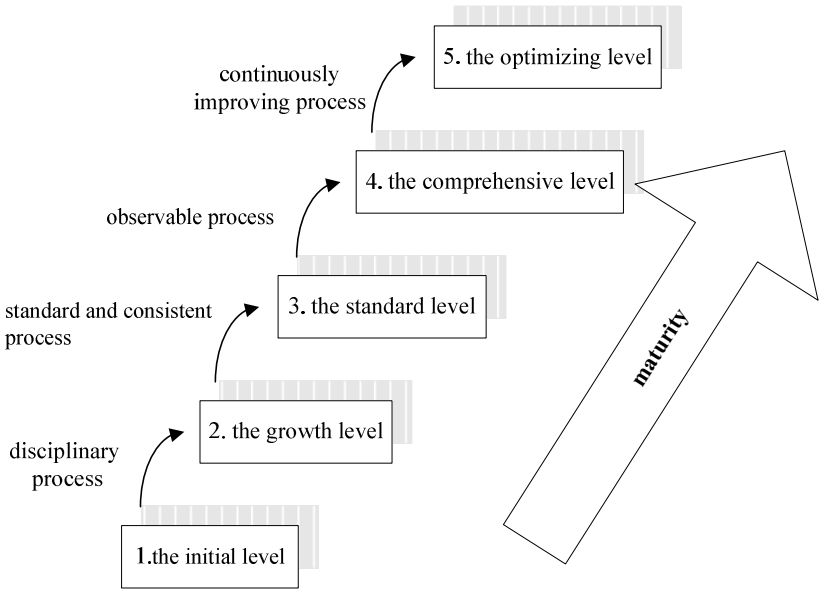

Figure 2. Highway standardization management maturity level

The definition for each level and content description of the situation as follows:

(1) The initial level: Highway enterprises are relatively conservative in this mature level, in which standardization management work is temporary, sometimes even chaotic, and no several management works are institutionalized and lack of necessary technical tools.
(2) The growth level: Highway management unit has been aware of the importance of standardized management in this level of maturity, and has initially established a special standardized management agency. However, these management processes and methods can be poorly repeatable used, cannot be completely successful experience of the past for current and future similar projects.
(3) The standard level: Standardization management in this level has got the unit's enough attention, and the process of the management activities and responsibilities begins to be documented, simultaneously applied to the whole management process of organization.
(4) The comprehensive level: Standardized management culture in this level has been very accepted and fully followed by the entire organization in the implementation. All the elements of highway project management and operation management have gradually realized standardization, and it has become a kind of effective method that the project management is implemented through the management standard.
(5) The optimizing level: In the highest level of this maturity model organization can regularly review and continuously improvement standardization management.

The five maturity level in Figure 2 (i.e. the initial level, the growth level, the standard level, the comprehensive level, the optimizing level) will be connected with "maturity value", and defined the range change of each level "maturity value". Then in which maturity level are the evaluation targets can be determined. According to previous studies, this paper gives the relationship between them in table 2.

Table 2. Maturity value cross-references

maturity level	maturity value	direction
initial	1.0-2.2	at least one evaluation objects maturity value below 2.2
growth	2.2-3.2	at least one evaluation objects maturity value less than 3.2
standard	3.2-4.0	almost all evaluation objects maturity value is more than 3.2
comprehensive	4.0-4.6	almost all evaluation objects maturity value is more than 4.0
optimizing	4.6-5.0	almost all evaluation objects maturity value is more than 4.6

2.3. Highway Standardized Management Maturity Evaluation Index System

Highway standardization management maturity index, is to identify highway standardized management maturity of the evaluation factors, and to decompose the complicated factors which influences the highway standardization management level into the basic unit which is quite simple and easy to be understood. And then the essential relationship from the intricate relationship between factors and the principal contradictions in numerous factors can be found out [5].

Table 3. Highway standardization management maturity evaluation index system

number	dividing basis	first-class index	second-class index	index interpretations
1	technology tools layer	highway project standardized management level	planning stage standardization level	reflect the situation of complying with national highway road network planning
2			design stage standardization level	reflect the following procedures situation of highway project design specification, the standard of construction, supervision ,etc
3			construction stage standardization level	reflect the following procedures situation of highway project design specification, the standard of construction, supervision, etc
4			completion stage standardization level	reflect the meet situation upon the acceptance of delivery
5			maintenance standardization level	reflect the keeping state of highway and its facilities
6		highway operation project standardized management level	collection standardization level	reflect formulation and implementation of highway charging standard
7			highways standardization level	reflect the standard situation of road administration
8			electromechanical standardization level	reflect the highway electromechanical system operation conditions
9			service standardization level	reflect the service level of service area
10	concept layer	organization's awareness of standardization	——	reflect the highway enterprises' attention of standardization management
11		Organization's practical impetus of the standardized management	——	reflect the highway enterprises' promoting and executing situation of the standardization management work
12		establishment degree of standardized training system	——	reflect the highway enterprises' establishment on standardized training system
13		Standardization organization degree of perfection	——	reflect the highway enterprises' establishment on standardization organization
14		standardized professional staffing levels	——	reflect the highway enterprises' staffing situation on standardization professional personnel

Establishing a set of scientific, objective and practical highway standardization management maturity evaluation factors and indicators, has great effect on taking an objective evaluation of the current status , identifying the advantages and disadvantages of current

organization standardization management, making improvement plans, and promoting an enterprise competitiveness [6].

As shown in Table 3, according to the previously mentioned factors which influence highway implementation standardization management in evaluating dimensions and reality, this paper has evaluated the highway management level on standardization management technology layer and organizational concept layer, and also establish the highway standardization management maturity evaluation index system.

3. The Comprehensive Evaluation of Highway Standardization Management Maturity in Henan Province

3.1. Assessment Tools – Radar

Highway standardization management maturity evaluation system covers 14 items performance indicators, the ratio of ideal level entirely solves a problem how will these indicators analyzing data calculated, and comprehensive up than actual level of maturity. Figure 03 shows, the analysis methods: (1) entirely if the index value is located within line illustrate this index of the standardized management level below the desired level, should seriously analyze the causes and puts forward improving direction; (2) if the index evaluation value near or below small round (rank 1 component), then explaining this index did not implement standardized or vexing reform measures should be introduced to reform the losses situation; (3) if more than large circle (rank 5), is this index advantage; (4) all index connected into shadow graphics area represents highway standardization management maturity level, more maturity level, puts forward the corresponding improvement measure.

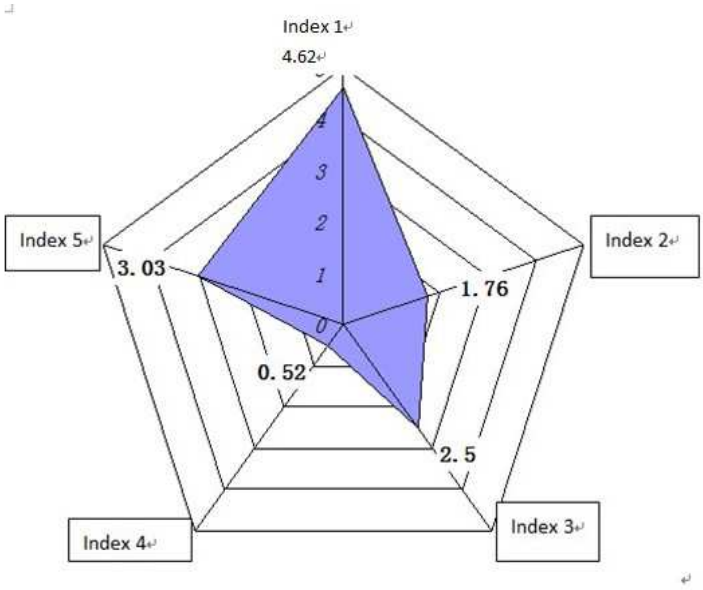

Figure 3. Radar

As the radar showed, if the assessed value of all indicators reaches 5, the acreage shown in blue area will be equal to the size of the regular pentagon in the figure; At the same time, as all the five indicators do not exist substitutes, so it is not appropriate using the usual weighted average method to calculate the phase of maturity. Therefore, the calculation used in this paper quantitative way of maturity is as follows:

$$\text{Maturity value} = \sqrt{\frac{\text{acreage of the blue area}}{\text{acreage of the regular pentagon area}}} \times 5 \quad (1)$$

Formula (1) conversion can be drawn:

When the index number is 2n, firstly the indexes for all the evaluation value are ascendingly arranged to get a sequence" $a_1, a_2, \cdots, a_{2n}$ ".Then,

$$\text{Maturity value} = \sqrt{\frac{a_1(a_{2n} + a_{2n-1}) + \sum_{i=2}^{n-1} a_i(a_{2n-i} + a_{2n+2-i}) + a_n(a_{n+1} + a_{n+2})}{2n}} \quad (2)$$

When the index number is 2n + 1, firstly the indexes for all the evaluation value are arranged to get a sequence" $a_1, a_2, \cdots, a_{2n+1}$ ".Then,

$$\text{Maturity value} = \sqrt{\frac{a_1(a_{2n} + a_{2n+1}) + \sum_{i=2}^{n} a_i(a_{2n+1-i} + a_{2n+3-i}) + a_{n+1} \times a_{n+2}}{2n+1}} \quad (3)$$

3.2. Empirical Study

According to maturity level in Figure 2, the Standardization Administration of Henan Province Highway maturity evaluation index is defined as the assessed value of 5 rating scale, where 1 indicates the initial level, indicated optimization level 5.The assessed value of each indicator can be standardized management of external experts and internal staff access to the common assessment (using the arithmetic mean), and then calculated using the weighted average. Among them, 40% of outside experts, internal management staff accounted for 40%, 20% within the general staff[7]. As shown in Table 4, Highway comprehensive survey assessor standardized management status in Henan Province, and identify indicators that can assess the value of direct measurement.

Table 4. Henan Highway standardized assessment of management maturity evaluation index value

assessed value / direct measurement indexes	external experts（40%）	Internal managers（40%）	Internal ordinary employees（20%）	weighted mean
planning stage standardization level	3.5	3.8	2.6	3.44
design stage standardization level	3.0	2.8	2.2	2.76
construction stage standardization level	2.5	3.2	2.0	2.68
completion stage standardization level	3.2	2.6	3.0	2.92
maintenance standardization level	3.2	3.5	3.8	3.44
collection standardization level	4.0	4.2	4.6	4.2
highways standardization level	2.8	3.0	3.5	3.02
electromechanical standardization level	2.2	2.8	3.2	2.64
service standardization level	2.0	3.2	3.0	2.68
organization's awareness of standardization	4.0	4.6	4.5	4.34
Organization’s practical impetus of the standardized management	4.0	4.5	4.2	4.24
establishment degree of standardized training system	3.0	3.2	3.0	3.08
Standardization organization degree of perfection	2.5	3.0	2.5	2.7
standardized professional staffing levels	1.5	2.8	2.2	2.16

As shown in Figure 4, according to level 2 index calculation one class index evaluation value, the highway project standardized management level of four secondary index evaluation value is drawn in Table 4 by using radar.

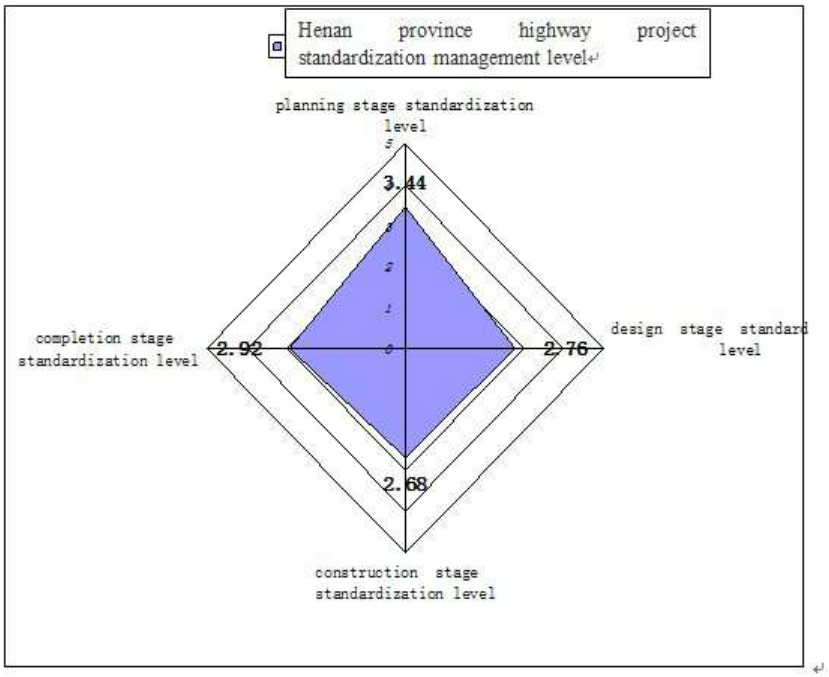

Figure 4. Highway project standardization management level in Henan

We can calculate expressway project standardized management maturity evaluation value in Henan showed in Figure 4 is 3.5955 by following the formula (2); and according to the order, we can also calculate the highway operation of standardization management maturity value of in Henan is 3.6984. What's more as shown in Figure 5, combining with remaining five primary index, we can draw evaluation value, draw the radar which reflects highway standardization management level in Henan, and at last calculate its maturity evaluation value of 3.8180. Referencing table 2, highway standardization management level in Henan is in the normal level, which explains that the standardized management has been paid enough attention by the Henan highway management unit, and the process of standardization management activities and responsibilities, begins to realize documentation, which is applied to the organization's overall management process [8].

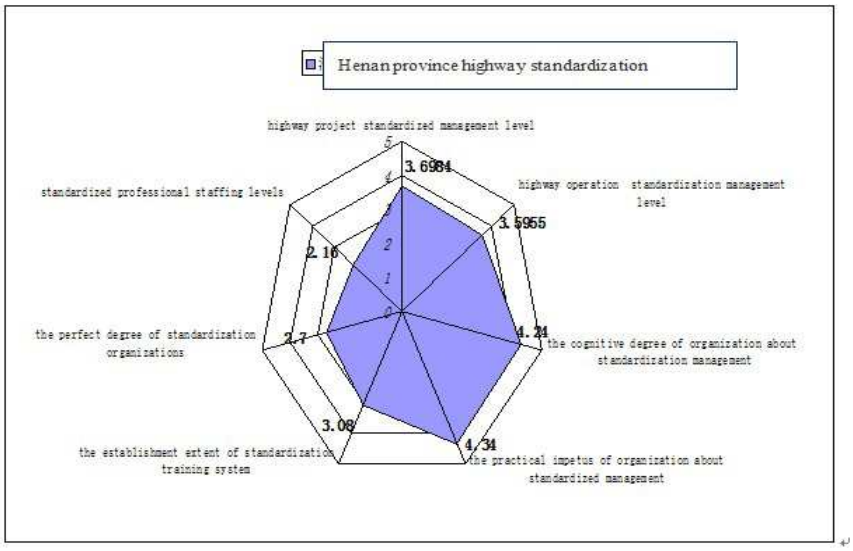

Figure 5. Highway standardization management level in Henan

4. Conclusion

Based on the analysis of the highway industry and enterprise standardization management, this paper has established the highway standard management maturity evaluation model, and combining with the factors during standardized management implementation, has constructed a set of evaluation index system. Through the evaluation experts' inspection and evaluation to highway standardization management present situation in Henan, we calculated its maturity evaluation value, and finally proof that highway standardization management level in Henan is in the normal level, which suggests that highway management unit in Henan begin to pay high attention to the standardized management and gradually implement it, and local management activities also begin to implement documented. Meanwhile, Henan local standard which was carried out from 2010 January 1---highway tolling personnel operation norm (DB41 / T 610-2009) ---just proved this point. Therefore, the next work of highway management unit in Henan is full implementation of the standardized management, and will strive for realizing the comprehensive level and continuously improving to the optimizing level.

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