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Non-operating Urban Infrastructure Project Management Maturity Model on Agent Construction Based on the Evolutionary Algorithm

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Abstract: On the basis of comparing domestic and abroad project management maturity model and issuing questionnaires to collect the views of museum project management staff, we construct a project management maturity model based on agent-construction system by non-operating urban infrastructure projects. The results show that application of agent-construction system in non-operating urban infrastructure projects is feasible.

Keywords: Agent-construction system, non-operating urban infrastructure projects, project management maturity.

1. INTRODUCTION

Non-profit urban infrastructure not only for the lives of citizens to provide related services, is one of the important measures of governmental functions, non-profit urban infrastructure construction projects to also play a role in promoting economic development. Therefore, in recent years the Government has increased non-operating the construction of urban infrastructure projects. But for a long time, our non-profit urban infrastructure construction projects management using "construction, management and use of" integration model, but exposes many drawbacks, serious waste of resources and low efficiency of construction of the project, construction management, such as the low level of investment out of control occurred. In order to improve the economic and social benefits of government investment projects, our government adopted in urban infrastructure project management operations not the agent based on the concept of urban infrastructure operations not based on non-operational project for the study of urban infrastructure, urban infrastructure project management operations with reference to the construction mode, and maturity model analysis of construction agent system mode of project management implementation status on non-business agent of urban infrastructure project management maturity assessment. Evolutionary is one of the most important algorithm in computer algorithms, internationally have done a lot of research on it, we will conduct detailed.

2. ANALYSIS OF NON-OPERATION PROJECT MANAGEMENT MODE OF URBAN INFRASTRUCTURE

2.1. Non-Operational Overview of Urban Infrastructure Projects

Urban infrastructure refers to citizens for the city public works and public life, which is needed for the production and development of general infrastructure of the city. According to urban infrastructure projects to provide the physical nature of the products and services, urban infrastructure projects can be divided into urban infrastructure projects, non-operating profit urban infrastructure projects [1]. In this paper, urban infrastructure project in non-operational overview of this type of infrastructure.

Non-profit urban infrastructure projects are public goods, demonstrated in consumption of public goods of non-competitive and non-exclusiveness, inefficient allocation of resources, resulting in non-operating on the supply of urban infrastructure of market failure. Because the market cannot fully provide citizens of non-profit urban infrastructure needed, this requires the Government to non-business involvement and intervention in the supply of urban infrastructure. In order to meet the needs of citizens for life, the Government will provide urban infrastructure operations not directly funded. Of course, with the social development, market completion, and increased participation of private capital, which means that non-profit urban infrastructure projects between public spending and private consumption and consumption will, its scope was changed and gradually narrowing.

2.2. Non-Operational Analysis of Management Mode of Urban Infrastructure Projects

At this stage, non-operational during the effective management of urban infrastructure projects, for non-operational management mode of urban infrastructure projects are as follows:

Mode of construction headquarters: Construction headquarters is planned in China under the system of middle and large capital construction project management by using a basic form [2]. It was designed by the employer, the construction units, local units, staffed by some staff members from relevant government departments at all levels to form a temporary construction project management body until after the completion of construction, command personnel are returned to the initial jobs, retiring the project organization.

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Infrastructure mode: Infrastructure services are units within ministries responsible for infrastructure construction. Its main job: responsible for land management and use of making overall planning; development plan for infrastructure; responsible for building the infrastructure; for Omnidirectional management of project; responsible for bidding. Therefore, the infrastructure mode with "construction, management and use of" three-in-one features.

Responsibility system of project Corporation model: Project legal person responsibility system is the construction project by project legal person of project planning, financing, construction, production and operation, debt repayment and the whole process is responsible for increasing the value of the assets of a project management model [4, 5].

Although above three species management mode has respective of advantage, but this three species management mode are reflected out units and using units integration of phenomenon, that using units acts as a with units of role, in investment process in the lack on cost control of supervision, thus makes investment cost cannot get effective to control [7]; also, due to this class project management institutions of features Basic are is temporary, its most related staff is temporary drawn and to, they on temporary institutions by gives to they of post lack sense [8], and unclear responsibilities phenomena occur, resulting in low efficiency of project management.

2.3. Analysis of Construction Mode

Disadvantages based on such traditional management mode, the agent is in this case as a non-operational a new management mode of government investment projects and development of. Agent originated in United States construction manager (CM), which is generated by a combination and construction practices in China out of a non-operational management mode of government investment projects. From July 2004 to articulate "on non-business investment project to expedite the implementation of the Government agent" until today most provinces and municipalities in China have introduced a generation of organic, and has gained valuable experience in some areas.

According to the national development and Reform Commission of the draft, the State Council approved in principle of the reform of the investment system decision, refers to the Government of acting by way of bidding, select a professional project management unit, namely, construction units, is responsible for the construction of the projects management and implementation, delivery and use of the system after the project is completed. Agent construction management mode features, that is, employer, the agent on agent construction management mode, and use through economic contracts to determine relationships among, the construction unit has a new Division of responsibilities [3]; it is no longer the sole owners. Due to the construction mode, construction units were responsible for the design and construction of the project, as well as to control the project cost, schedule, quality, so agent units played the role owner during the construction period, which makes construction units are no longer confined to the so-called consultant role. This management model to solve the non-business of government investment project construction occurred during the "construction, management and use of the" three-in-one, the investment costs are out of control, and project management inefficiency has played a big role. Therefore, the agent mode is a more suitable for non-operational management mode of government investment projects.

3. ESTABLISH NON-BUSINESS AGENT OF URBAN INFRASTRUCTURE PROJECT MANAGEMENT MATURITY MODEL

3.1. Project Management Maturity Concept Introduced

Project management maturity to express is an organization (usually refers to an enterprise) in accordance with the objectives and conditions of the capacity to implement the project successfully and reliably. In other words, the project management maturity refers to the degree of maturity of project management processes.

Project management maturity model in project management process maturity concepts evolved. According to the accumulated experience of traditional project management practice and project management to the project's success or failure has a greater degree of influence, so the researchers introduced the concept of project management process maturity model, the model used to assess the overall project management process measurement and control, the extent of management and effective, so as to identify problems and propose appropriate solutions. The project mode formula is as follows:

$$\sqrt{\frac{c(m+n)+\sqrt{4a+b}}{2n}} \qquad (1)$$

3.2. Non-Operating Urban Infrastructure Construction Project Management Maturity Models

At present, we have testing more than 30 kinds of project management maturity model. Among them, the OPM3 model CMM model, K-PMMM model, FMS-PMMM model, the most famous, these models are based on the qualitative or quantitative measurement. Paper for non-operating sex City based facilities project management mature degrees of detection, is in reference past scholars in generation formed mode Xia on operating city based facilities project management mature degrees model of exploration and research, that: in OPM3 mature degrees model of based Shang, intends used quantitative measurement method building a three dimensional of project management mature degrees model, and using "wind rose figure" of calculation method measurement research object of mature degrees grade.

3.2.1. Build Urban Infrastructure Operations Not Dimensions of Project Management Maturity Model

Based non-profit urban infrastructure projects built by the three dimensional structure of a project management maturity model. These eight elements in a different perspective on the entire project constitutes a comprehensive set of management, these eight factors are as follows: contract management, progress control, quality control elements, elements, elements of cost control, risk management, safety and environmental management, information management, warranty management and coordination elements. Dimensions 2-project management life-cycle stages, life cycle stage are

divided into five stages: decision making, design, and construction, operation, and maintenance phases. Dimension 3 is project maturity level. Project management maturity is divided into five levels, specific description as shown in the table. Which grade 1 chaos level is minimum level, the level of significantly features is enterprise began realized that project management for enterprise competitiveness of upgrade role, but for project management also in disorder State; Dang organization management mature degrees in grade at 2 o'clock, organization has established preliminary of project management process, but overall of project management level still lower, the level for simple level; in mature degrees grade at 3 o'clock, organization on project management has height of concern, and management process has strictly have specification defined, the level can called specification level ; In the level 4 maturity level, enterprises can control various elements of project management, can call this level of lean level, enterprise integration capabilities have been greatly improved. Step by step to the highest levels of project management maturity level 5, which is characterized by enterprise has formed a relatively complete system of project management, needs to maintain optimized, so this level is also known as a high quality level [6]. Planning helps us to reduce the rate of job loss; diagram shows the use plan within 12 months after the reduction in losses.

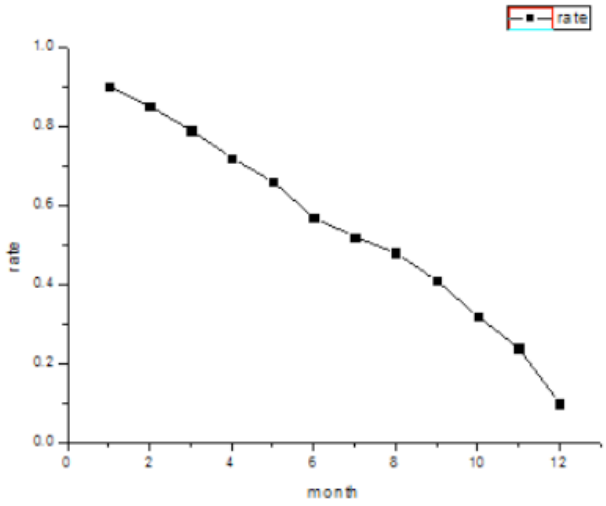

Fig. (1). Diagram of time and efficiency.

In urban planning, damage model could also increase the rate of worker productivity, avoid duplication and ineffective work, so as to make full use of time, speed up the progress of work. Corresponding comparison chart is shown as follows:

3.2.2. Build Urban Infrastructure Operations Not Under Agent Construction of Project Management Maturity Model

The model is based on a quantitative, using dynamic angle measurement to assess the maturity level of project management. The basic idea is this: first set the maturity level and the assessed value of the corresponding relation, then set the angles and corresponding indicator system of evaluation, then the measured values on the object being evaluated in these indicators are calculated based on these measurements it is worth assessing the project management maturity levels.

The model selection of the above three dimensions in the dimensions of the two, namely project management life-cycle stage of evaluation. Specific steps of the model as shown in Fig. (**3**):

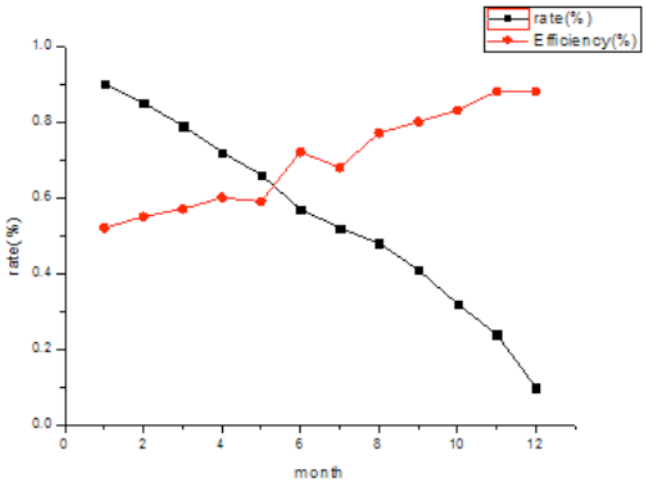

Fig. (2). Efficiency and losses comparison chart.

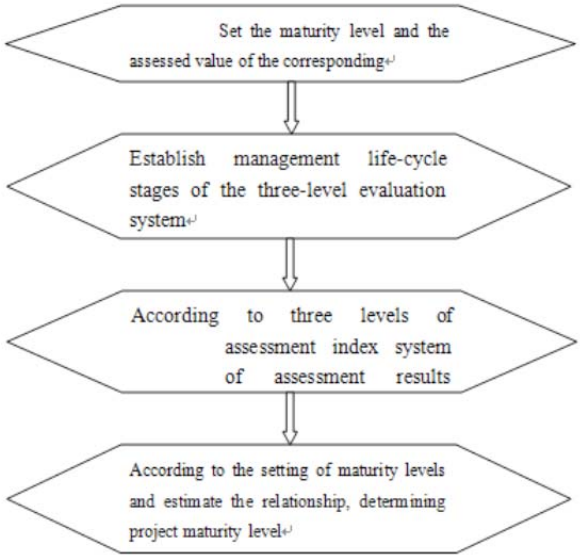

Fig. (3). Project management maturity models to assess the four steps.

In step 1, and maturity level and maturity of the relationship between assessed values.

Steps 2 in the, reference past project management mature degrees model evaluation indicators system of established method, this model of evaluation indicators system is divided into three a grade: first indicators system is on assessment object in full life cycle all stage of project management mature degrees indicators for assessment; second level indicators system [7] is on first level indicators system for refinement; third level indicators system is on second level indicators system of refinement, it has can operation .

In step 3, through the wind rose showing the minimum shadow area to get project maturity assessment values and practices described in the instance of the wind rose.

When the level indicator project is an even number 2n, ascending order arranges all estimates obtained a1, a2, …, a2n.Maturity rating show as follows:

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

When the level when the item index is odd 2n+1, ascending order arranges all estimates obtained a1, a2, …, a2n+1. Maturity rating show:

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

In step 4, step 3 results of project management maturity assessment values and comparing the maturity level they set up step 1, identify project maturity level.

$$\sqrt{\frac{a_1(a_{2n}+a_{2n+1})+\sum_{i=2}^{n}a_i(a_{2n+1-i}+a_{2n+3-i}))}{2n-1}} \quad (4)$$

4. AGENT MODE APPLICATION OF PROJECT MANAGEMENT MATURITY MODEL IN MUSEUM AND EVOLUTIONARY ALGORITHM

4.1. Project Background

Museum is a national symbol of culture, bearing the weight of a nation's culture, strengthening the construction of museums, heritage of Chinese civilization, the dissemination of scientific knowledge, promote harmonious economic and social development and improve the people's quality of life, is of great and far-reaching significance. Museum of nature, it is a public good, as museums can be used by all members of society to share, to meet the needs of citizens in different levels of society, demonstrated in consumption and non-competitive and non-exclusivity, so the Museum is a non-profit urban infrastructure. Pre-built in a city now a history museum [8], the project covers an area of 60000 square meters, 50800 square meters, area of 7500 square meters of the heritage area, exhibition area of 10500 sq. The city's agent wants to undertake the construction of the Museum project, which is typical of agent construction management mode in institutions. These designs models rely on mathematical formulas are as follows:

$$\sqrt{\frac{\sum_{i=1}^{m}4\left(i\left(m+\left(m*i\right)\right)\right)+\sum_{i=2}^{n}\left(in\left(n-1\right)\right)}{\sum_{i}^{m*n}i\left(m+n\right)}} \quad (5)$$

4.2. Overview of the Application Process

Selected museum project as the target, the five phases of the life cycle of the project sets criteria to measure the maturity, respectively. Because the calculation steps are basically the same in each stage, so just select the construction phase of the measurement process in detail. First will first level indicators system is divided into 12 items elements: development management elements, and quality control elements, and progress control elements, and cost control elements, and risk management elements, and financial management elements, and security and environment management elements, and information management and coordination elements, and integrated management elements, and procurement management elements, and contract management elements, and late management elements, next through survey questionnaire makes by visit who assessment all life cycle stage above 12 items elements in all life cycle of important degree. This example analysis of questionnaire data related to research methods, according to the rating criteria for this project of 12 questionnaires to technical staff and project managers. Principal Project Manager 4, construction unit technicians and project managers a total of 5 people, construction units of the General staff of 3 people. The model level indicator screening criteria to average 4.0 baselines greater than 4.0 were chosen as level indicators

4.3. Evolutionary Algorithm

An evolutionary algorithm (EA) is a heuristic optimization algorithm using techniques inspired by mechanisms [10] from organic evolution such as mutation, recombination, and natural selection to find an optimal configuration for a specific system within specific constraints.

In artificial intelligence, an evolutionary algorithm (EA) is a subset of evolutionary computation, a generic population-based met heuristic optimization algorithm. An EA uses mechanisms inspired by biological evolution, such as reproduction, mutation, recombination, and selection. Candidate solutions to the optimization problem play the role of individuals in a population, and the fitness function determines the quality of the solutions (see also loss function). Evolution of the population then takes place after the repeated application of the above operators. Artificial evolution (AE) describes a process involving individual evolutionary algorithms; EAs are individual components that participate in an AE.

Evolutionary algorithms often perform well approximating solutions to all types of problems because they ideally do not make any assumption about the underlying fitness landscape; this generality is shown by successes in fields as diverse as engineering, art, biology, economics, marketing, genetics, operations research, robotics, social sciences, physics, politics and chemistry

Techniques from evolutionary algorithms applied to the modeling of biological evolution are generally limited to explorations of micro evolutionary processes and planning models based upon cellular processes. The computer simulations Tierra and Aveda attempt to model macro evolutionary dynamics.

In most real applications of EAs, computational complexity is a prohibiting factor. In fact, this computational complexity is due to fitness function evaluation. Fitness approximation is one of the solutions to overcome this difficulty. However, seemingly simple EA can solve often complex problems; therefore, there may be no direct link between algorithm complexity and problem complexity.

4.4. Evolutionary Algorithm Types

Similar techniques differ in the implementation details and the nature of the particular applied problem.

Genetic algorithm - This is the most popular type of EA. One seeks the solution of a problem in the form of strings of numbers (traditionally binary, although the best representa-

tions are usually those that reflect something about the problem being solved), by applying operators such as recombination and mutation (sometimes one, sometimes both). This type of EA is often used in optimization problems.

Genetic programming - Here the solutions are in the form of computer programs [11], and their fitness is determined by their ability to solve a computational problem.

Evolutionary programming - Similar to genetic programming, but the structure of the program is fixed and its numerical parameters are allowed to evolve.

Gene expression programming - Like genetic programming, GEP also evolves computer programs but it explores a genotype-phenotype system, where computer programs of different sizes are encoded in linear chromosomes of fixed length.

Evolution strategy - Works with vectors of real numbers as representations of solutions, and typically uses self-adaptive mutation rates.

Differential evolution - Based on vector differences and is therefore primarily suited for numerical optimization problems.

Neuron evolution - Similar to genetic programming but the genomes represent artificial neural networks by describing structure and connection weights. The genome encoding can be direct or indirect.

Learning classifier system - Here the solutions are classifiers (rules or conditions). A Michigan-LCS works with individual classifiers whereas a Pittsburgh-LCS uses populations of classifier-sets. Initially, classifiers were only binary, but now include real, neural net or S-expression types. Fitness is determined with either strength or accuracy based reinforcement learning approach.

Probabilistic Solution Discovery Algorithm (PSDA) - uses a probabilistic solution discovery approach and Monte Carlo simulation to generate the pseudo-Optimal solutions.

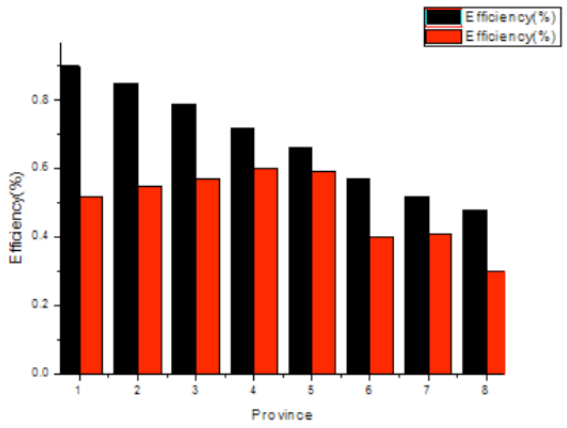

Fig. (4). Comparison chart.

CONCLUSION

Calculated from empirical analysis and empirical research on museum projects were selected by the project management maturity level control, although most of this result with the questionnaire and agent companies, but to some extent, explains the project's project management capability is superior. According to the survey, in government planning and an efficient list with project management model for planning services accounted for most of the provinces, We took one 8 efficiency data model in place in the provinces, the following Fig. (**4**) shows the before and after comparison chart:

In addition, this article should be admitted based solely on the maturity level of a project to determine the agent mode what is feasible or not has a certain degree of one-sidedness, but the maturity level of this project in a sense, or is the agent system is not adapted to the Museum project, at least we can now say that agent in the Museum project is worth trying. And in the future, we will continue research on agent-based non-profit urban infrastructure project management maturity.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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