Seventh International Conference on Construction in the 21st Century (CITC-VII)
"Industrial Policy Impact Analysis on China's Construction Industry Development"
December 19-21, 2013, Bangkok, Thailand

Industrial Policy Impact Analysis on China's Construction Industry Development

Ming Luo
School of Construction Management and Real Estate, Chongqing University, Chongqing, China
lm19890311lmx@163.com

Guiwen Liu
School of Construction Management and Real Estate, Chongqing University, Chongqing, China
gwliu@cqu.edu.cn

Pengpeng Xu
School of Construction Management and Real Estate, Chongqing University, Chongqing, China
xupp.cn@gmail.com

Abstract:

With the advance of urbanization of China, construction industry has made great progress in recent years. In the initial stage of industry development, the role of industrial policy on the development of construction industry cannot be ignored. Therefore, ascertaining the impact of industrial policy will help to guide the sustainable development of construction industry. The paper combining the theory of policy evaluation is to build construction policy evaluation system, then determine the index weight through questionnaire survey subjectively and entropy method objectively based on the construction industry statistical data from 2001 to 2011, finally analyzing the practical effect of construction industry policy by fuzzy optimization model. The result shows that industrial policy plays a vital role in the rapid development of China's construction industry, but there are still many deficiencies which lead to a series of significant problems in the construction market.

Keywords:

China, Construction industry, Industry policy evaluation, Fuzzy optimization model

1. Introduction

China has undergone dramatic changes in both economics and society since reform and open policy. In the past three decades, construction industry plays a key role in promoting economic growth and social comprehensive development, showing a steady upward trend in the proportion of construction output in GDP which is closely related to country's overall economics. Besides, it has made huge contributions on the development of related industries, improvement of people's living standard and provision of jobs in the community, and all of these prove to be one of the pillar industries. Thus, construction industry development has become an important factor which affects national economic growth and recession. Accelerating construction industry reform turns into the main form of economic regulation by expanding or compressing the scale of investment in the fixed assets and a series of institutional measures to guide the direction of social development in a flexible way.

From the review of thirty years of development in China's construction industry, we can easily find that construction output, value added and other key indictors present various trends at each stage. But almost significant changes in data corresponds exactly to the time node of "Five Year Plan", we can conclude that the development of China's construction industry has obvious stages, and it can be divided into three phases according to its industrial development process: pioneering exploration phase (1978 to 1991), reform perfection phase (1992 to 2000) and promoting innovation phase (2001 to now). Based on national basic conditions and characteristics, government focuses on different goals and formulates distinct industrial development policies and measures which is not only suitable for current socio-economic development, but also lays a solid foundation for valuable future guidance, reflecting its gradient and continuity at different phases and indicating that the development of China's construction industry has been greatly affected by the national macro-industrial policies.

2. Industrial Policy Evaluation Concept

The concept of industrial policy began with formal establishment from the report "Japan Industrial Policy" in Economic Cooperation and Development (OECD) in 1970. As one of government interventions towards industrial development, it has been fiercely debated on the necessity for its implementation. Supporters argue that it can promote industrial upgrading process effectively and complete industrial structural adjustment scientifically. However, opponents hold that industrial policy hinders normal operation of market mechanisms and inhibits the effective role of market at the expense of interests of other sectors.

Although there are lots of researches in these fields, it has not yet formed a conclusion due to different focuses on defining policy evaluation, and the definition criteria are mainly three kinds as follows:

Firstly, it focuses on the whole process of research whose evaluation runs through the entire process from policy formulation to activity implementation, including pre-evaluation, during evaluation and ex-post evaluation;

Secondly, it focuses on the process of correction which policy evaluation is to find errors and fix errors;

Thirdly, it focuses on the implementation of policy effect, and the main purpose of evaluation aims at examining policy effect on goal achievement and recognizing whether policy implementation solves the forecasting problems.

In the recent years, some scholars have done plenty of detailed study in the construction industry, construction enterprises and so on (Chalmers.Johnson,1984), and they have achieved many important results in selection of evaluation index and method (Stuart.S.Nagal,1999), construction of evaluation model (Carl and David, 2001), but rarely involve the construction industry policy analysis (William.N.Dunn, 2002). However, Chung-Chiang Chen presents a framework to evaluate the effectiveness of energy policies and provides a contextual view of measures on energy policies in linking with the objective of a sustain economy (Chung-Chiang Chen, 2011). And Marleen A.H.Schouten also proposes a framework based on the complexity of the social-ecological system and takes the resilience thinking into unpredictable future (Marleen et al, 2012), Kallan F.Picha considers the institutionalization of policy evaluation across directorates and over time, and the structure and evaluation framework was discussed to set the stage for an analysis of 48 cases between 2000 and 2010 (Picha, 2012).

In view of these, according to different policy standards, the paper will build integrated policy index system based on China's industrial policy and focus on defining the effect of policy implementation in order to test the role of industrial policy for reference value in the near future and promote sound and rapid development of construction industry.

3. Policy Evaluation Index System

Combined with China's actual development, the formulation, implementation and evaluation of industrial policy separately lies in different stages, so the methods of indicator assessment differ from each other. Policy formulation is based on expert surveys, policy implementation aiming at the inquiry of relevant crowds of people, and finally policy evaluation through statistical analysis. Their main purposes are to speed up construction industry reform and development. Accordingly, the paper chooses the third way to take the target-reaching pattern for testing the effect of policy evaluation of construction industry, and evaluate whether the policies obtain the desired effect especially some important goals and objectives of the variables change impact.

3.1 Policy Evaluation Factors Selecting Standard

Since there are many factors involved in the construction industry policy evaluation, the paper sets up several evaluation criteria for different aspects of construction industry policies after a series of related research and expert interview including policy objectives standard, policy affecting standard, policy developing standard and policy basic standard.

3.1.1 Policy Objectives Standard

Generally speaking, every construction industry policy has its clear policy objectives, and whether they can be achieved is an important measure of the effect of the construction industry policy. By reading different levels of related policy documents, it is easy to find that each five-year construction special plan focuses on the overall industrial objectives with reasonable arrangement and deployment which indicates industrial growth remains to be the core of measuring development level of construction industry. Therefore, the paper selects the following seven representative indicators: construction output, value added, value added proportion in GDP, number of enterprises, total tax, export-oriented index and tax contribution.

3.1.2 Policy Affecting Standard

The most direct impact of policy implementation of construction industry is to see if it can attract more people to join this industry and guide enterprises through accelerated infrastructure investment, driving the development of related industries at the same time. Besides, it can also ease the growing tension of employment pressure to solve related issues such as social and people's livelihood in order to draw attention of government, all above proves funds and talents is the emphasis to enhance competitiveness in the construction industry. According to these, the paper selects the following three representative indicators: fixed assets investment scale, practitioner and construction enterprises corporate assets.

3.1.3 Policy Developing Standard

The key to determine a policy reasonable or not is to judge whether it considers long-term industrial indicators in specific situation, and technical innovation is undoubtedly the fundamental driving force for industrial sustainable development. It can not only promote scientific technology research but also facilitate the application of scientific achievement through a variety of encouraging activities, measures and policies. Consequently, the paper selects the following four representative indictors: Zhan Tianyou Award, scientific activities funds, technical equipment rate and power equipment rate.

3.1.4 Policy Basic Standard

To meet policy basic standard is the powerful guarantee of implementation of policies to reality needs of specific social groups. If fairs to reach basic requirements, that is bound to affect the entire whole process of development. As China's construction industry still lies in the primary stage, and the extensive mode of development may bring lots of problems: quality and safety is the most representative among these. Moreover, adjusting relevant policies, guiding the market order and cleaning up the market environment are the foundation to insure the rapid development of construction industry. So the paper selects the following four representative indictors: Luban Award, national labor law, accident and death.

3.2 Policy Evaluation Factors Selecting Principle

During the process of evaluation, it can be refined to target specific observable indicators according to the evaluation criteria on the base of industrial policy objectives, and come up with the policy effect of implementation through the indictors' changes in the evaluation period. Considering the selection of evaluation indicators may be subject to various factors such as evaluation object characteristics, model features and data status. The principles below should be followed when establishing the assessment index system for construction policy.

3.2.1 The Principle of Systematic Emphasis

Evaluation system contains many indicators and every indicator is independent with each other, so the role and status of them differ from each other. Specific evaluation will focus on different places according to weights distribution to distinguish the degree of importance of each indicator.

3.2.2 The Principle of Operational Rationality

It is reasonable to make comprehensive analysis of the development of domestic construction industry and long-term follow-up study of construction industry policy in order to have a uniform operational evaluation which can reflect the real implementation of the policy effect.

3.2.3 The Principle of Data Availability

The source of evaluation data is based on feasibility of assessment system and credibility of assessment results, taking full account of their relevance and availability when selecting evaluation index, and then lays a solid foundation for the final policy evaluation results.

3.3 Policy Evaluation Index System Establishment

The main problems or bottlenecks in the development period arising from construction industry can be categorized into four aspects: industrial growth, funds and talent, technical advance, quality and safety. Thus, how to overcome the barriers and face with these challenges becomes an important issue. In this paper, an analytic framework is shown in Fig.1 for the assessment of construction industry policies by complying with four different kinds of standards including stated objective, basic guarantee, scope of influence and sustainable development with the specification above to improve the development of construction industry.

The indicator system consists of four aspects: industrial growth (output, export-oriented, value added, value added proportion in GDP, number of enterprises, total tax and tax contribution), funds and talent (fixed assets investment scale, practitioner, construction enterprises corporate assets), technical advance (Zhan Tianyou award, technical equipment rate, power equipment rate and scientific activities funds proportion in GDP) and quality and

safety (national labor law, Luban award, accident and death), involving 18 specific core indexes in total. All of these indictors can reflect the policy effect from various aspects with a high degree of correlation to some extent.

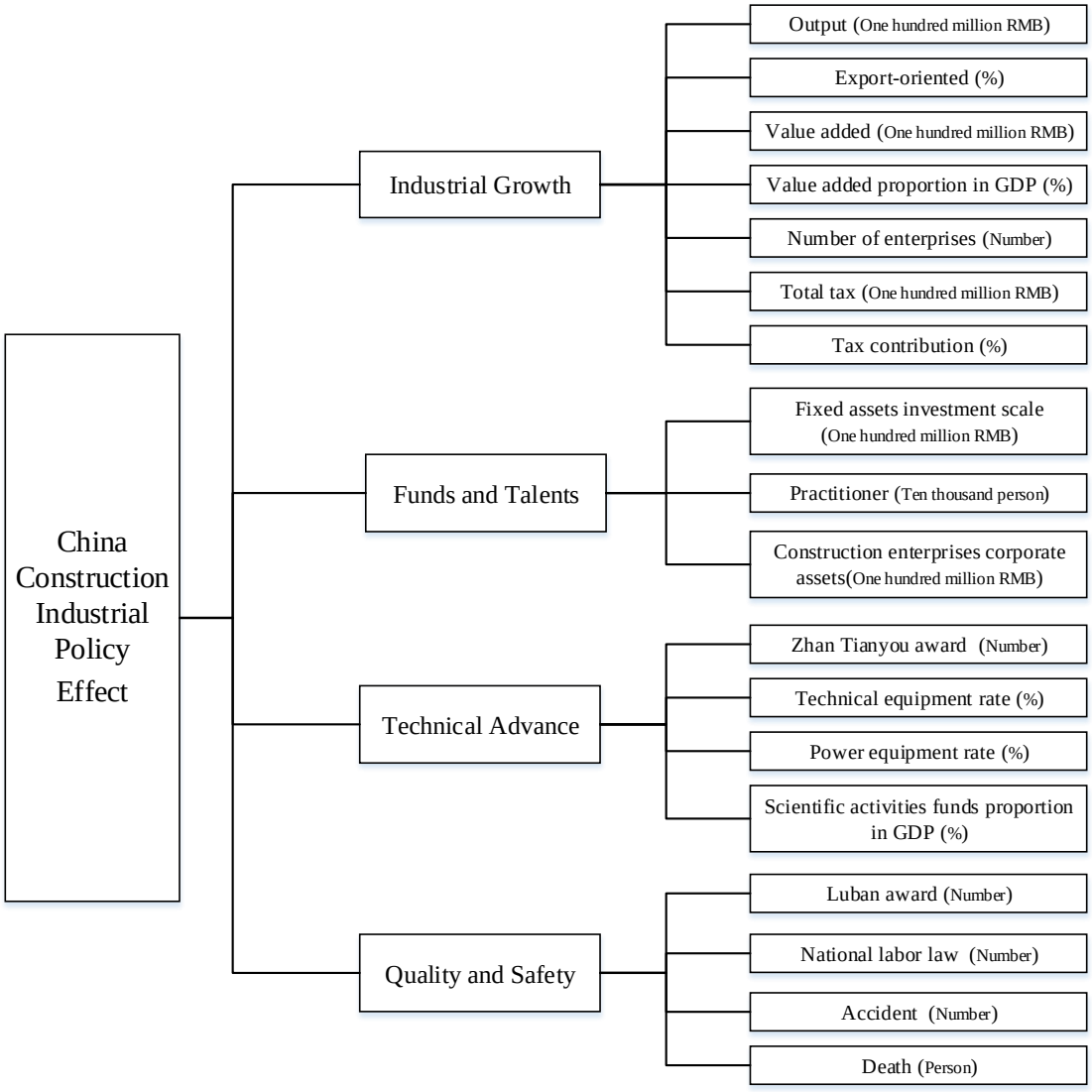

Figure 1 Policy Evaluation Indicator System of Construction Industry

4. Methodology

In order to make whole measures towards policy implementation at each level, the paper is designed for the construction industry policy evaluation index system based on entropy method to determine the index weights and use the fuzzy optimization model to calculate the value of belonging excellence, and then get a comprehensive evaluation effect of industrial policy of each year.

4.1 Entropy Method (Guo Xianguang,1994) (Zhang Yanfeng et al,2004) (Yue and Zhang,2004)

(1) Establish the initial matrix

Domain: $U = \{U_1, U_2, ...U_j, ...U_{11}\}(j = 1, 2, ..., 11)$

Each evaluation object (i.e. annually) has 18 evaluation index values characterize:

$$U_j = \{X_{1j}, X_{2j}, ..., X_{ij}, ...X_{18j}\}(i = 1, 2, ..., 18)$$

The initial index matrix of evaluation model:

$$X = \{X_{ij}\}_{m\times n}$$

(2) Indicator metrization

$$P_{ij} = X_{ij} / \sum_{j=1}^{n} X_{ij}$$

(3) Calculate the entropy

$$e_i = -k\sum_{j=1}^{n} p_{ij} \ln(p_{ij})$$

$$k = \ln(n)$$

n denotes the total number of evaluation object

(4) Calculate the difference coefficient

$$g_i = 1 - e_i$$

(5) Calculate the index weight

$$W_i = g_i / \sum_{i=1}^{m} g_i$$

m denotes the total number of evaluation index

4.2 Fuzzy Optimization Model (Chen and Zhao,1990)(Li Xican et al, 2005)

(1) Establish evaluation index membership degree matrix

The paper regards the policy effect of construction industry in the last decades as evaluation scheme, and the fundamental purpose of fuzzy optimization is to determine the effect of policy implementation for fuzzy concept “excellence” (A represents) of membership.

$$X = (X_1, X_2, ..., X_n)$$

$$uA: X \to [0,1]$$

$$X_j \to uA(X_j)$$

(2) Get the matrix of index characteristic quantity

$$X = \begin{bmatrix} X_{11}, X_{12}, ..., X_{1n} \\ X_{21}, X_{22}, ..., X_{2n} \\ ..... \\ X_{m1}, X_{m2}, ..., X_{mn} \end{bmatrix} = (X_{ij})$$

$$i = 1, 2, ..., m; \qquad j = 1, 2, ..., n$$

(3) Membership degree formula

$$r_{ij} = \frac{X_{ij} - X_{i\min}}{X_{i\max} - X_{i\min}}$$

Among the formula above, r means the membership degree of evaluation index and X represents the maximum and minimum of index characteristic of each year.

(4) Get the matrix of index membership degree

$$R = \begin{bmatrix} r_{11}, r_{12}, ..., r_{1n} \\ r_{21}, r_{22}, ...r_{2n} \\ ..... \\ r_{m1}, r_{m2}, ..., r_{mn} \end{bmatrix} = (r_{ij})$$

(5) Determine the membership degree program

Best scheme:

$$a = (a_1, a_2, ..., a_m)^T, \ a_i = \max\{r_{ij}\}$$

Worst scheme:

$$b = (b_1, b_2, ..., b_m)^T, \ b_i = \min\{r_{ij}\}$$

Fuzzy Matrix:

$$G_{2\times n} = \begin{pmatrix} g_{11}, g_{12}, ..., g_{1n} \\ g_{21}, g_{22}, ..., g_{2n} \end{pmatrix}_{2\times n}$$

Satisfy the following constraints:

$$\begin{cases} 0 \le g_{uj} \le 1 (j = 1, 2, ..., n) \\ \sum_{u=1}^{2} g_{uj} = 1 (j = 1, 2, ..., n) \\ 0 \le \sum_{j=1}^{n} g_{uj} \le m (u = 1, 2) \end{cases}$$

When u=1, g represents the best scheme. On the contrast, g denotes the worst scheme when u=2.

(6) Compute excellence program under the optimal value of membership

Weight vector:

$$w = \left(w_1, w_2, ..., w_m \right)^T$$

$$\sum_{i=1}^{m} w_i = 1$$

(7) Construct the objective function

$$F(g_{1j}) = \sum_{j=1}^{n} \left[D^2(r_j, a) + D^2(r_j, b) \right]$$

$$= \sum_{j=1}^{n} \left[g_{1j}^2 \times \left\| w \times (r_j - a) \right\|^2 + g_{2j}^2 \times \left\| w \times (r_j - b) \right\|^2 \right]$$

Order $\frac{dF(g_{1j})}{dg_{1j}} = 0$,

This shows:

$$g_{1j}^* = \frac{1}{1 + \left\{ \frac{\sum_{i=1}^{m} \left[w_i \times (r_{ij} - a_i) \right]^p}{\sum_{i=1}^{m} \left[w_i \times (r_{ij} - b_i) \right]^p} \right\}^{\frac{2}{p}}}$$

$$p = 2$$

(8) Get the belonging excellence

$$g_{1j}^* = \frac{1}{1 + \left\{ \frac{\sum_{i=1}^{m} \left[w_i \times (r_{ij} - a_i) \right]^2}{\sum_{i=1}^{m} \left[w_i \times (r_{ij} - b_i) \right]^2} \right\}}$$

At this point, we can judge final results of each year according to the order of g and come up with the best and worst year by comparing with each other.

5. Results and Discussion

The article selects China as research object to evaluate the policy effect of construction industry which draw up and carry out in the last several decades especially from the beginning of “fifteen period” till now.

Moreover, it also designs the expert questionnaire based on policy evaluation indicator system of construction industry, measured by the importance of indictors in basic order including government manager, corporate executive officer and relevant researcher as many as 38 valid individuals. Then it comes up with the result of general weights, that is, most of experts think policies start from promoting the industrial development, so the weight of industrial growth is superior to other aspects. On the following, technical advance is in the second place which determines the sustainable rapid development of construction industry instead of depending on constant investment and increasing practitioner. Anymore, QS(quality and safety) serves as an indispensable part to guarantee the whole development of construction industry, so its importance goes without saying.

According to the method and principle of entropy, we can obtain parameter values after computing by MATLAB7.0, which is approximately consistent with the result of weights calculated by expert questionnaire above(National Bureau of Statistics of China, 2002~2012).

Table 1 Weights of Construction Industry Policy Indicators Defined by Entropy Method

Index	Entropy e	Different coefficient g	Weight W
Output	5.310	-4.310	0.0535
Export-oriented	5.694	-4.494	0.0583
Value added	5.364	-4.364	0.0542
Value added proportion in GDP	5.741	-4.741	0.0589
Number of enterprises	5.720	-4.720	0.0586
Total tax	5.276	-4.276	0.0531
Tax contribution	5.736	-4.736	0.0588
Fixed assets investment scale	5.378	-4.378	0.0544
Practitioner	5.694	-4.694	0.0583
Construction enterprises corporate assets	5.429	-4.429	0.0550
Zhan Tianyou	5.740	-4.740	0.0589

award			
Technical equipment rate	5.734	-4.734	0.0588
Power equipment rate	5.744	-4.744	0.0589
Scientific activities funds	5.702	-4.702	0.0584
National labor law	5.029	-4.029	0.0500
Luban award	5.185	-4.185	0.0520
Accident	4.445	-3.445	0.0428
Death	5.559	-4.559	0.0566

Then we can calculate to get the best matrix of membership of excellent value in each year by turning the indicators' entropy weights into the fuzzy optimization model.

Table 2 Evaluation of Construction Industry Policy Effect

Year	Worst scheme	Value of excellence program membership	Best scheme
2001	0	0.0087	1
2002	0	0.0478	1
2003	0	0.0889	1
2004	0	0.1292	1
2005	0	0.2790	1
2006	0	0.2096	1
2007	0	0.4041	1
2008	0	0.6157	1
2009	0	0.7298	1
2010	0	0.7902	1
2011	0	0.8569	1

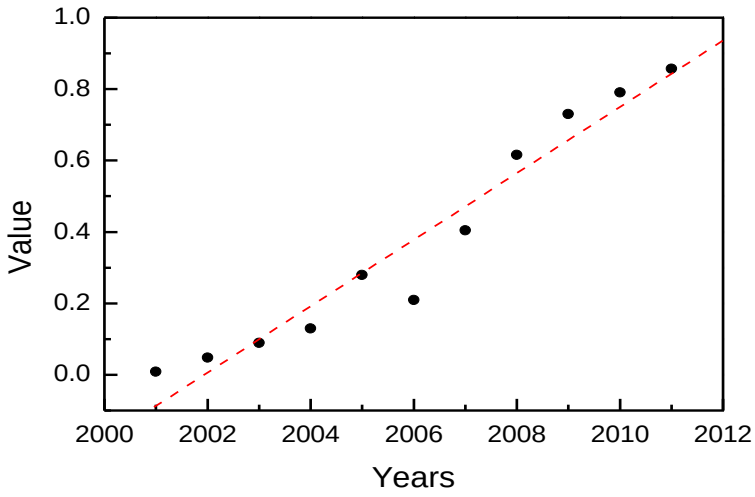

Figure 2 Scatterplot of Construction Industry Policy Effect

According to the evaluation results, the belonging membership values show a steady growth trend from 2001 to 2011.Moreover, it appears dramatic rise in 2006 and reaches the peak value in 2011, illustrating that industrial policies during these years achieve remarkable results in accelerating industrial development and improving comprehensive competitiveness. Compared to rare major industrial policies in the "fifteen period" (2001 to 2005), the following five years (2006 to 2010) aim at the strategic plan for fostering architectural province especially in industrial development, enterprise cultivation and sector reform these three aspects. The overall implementation results improve steadily along with GDP, performing a good industry trend at the same time.

The bidding case as the introduction and promotion of previous stage (1992 to 2000) is implemented formally in the early twenty-first century which has a great significance on the protection of public interest, improvement of economic efficiency and so on. Followed by a series of work for quality and safety has started in 2001, also making emphasis on the development of construction enterprises in the next five years including specifying its categories, establishing a strict rule of entering and eliminating with property reform. At the same time, government introduces the standardized document for project management in order to face with market pressure from overseas after entering WTO. In the "sixteen period" (2006 to 2011), public focuses transfer to technical innovation and application and training of practitioner especially the labor worker on site. In addition, the building department also develops a long-term planning of energy-saving for sustainable development to keep pace of international progress in recent years, but current technology is far from mature which requires further experiment and promotion.

Besides, the biggest changes of the belonging membership values during the last decade are located in three time period (2004 to 2005, 2006 to 2007 and 2010 to 2011). The industrial policy effects of implementation in these stage are relatively good which also coincide with the time node of the introduction of the key guiding document, indicating that major policy measures plays a vital role in the implementation of industrial policy on the other side.

Considering the effect of the time continuity of industrial policy, it also proves the crucial guiding documents issued previously lay a solid foundation for implementation of the next follow-up policies. On the basis, government works out the main points of each year and clears the working direction of various departments according to construction industry overall development planning and integrated actual situation, and gradually issues a series of supporting policies complementary with each other to improve the integrated system of industrial policy, promoting sound and rapid development of construction industry in order to achieve the strategic goal of building architectural country as soon as possible.

6. Conclusion and Suggestion

This study aimed at different kinds of problems existing in construction industrial policy of China's proposes a series of related suggestions for improvement. In summary, the paper constructs a comprehensive index system for the evaluation of construction industrial policy, verifying its reasonability with actual case study and qualitative analysis. The results show that construction industrial policy has a close relationship with the rapid development of construction industry, and it plays a crucial role in various fields especially in promoting industrial growth and ensuring QS. However, since the regional economic development in China is extremely uneven, so the level of construction industry development in different regions have become increasingly evident polarization which has a deep influence on overall development, and there are still many deficiencies like financial burden, lack of talent and technology application which call for government's attention.

(1) Industrial Growth

The most urgent and important is to try to seek the change of development pattern from labor-extensive to technology-intensive. Combined with building energy efficiency, green building and other new technology-related requirements, it is necessary to draw up industrial building standards, form a relatively mature and stable system, formulate related supporting economic incentive policies and nurture market demand for construction industry to maintain the sustainable development.

(2) Funds and Talents

On the one hand, government can make allowance for the relevant tax and cancel some merged or duplicated security deposit in order to stimulate construction enterprises to use excess funds to open up external markets and promote the development of emerging field, realizing the integration between technical innovation and practical application. On the other hand, it is required to improve the construction personnel structure, perfecting practitioners' introduction and training institutions.

(3) Technical Advance

Under highly competitive environment, it is no longer a popular way to get the project with low labor cost advantage. The automated machinery replaces large number of labor is an urgent trend to promote the development of integrated construction industry. Government should strengthen scientific and technical achievements into assessment in innovation and application. In this international market, only high standards and strict requirements can maintain long-term development of construction industry.

(4) Quality and Safety

The Government should try to implement engineering insurance and guarantee system, and use market mechanism to enhance the quality and safety management instead of avoiding or transferring projects risks. More importantly, it is essential to establish long-term rapid response mechanism to deal with sudden major accidents and prevent the similar situation from happening again.

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