MINISTRY OF EDUCATION AND TRAINING MINISTRY OF CONSTRUCTION

HANOI ARCHITECTURAL UNIVERSITY

MANAGEMENT OF CONSTRUCTION PLANS FOR NEW URBAN AREA PROJECTS IN VIETNAM

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SUMMARY OF DOCTORAL THESIS

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PREAMBLE

1. Rationale of the study

Many new urban areas (NUAs) have been formed, changing the face of the country, contributing to promoting economic growth, creating jobs, changing labor structure, and creating an urban environment with modern living conditions. However, due to the high diversity and special characteristics of the investment and construction production process, the cost for construction of large NUAs, the long periods of time, and the impacts of many factors and other characteristics, construction management is an important and pivotal factor in the country's urban development.

The research and analysis of the factors affecting the project construction plan management of investors have not been given due attention. Currently, in Vietnam, there is no scientific model or method that helps investors monitor and evaluate the project construction plans, and the overall model to effectively manage the construction plans of new urban area projects.

Facing this situation, the identification of factors that create favorable conditions for proactively developing NUAs to achieve desired objectives is an extremely important content in the renovation of construction management system of NUAs in Vietnam.

Thus, the topic: **Management of construction plans for new urban area projects in Vietnam** is extremely necessary. The results of the thesis can form a methodology for investors in managing the construction of NUAs.

2. Study objectives

To perfect some contents of construction plan formulation and control of construction plan implementation aiming to properly manage construction plans of new urban area projects in Vietnam.

3. Subject and scope of the study

- *Subject of the study:* Construction plan management of project investors
- *Scope of the study:*

Object of the study: NUAs in Vietnam.

Duration of study: 2010-2018.

Contents of study:

+ Construction plan formulation in the project investment preparation phase:

(1) Construction sequencing;

(2) Project construction schedule planning;

(3) Investment capital planning for construction projects.

+ Control of construction plan implementation of new urban area projects in the project implementation phase:

(1) Construction cost control;

(2) Construction progress control.

+ Perfection of regulations on construction plan management by the state management authorities.

4. Methods of study

- Theoretical research method
- Actual investigation and survey method
- General evaluation and analysis method

5. Scientific and practical significance

- Scientific significance:

+ Using forecasting method, multivariate regression and dynamic planning problem to determine the construction sequence of new urban area projects.

+ Applying fuzzy theory to plan new urban area project construction schedule.

+ Overcoming the shortcomings of earned value method (EVM) and earned schedule method (ES), proposing the method to control construction plan implementation of new urban area projects.

- Practical significance: The thesis's results help investors get more tools to manage construction plans of new urban area projects.

6. New contributions of the study

- Applying forecasting method and multivariate regression to forecast market demand for deliverables of new urban area projects, combined with dynamic planning problem according to proposed solution method to help Investors determine the construction sequence, ensuring efficiency and achieving desired objectives.

- Appling fuzzy theory to schedule project construction.

- Overcoming the shortcomings of earned value method (EVM) and earned schedule method (ES), developing a method to monitor and evaluate the construction process of new urban area projects through construction cost and schedule measurement and forecasting at the time of updating.

7. Thesis structure

In addition to the preamble, conclusions, recommendations and appendices, the thesis is structured into 4 chapters as follows:

Chapter I: Overview of construction plan management of new urban area projects in Vietnam (30 pages).

Chapter II: Current status of construction plan management of new urban area projects in Vietnam (23 pages).

Chapter III: Legal and scientific bases for formulation and control of construction plans of new urban area projects (48 pages).

Chapter IV: Solutions for formulation and control of construction plans of new urban area projects in Vietnam (50 pages).

CONTENTS

CHAPTER I

OVERVIEW OF CONSTRUCTION PLAN MANAGEMENT OF NEW URBAN AREA PROJECTS IN VIETNAM

1.1. Some basic definitions

1.1.1. Definition of a new urban area

An area located in urban region, invested in new construction of synchronous infrastructure, planned and developed in accordance with what proposed in the planning, with the main function of providing living environment for urban residents.

1.1.2. Management of construction plans of new urban area projects

The thesis introduces a number of definitions and terms related to the topic such as: New urban area construction investment projects, Management of construction plans, Management of construction plans of new urban area projects.

1.2. Classification of construction plans

- Classification according to management level.

- Classification according to phases in the construction investment process.
- Classification according to the level of detail.

1.3. Bases for construction plan management

- Investment project formulation phase.
- Design phase.

1.4. Scientific literature review

Currently, in the world as well as in Vietnam, there are many scientific works related to the contents of study of the thesis. With the author 's knowledge, some outstanding scientific works among countless works closely related to the thesis are presented, including the following:

* Construction plan formulation

- Construction sequencing:

+ Forecasting;

+ Dynamic planning problem.

- Formulation of construction investment capital sources.

- Construction scheduling using Fuzzy theory.

* Control of construction plans:

Monitoring and measuring construction costs using earned value method (EVM) monitoring and measuring construction progress using earned schedule method (ES).

This thesis inherits the study results of the above-mentioned works, investigates the shortcomings and conducts remedial research, and at the same time combines individual methods into systems to provide effective solutions in the construction sequencing, investment capital planning, construction scheduling, construction cost and progress control of new urban area projects in Vietnam.

CHAPTER II

CURRENT STATUS OF CONSTRUCTION PLAN MANAGEMENT OF NEW URBAN AREA PROJECTS IN VIETNAM

2.1. Current status of construction sequencing of new urban area projects

2.1.1. Construction sequencing method currently applied by investors

Currently, the construction sequencing of new urban area projects is carried out by investors in the investment project formulation phase, specifically the content

"Investment phasing".

2.1.2. Current status of construction sequencing of technical and social infrastructure works

The technical and social infrastructure works are not built synchronously with residentual works. Many inhabited NUAs have not yet completed technical and social infrastructure systems, causing many consequences and social frustrations.

2.1.3. Residential works

Residential works in the NUAs consist of many products: Villas, townhouses, high-end apartments, commercial apartments, and houses for low-income people. The construction sequencing for residential works of Investors is carried out in the investment project formulation phase. This work is mostly done according to the intention of the investors, while the formulation method is mainly based on investment experience of the project investors or refers to projects with similar economic - technical conditions.

2.1.4. Analysis of reasons for shortcomings

There are many reasons leading to the shortcomings of the construction sequencing of new urban area projects. From the Investors' side, the main reasons are as follows:

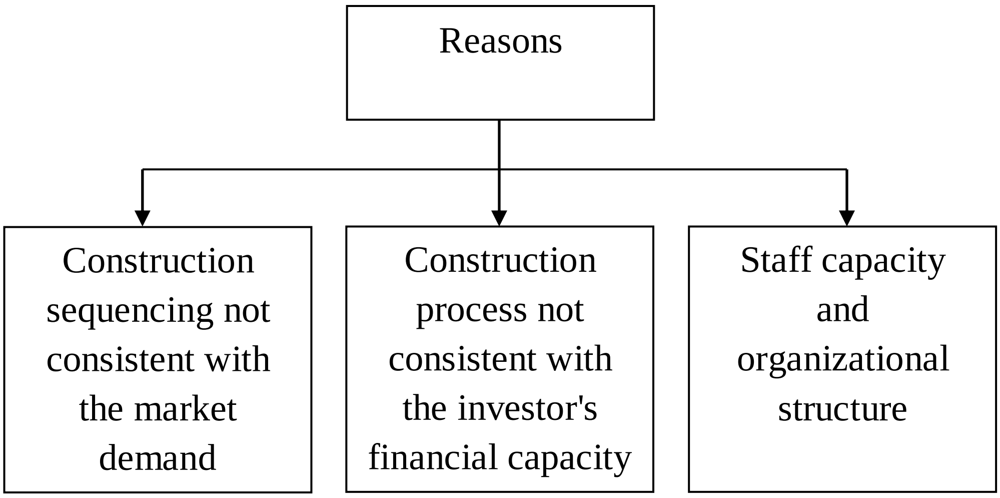


Figure 2.1: Reasons in the construction sequencing

2.2. Current status of formulation and control of investment capital sources for construction of new urban area projects

2.2.1. Planning for investment capital mobilization

The investors currently has 4 main sources of capital to invest in the construction of NUAs, including: Equity capital; Capital mobilized from customers; Loan capital and capital from issue of bonds. However, the funding flows for new urban area projects are not stable. The projects mainly rely on external funding sources, which are credit loans and capital mobilized from customers; however, both of these sources are short-term and very sensitive to market developments.

2.2.2. Current status of construction investment cost planning

The planning of construction investment costs of new urban area projects is basically complied with by the Investors in accordance with the law. However, there are many shortcomings in the planning of investment costs, resulting in increased total investment, cost errors and low capital efficiency.

2.2.3. Current status of construction cost control

In recent years, the control of construction investment costs of new urban area projects has been given attention by investors, obtaining many remarkable achievements. Many investors, when calculating construction investment costs, have closely followed and well complied with regulations on investment cost management promulgated by the state. However, there are also projects that have not been well controlled in terms of costs, leading to the fact that actual costs often exceed expected costs, resulting in reduced profits or even losses.

2.2.4. Analysis of reasons for shortcomings

There are many reasons leading to the shortcomings of the formulation and control of investment capital sources of new urban area projects. From the Investors' side, the main reasons are as follows:

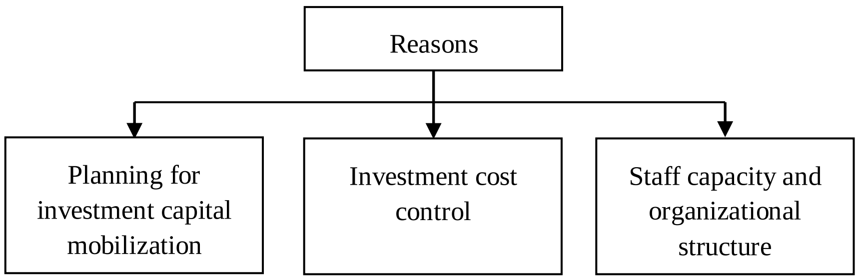


Figure 2.2: Summary of reasons for formulation and control of capital sources

2.3. Current status of formulation and control of construction progress of new urban area projects

2.3.1. Current status of project implementation progress

In addition to projects implemented on schedule, there are still many projects not completed on schedule due to many different reasons, both objective and subjective.

2.3.2. Current status of determination of time for implementation of project work

The time for implementation of project work consists of 3 time components: Time for implementation of administrative procedures (submission for approval, applying for permission, approval...); Time for implementation of consulting work (project formulation, total investment formulation, design, cost estimation...); Time for implementation of "technical" work (construction, equipment installation...).

2.3.3. Analysis of reasons for shortcomings

According to the author of the thesis, in general, there are 4 main reasons affecting the progress of new urban area construction investment project in recent times, which are:

(1) Many shortcomings in the construction scheduling;

(2) Lack of control of construction implementation;

(3) Unreasonable allocation of funds.

(4) Limited capacity of staff of investors.

2.4. General comments and problems solved by the thesis

2.4.1. General comments

The construction sequencing of the projects is mainly based on the subjective intention of the investors, not really consistent with the market demand and investment financial resources. Many projects are behind schedule, leading to waste of resources, affecting the social security life and causing frustration among the public. The formulation and control of investment costs still have many shortcomings and lack concentration, leading to many projects losing money or not having enough capital sources for investment in construction, causing projects to be suspended or delayed.

2.4.2. Research issues of the dissertation

Firstly: Analyze and evaluate the current status of the new urban area project construction investment, the quality of the preparation and control of the new urban area project construction plan over the past time on the basis of specific objectives.

Point out the difficulties, shortcomings, analyze and clarify the causes leading to the limitations in preparation and control of the new urban area project construction plan.

Secondly: Systematize and clarify the rationale for formulation and control of new urban area project construction plan, including: General arguments about the new urban area project, project formulation and control.

Thirdly: Propose solutions for determining the work construction order, planning schedule and construction investment capital sources, controlling the scientific and practical implementation of the new urban area project construction plan .

CHAPTER III

LEGAL AND SCIENTIFIC BASES FOR FORMULATION AND CONTROL OF CONSTRUCTION PLANS OF NEW URBAN AREA PROJECTS

3.1. Legal basis

3.1.1. Law system

- Law on Construction 2014
- Law on Local Government Organization

3.1.2. Decree system

- Decree 11/2013/NĐ-CP on management of urban development investment
- Decree 59/2015/NĐ-CP on construction project management

3.2. Methods of construction schedule planning

3.2.1. Method group on straight line schedule

a. Gantt Chart Method

Means method of using horizontal bar chart. Time and task of performing each stage are represented by horizontal lines of a certain length, indicating the starting time, execution time, and finishing time of construction of work items in a certain order.

b. Linear Scheduling Method (Cyklogram)

The Linear Scheduling Method is basically similar to the Gantt Chart Method, with only the following basic differences: Instead of performing tasks with horizontal lines, people use oblique lines to indicate the construction schedule over time (horizontal axis) and space (vertical axis).

3.2.2. Critical Path Method (CPM)

Critical Path Method (CPM) determines project schedule including the following elements: Develop step-by-step list of all the tasks expected to be done to complete the project and its completion time. Critical Path is the arrow line from the time of project commencement to the end of the project with the largest length on the time axis, tasks with zero total reserve mean Critical Tasks. The length of Critical Path on time axis is the smallest possible time for the project completion as planned.

3.2.3. Evaluation of construction schedule formulation and control methods

a. For Straight Line schedule method group

Gantt Chart Schedule does not represent the complex logical relationship between the tasks to be described.

Cyklogram Schedule is static operating model, not suitable for projects with many similar items, high task repeatability.

b. For Critical Path Method group

If the project is large-scale with large and intertwined activities, establishment of Critical Path to determine schedule is relatively complicated in identifying nodes and the relationships among nodes.

The duration for construction work determined by Critical Path Method is mainly one value, thus limiting the flexibility in fluctuations and adjustments.

3.3. Theoretical basis for planning investment capital for project construction

3.3.1. Contents of the plan to mobilize project construction investment capital

Firstly: Determine the amount of capital required in the construction process.

Secondly: Organize the exploitation of financing sources for capital needs.

Thirdly: Take measures to preserve and develop investment capital.

Fourthly: Regularly analyze and evaluate the use of investment capital.

3.3.2. Planning to mobilize capital for construction investment

Principles in making project construction investment capital plan are as follows:

- Principle comes from the construction process and meets the construction needs, to ensure the capital needs for the project construction process *in* reasonable way.

- Principle of ensuring balance with planning departments
- Principle of savings.

3.3.3. Method of determining the demand for construction investment capital

- Indirect method:

Characteristics of this method are based on empirical statistics to determine the need for investment capital for project construction. Determining the investment capital needs in this way is based on the amount of investment capital drawn from the actual operations of investors of the same type and industry. On the basis of considering the project construction scale, the required investment capital must be calculated.

- Direct method:

The main content of this method is based on factors with direct impact on the project construction and product consumption to determine the needs of each investment capital in each stage and then aggregate all the investment needs of the project.

$$NC_{VLĐ} = \sum_{i=1}^{n} \sum_{j=1}^{m} M_{ij} N_{ij} \qquad (3.41)$$

In which:

M_{ij} - Daily average consumption of the jth capital in the ith calculation step.

N_{ij} - Number of circulating days of the jth capital in the ith calculation step.

The advantage of the direct method is to determine the specific investment capital needs of each capital type in each period. Therefore, creating good conditions for the Investor to manage and use capital for each type in each stage of use. However, due to many stages, extended time of project construction investment process, the calculation of investment capital requirements for project construction according to this method is relatively complicated and takes a lot of time.

3.4. Construction plan performance control tools

3.4.1. Earned Value method (EVM)

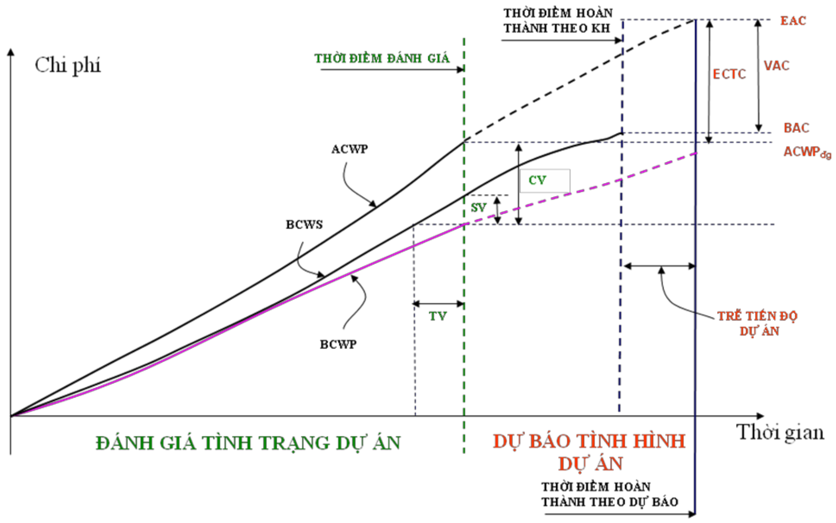
- Planned Value (PV): $PV = \sum_{i=1}^{n_t} PV_i$

- Earned Value (EV): $EV = \sum_{i=1}^{n_t} EV_i$

- Actual Cost (AC): $AC = \sum_{i=1}^{n_t} AC_i$

- Cost Variance (CV): CV= EV – AC

Figure 3.1: Meaning of parameters in EVM



** Overall assessment on overall status of the project:*

- Cost performance index (CPI): $CPI = \frac{EV}{AC}$

- Schedule Performance Index (SPI): $SPI = \frac{EV}{PV}$

3.4.2. Earned Schedule (ES) method

Earned Schedule is a similar concept to the EVM, but it measures in units of time, rather than cost.

By using the ES index, approximate performance indexes when implementing SV, SPI schedule in EVM method into performance index of schedule SV_t, SPI_{ES} in Earned Schedule (ES) method.

3.4.3. Evaluation of construction plan performance control methods

a. Earned Value method (EVM)

EVM’s ability to measure and forecast completion time is limited in accuracy because the Critical Task has not been considered.

b. Earned Schedule (ES) method

Based on cost data of EVM, Earned Schedule shall measure and forecast the project duration, so the time forecast method is based on cost data without considering Critical Task, thus the resultant accuracy is limited.

3.5. Dynamic planning problem

3.5.1. Concept of optimization problem

The optimization problem consists of function f called as the objective function or the evaluation function; The functions g1, g2, ..., gn give a logical value called as the constraint function. The problem requirement is to find an option x that satisfies all the constraints g1, g2,…, gn and x are the best, it means that there is no other x * configuration that satisfies the constraint functions and f (x *) is better than f (x).

3.5.2. Bellman's optimization principle

The optimization principle of R. Bellmam is stated as follows: “Optimize the nth step by optimizing all the paths to step n-1 and choosing the best (at most) total cost path from step 1 to step n-1 and from n-1 to step n.

The method of finding the optimal solution according to Bellman's principle is called the dynamic planning method.

3.5.3. Dynamic planning method

The dynamic planning method uses the bottom-up principle, it means “from bottom to up". First, solve the simplest, basic subproblems and find out solutions immediately. Then combine these subproblems together to find a solution to the larger problem and so on until the original problem is solved.

3.5.4. Dynamic planning steps

Step 1: Create regression system

Step 2: Organize data and programs

Step 3: Trace, search

3.6. Fuzzy Theory

The concept of “Fuzzy Set” is an extension of the concept of classical set, to meet the need of expressing inaccurate knowledge.

The member function of a fuzzy set A on the sum set X is denoted by μ_A, confirmed by:

$\mu_A : X \to [0,1]$ with μ_A: The membership degree of the element x of X on the fuzzy set F.

With $\alpha \in [0,1]$, the cut set α of the fuzzy set F is the clear set $F\alpha$ consists of elements of X whose membership level F is greater than or equal to α:

$$F_\alpha = \{x, \mu_A(x) \geq \alpha\}$$

Consider probability measure Pos on set P (X) as subsets of set X

Call the function $r : X \to [0,1]$ so that: r (x) = Pos (x) with all $x \in X$

The function r is called as probability distribution function corresponding to the probability measure Pos. Each probability level Pos on set P (X) is determined by the probability distribution r as follows:

$$Pos(A) = \max_{x \in A} r(x), A \in P(X) \qquad (3.37)$$

In probability theory, the probability distribution is the distribution of a probability or fuzzy variable. Consider probability measure Pos on set P (X), if a variable V takes value on set X, call function r (x) as the probability level for event V then:

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

$$r(x) = Pos(V = x) = Pos(x) \text{ with } x \in X \qquad (3.38)$$

The function r is called as the probability distribution function of variable V corresponding to the given probability measure Pos. The function r describes the uncertainty of the probability variable V when there is incomplete information leading to given Pos probability measure.

The Pos probability level is directly linked to the fuzzy set through the corresponding probability distribution. Consider probability variable V on a set X, see a fuzzy set F on set X describing the assignment of value to variable V through the proposition “V is F”, so that $\mu_F(x)$ is the compatibility of the element x with the concept described by the fuzzy set F, call $r_F(x)$ as the probability distribution of V or the variable probability level V is x when the proposition “V is F” is given, we have:

$$r_F(x) = \mu_F(x) \qquad (3.39)$$

Function $r_F : X \to [0,1]$ is the probability distribution function on set X of the possibility variable V, describing the uncertainty of possibility variable V when there is incomplete information "V is F".

On the other hand, for possibility distribution r_F on x, the corresponding probability measure Pos_F is defined for every set $A \in P(X)$:

$$r_F \to Pos_F : Pos_F(A) = \sup_{x \in A} r_F(x), A \in P(x) \quad (3.40)$$

3.7. Factors influencing construction planning and construction planning control

a. Indirect factors

- Project environment.
- Project scale and nature.

b. Direct factors

- Human Resources.
- Capital.
- Organizational structure.

3.8. General comments on the applicability of the rationale on implementation of the solutions

- There is not yet a scientific method to determine the construction order, in accordance with the market demand and investor's capital.
- Determination of construction schedule planning: CPM method has the disadvantage that the calculation does not consider the fuzziness of the input parameters when the project is first implemented.

Construction plan performance control: Two main tools are EVM and ES method. Through analysis, both methods are methods with many advantages, but there are still some disadvantages. Therefore, overcoming the shortcomings of these two methods will complete the rationale in construction plan performance control process.

CHAPTER IV

SOLUTIONS FOR FORMULATION AND CONTROL OF CONSTRUCTION PLANS OF NEW URBAN AREA PROJECTS IN VIETNAM

4.1. Orientation to propose solutions

- Proposed solutions is towards the common goals of construction plan management, to achieve the expected objectives on two main aspects: Construction

Planning and Performance Control of New urban area construction plan.

- The proposed solutions are researchable and applicable to all investors of New urban area projects in Vietnam.

4.2. Solutions for determining the construction order of works in new urban areas

4.2.1. Principles of determining the construction order of works of new urban areas

(1) Technical infrastructure must be built first, synchronous with housing, social infrastructure construction works.

(2) Social infrastructure works are built synchronously with housing works. All social infrastructure works must be completed before handing over houses in each investment phase.

(3) Housing construction works with construction priority are those suitable to market demand and investor's financial capacity.

4.2.2. Determine market demand for construction products of new urban areas

4.2.2.1. Process of forecasting market demand

Step 1: Define objectives and forecast audience.

Step 2: Design Questionnaire.

Step 3: Build a list with required comments.

Step 4: Issue questionnaires to experts of the general expert group. After consulting the general experts, conduct the first comment synthesis.

Step 5: Issue the 2nd questionnaire and the 1st result summary.

Step 6: Compare the results of the 1st and 2nd opinion results, keep factors with the average score greater than 3 and deviation level less than 15% in the formal questionnaire. Unsuitable factors will be removed from the questionnaire.

Step 7: Confirm formal questionnaire.

Step 8: Sampling. The number of samples is not less than the minimum number of samples.

Step 9: Issue questionnaire.

Step 10: Give data analysis by regression method.

Step 11: Synthesize and evaluate. Regression results synthesized and evaluated by the group of experts.

Step 12: Forecast.

Step 13: Make decision. On the basis of the forecast recommended by the general expert group, the manager will make implementation decision.

4.2.2.2. Build model of impact factors

The impact factor model includes: Bank interest rate (IR); Economic growth (GG); Foreign direct investment (FDI); Support package (HT); Population (DS); Legal policy (CS); Taste (TH).

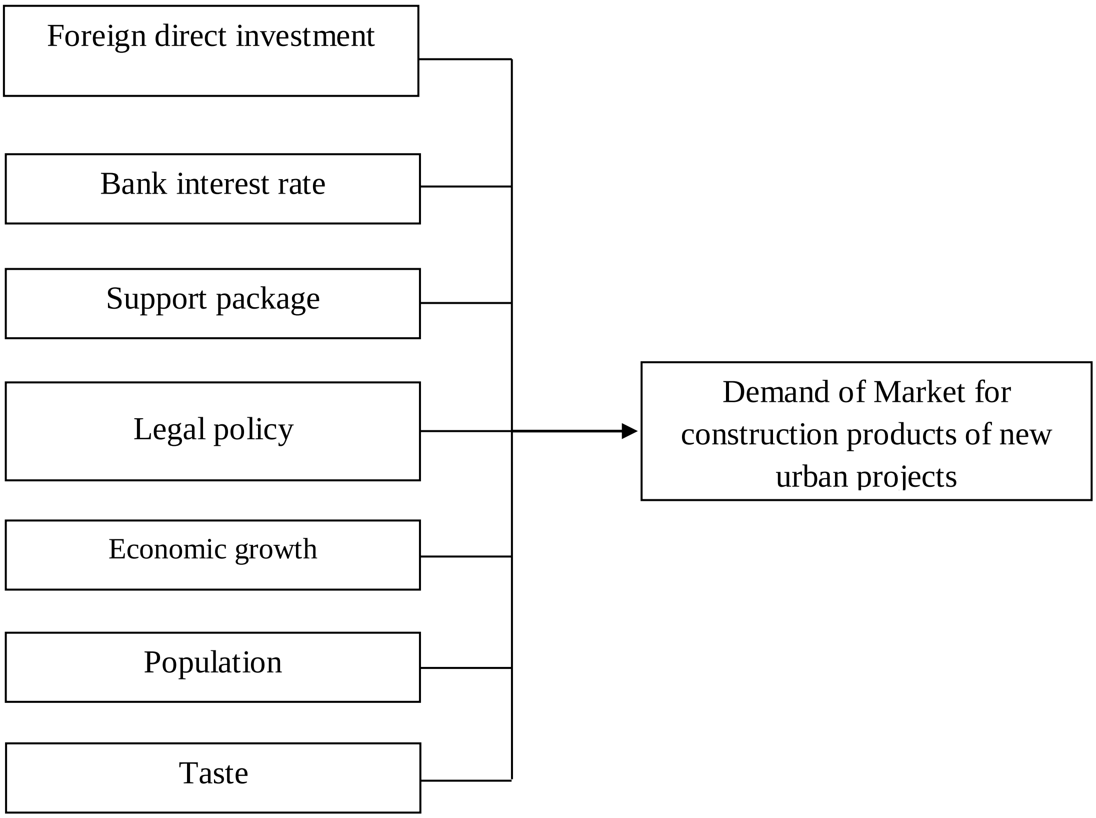


Figure 4.1: Model of impact factors

4.2.2.3. Apply the forecasting model for commercial apartments

Regression model of factors affecting market demand for commercial apartments:

$$\mathbf{Y = 0.933 + 0.301*GG + 0.369*FDI - 0.128*IR + 0.161*HT} \quad (4.1)$$

**** Regression model inspection***

With VIF coefficients all less than 10, it shows that the model does not exist multicollinearity.

4.2.3. Set up an algorithm model to determine the construction order of works of new urban areas

** Target function*

Min Fi(n):

$$F(0) = 0$$

$$F_i(j) = \text{Min}\left\{F_i(t-1) + A_i(t, j)\right\} \quad (4.2)$$

$$1 \le t \le j$$

Constraint functions:

$$\sum_{u=1}^{j} a_{it} b_{iu} \le V_{it} \quad (4.3)$$

$$\sum_{u=1}^{j} \beta_i a_{iu} \le S_i \quad (4.4)$$

$$i \in T \quad (4.5)$$

$A_i(t, j)$: Construction cost function of work item i at time t in period j

Parameters of the model:

$i = \{1, 2, \ldots.., n\}$: Set of indexes of construction items;

$j = \{1, 2, \ldots..n\}$: Set of indexes of the construction period;

a(i,j): Construction demand for item i in period j;

b(i,j): Construction cost of item i in period j;

A0: Construction cost of technical infrastructure and initial expenses;

c(i,h): Cost of operation and maintenance of item i for period h;

V(j): Initial capital of period j;

β_i: Area coefficient of item i;

α: Capital regulation coefficient;

t: Construction time;

h(i): Maximum inventory period of item i;

T: Demand for the project's construction products.

Variables of the model: Total construction area of item i at the beginning of period x (t, i).

Possible values of x (t, i) are: 0; the total area to be built is equal to the total area of items according to the approved planning; total area of such period and the number of subsequent periods.

b. Solve the problem of determining the construction order of the project's work items.

The problem is identified as bound dynamic planning problem. The solution method is as follows:

Step 1: Solve m problems for m items of the objective function (4.2) ignoring the constraints (4.3) (4.4) (4.5). Check the results if (4.3) (4.4) (4.5) is satisfied, and get the solution of the problem. If (4.3) is not satisfied, go to step 2.

Step 2: Choose a value $\alpha > 0$ as small enough value. Continue solving the model as in step 1.

The result of step 2 could be:

- Get a number of satisfied options (4.3), go to step 3.

- If there is no plan satisfying (4.3), increase α and repeat step 2. Continue doing so until you find a satisfying solution. If all options are not satisfied, it can be concluded that the problem has no solution or cannot get the minimum cost solution satisfying (4.3).

Step 3:

- If step 2 receives plan satisfying (4.3) in which there is plan satisfying (4.4), the plan satisfying (4.4) with the smallest cost is the chosen option.

- If step 2 does not get plan satisfying (4.4), add the coefficient $\beta > 0$ as small enough value in the Ai function (t, j) as in step 2. This process selects only on the plans satisfying (4.3) in step 2.

The result in step 3 could be:

- Get a number of plans satisfying (4.4) with some minimum β, then choose the plan with the smallest cost.

- There is no plan satisfying (4.4), the problem has no solution.

* In case the problem has no solution

In case the problem is not solved in step 2, it can be shown the capital shortage in some period. Then choose the most (4.3) satisfying plan.

In case the problem is not solved in step 3, it can also be shown that the scale of the items to be built according to the approved design is not guaranteed.

4.3. Project construction investment planning solution

4.3.1. Planning to accelerate the capital turnover of the Investor

Apply appropriate payment methods to speed up the payment schedule and capital recovery, creating conditions for bringing investment capital for the next stage. Speed up the capital turnover and improve efficiency of capital use. Improve efficiency in using fixed assets and select appropriate service management.

4.3.2. Adjust the structure of construction investment capital

- Define fully and accurately investment capital sources for each period.
- Adjust the structure of construction investment capital in the direction of key and in-depth investment.
- Exploit existing capital potentials, decide on forms of capital mobilization to meet construction investment requirements.

4.3.3. Build system of indicators to evaluate construction investment capital efficiency

The criteria system for analysis of capital efficiency for the construction of New urban area works includes:

- Situation of construction of works;
- Situation of Payment up to assessment time;
- Ability to pay for the next installments;
- Capital recovery and debt settlement;
- Rate of return of capital for each project with completed investment;
- Capital turnover rate.

4.4. Plan schedule by fuzzy set theory method

4.4.1. Determine the project completion time distribution

Call T_P as the project completion time. Based on CPM method, the fuzzy number T_P can be calculated based on cut α described as follows:

(1) Cut each fuzzy number T_j into clear spaces. With each cut α, $0 \le \alpha \le 1$ calculate lower bound values $LT_j(\alpha)$ and upper bound value $UT_j(\alpha)$ of task completion time.

(2) Use values $LT_j(\alpha)$ and $UT_j(\alpha)$ according to CPM method, in turn, determine the lower bound value $LT_P(\alpha)$ and upper bound value $UT_P(\alpha)$ corresponding of the project completion time.

(3) Determine the fuzzy number T_P

(4). Determine the probability distribution of project completion time as follows

$$r_{T_P}(x) = Pos\left[T_P = x\right] = \mu_{T_P}(x), x \in X$$

The calculated project completion time is a fuzzy number:

$$T_P = \left[LT_P(1) + UT_P(1)\right] / 2$$

Based on the nature of fuzzy set, the minimum project completion time $T_{P\min}$ and the maximum project completion time $T_{P\max}$ are estimated as follows:

$$T_{P\min} = LT_P(0); T_{P\max} = UT_P(0)$$

4.4.2. Determine the fuzzy Critical Path

Put $\tilde{V} = \left\{\tilde{v}_1, \tilde{v}_2, \tilde{v}_3, ..., \tilde{v}_n\right\}$ as a set of fuzzy vertices (events) in which $\tilde{v}_1$ and $\tilde{v}_n$ are the end and head events of the project; every $\tilde{v}_i$ belongs to some path from $\tilde{v}_1$ to $\tilde{v}_n$. Critical Path is the longest path from the original event $\tilde{v}_1$ to the end event $\tilde{v}_n$ of the Critical Path and an activity $\tilde{a}_{ij}$ on the Critical Path is called as Critical Task.

4.4.3. Make a decision about the project completion possibility

Make a decision about the project completion probability within a given time period T with time T and acceptability parameters $\pi_0, 0 \le \pi_0 \le 1$. The decision-making process consists of the following steps:

(1). Determine T time and acceptability $\pi_0, 0 \le \pi_0 \le 1$

(2). Calculate the project completion possibility in time T:

$$P(T) = Pos(T_P \le T) = \max_{T_P} \le \mu_{T_P(t)}$$

(3). Make a decision about the project completion possibility

$\pi_0 \le Pos(T_P \le T)$: The project can be completed with the possibility π_0

$\pi_0 > Pos(T_P \le T)$: The project cannot be completed with the possibility π_0

4.5. Solution to control the new urban area project construction

4.5.1. Propose to overcome disadvantages of Earned Schedule method

** EST method*

Basic criteria of the EST method

+ SAC: Total planned time for project completion

+ TP: Total planned time

+ n_t: Number of completed or ongoing tasks up to update time t_{AT}

+ TE: Earned Time

+ TA: Actual time

+ ES_T: Total Earned Schedule of the project at the update time t_{AT}

$$ES_T = t + \frac{TE - TP_i}{TP_{t+1} - TP_t}$$

+ Performance of Earned Schedule at the actual update time t_{AT}

$$SPI_{EST} = \frac{ES_T}{t_{AT}}$$

+ Time measurement at the update time

SV_{EST}= EST - t_{AT}

+ Forecast completion time at the update time

$$T_{EAC} = \frac{SAC}{SPI_{EST}}$$

** Apply EST method for Critical Task (EST_G)*

Step 1: From the Work breakdown structure (WBS), Critical Path is set up and used to build the basic Gantt Chart according to the Critical Path Method (CPM). Since then, identify the tasks on Critical Path.

Step 2: Apply the EST_G method on the tasks located on Critical Path to measure schedule and forecast the time of the project.

4.5.2. Propose system of methods to control project completion cost and time

Step 1: Based on planned cost data, planned schedule and actual cost data, actual schedule at update time, proceed:

- Cost measurement: Use EVM method to determine actual costs different from the plan at the update time (CV). Also determine cost efficiency at the update time (CPI).

- Schedule measurement: Use the EST_G method to identify actual schedule step different from planned at the update time. At the same time, determine the performance of the construction schedule on Critical Path at the time of the update

Step 2: Use indices (PV, EV, AC) and SPI_{ESTG} index at step 1, determine:

- Actual completion time forecast t_{EAC}
- Actual completion cost forecasting EAC.

4.6. Solutions to improve Investor's capacity

4.6.1. Human resource solution

- Put people at the center.
- Perfect the recruitment.
- Develop system of internal rules and strengthen labor discipline.
- Step up training and retraining to improve the quality of human resources.
- Improve the remuneration and commendation regime and work environment.

4.6.2. Solution on organizational structure

- Ensure good communication to make all members understand the purpose of the organization.
- The investor needs to pay attention to maintaining and developing an equal relationship between departments so that the operation of these departments will be coordinated, in order to manage construction plans to achieve the set goals.
- Build the core values of the Investor.

4.7. Solution of completing the investment institution in construction of new urban area projects

4.7.1. Clearly define the state capital sources in the new urban area construction investment projects

In order to facilitate the management of New urban area projects, the author proposes to the Government to issue a Decree to clearly define investment capital sources for construction projects in general and new urban area projects in particular, especially, specifying clearly the content on how to determine the amount of state capital in projects using mixed capital sources.

4.7.2. Develop and issue legal framework for the formation and development of new urban area projects

Research and promulgate the legal framework for the investment trust fund for construction products of the new urban area project.

Research and promulgate legal framework for new urban area project investment fund. Regulations related to the stock market, taxes ... also need to be adjusted to suit the unique characteristics of investment fund type.

4.7.3. Regularly inspect investment in the construction of new urban area projects

- Inspect the formulation, appraisal and approval of the new urban area project.

- Inspect capital sources for construction of new urban area projects.

- Strengthen remote monitoring and supervision to regularly update the construction investment project of new urban area; closely coordinate with the investment supervision and evaluation.

4.7.4. Complete legal regulations on investment in construction of new urban areas

Firstly: Regulate the capacity conditions of the Investor, in which the project construction investment capital has ensured adequate capital sources to build technical infrastructure system, social infrastructure in new urban areas. This capital is required to carry out the construction, not to be used for other purposes.

Secondly: There are sanctions imposed on investors after building houses and handing them over to use, but deliberately delaying completion or not perfecting the technical infrastructure system, social infrastructure.

Thirdly: During the bidding process for the project investor, it is required to specify the contents of the Investor's assessment of the market forecasts and the capital mobilization ability for each market stage. The capital committed by the investor to build the new urban area project must be guaranteed by one or more legal credit institutions in Vietnam.

Fourthly: Clearly stipulate the revocation of the project when the investor does not perform or incompletely performs the commitments when participating in the project bid.

CONCLUSIONS

After implementing the issues mentioned at the introduction, the dissertation has achieved the following results:

- Give overall analysis of new urban area project planning management in

Vietnam.

- Analyze the current status of new urban area project planning management in Vietnam, focusing on the formulation and control of construction planning.

- Summarize legal and scientific basis for formulation and control of construction planning.

- Propose solutions to improve the quality of formulation and control of construction planning, the research results of the dissertation will be useful documents on management of construction investment projects to achieve targets.

RECOMMENDATIONS

- Upon requiring to forecast market demand for construction products of the project, it is necessary to use prediction method, prediction analysis by multivariate regression problem on SPSS software platform.

- When it is necessary to balance costs to determine the order of priority for work construction, the dynamic planning problem and the proposed method are applied.

- When planning the construction schedule with unknown parameters, the fuzzy theory should be applied according to the proposed solutions.

- For controlling the construction plan through cost and schedule measurement, two methods EVM and EST_G are combined.

LIST OF PUBLISHED SCIENTIFIC WORKS OF THE AUTHOR

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2. Dinh Doan Tu, *Research to get improved the rationalale for management of construction plan in the investment project*, Journal of Construction (ISSN 0866-0762), January 2017.

3. Dinh Doan Tu, *Development of multiple regression model to forecast market demand for new urban area project deliverables*, Journal of Construction (ISSN 0866-0762), March 2017.

4. Dinh Doan Tu, *Preparation of construction schedule plan using Critical Chain method*, Journal of Construction (ISSN 0866-0762), July 2019.