

The Establishment of a Tourism Information Systems by Theory of Constraint (TOC)

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Contents:

- ✓ **Tourism Information Systems**
- ✓ **Planning Methods**
- ✓ **Theory of Constraints (TOC)**
- ✓ **Implementation Procedures of TOC**
- ✓ **Evaluation of Project Planning Methods**
- ✓ **Results**

2

Tourism Information Systems

- **Tourism Information System (TIS) is one of the fields of the Geographic Information System (GIS) useful for the tourism organization.**
- **The first duty of the TIS is serving knowledge to tourists on time and impressively. So, if tourists went to anywhere, they could get required data about the environment quickly and correct.**

3

Planning Methods

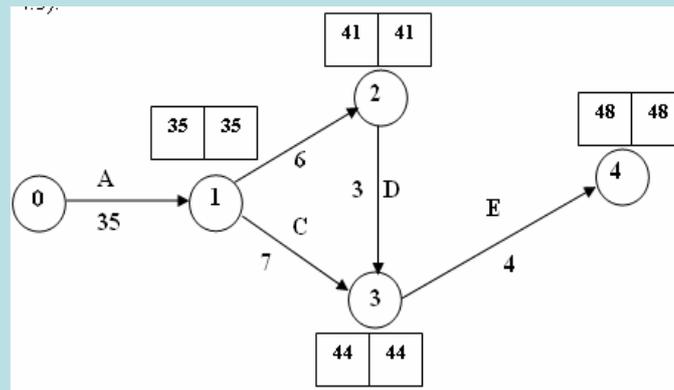
- **Studies on the development of project planning and programming techniques have been around since 1950.**
- **In this area, the main methods are GANTT diagrams, Critical Path Method (CPM), Project Evaluation and Review Technique (PERT) and Theory of Constraint (TOC).**

4

Critical Path Method (CPM)

- The CPM, worked out at the beginning of the 1960s, has become one of the tools that are most useful in practice and are applied in the planning and control of the realization of complex projects.
- First of all it consists in the identification of the so-called critical paths, critical activities and critical events in the network, which is the Project model, assuming the earliest possible completion time of the whole project.

7



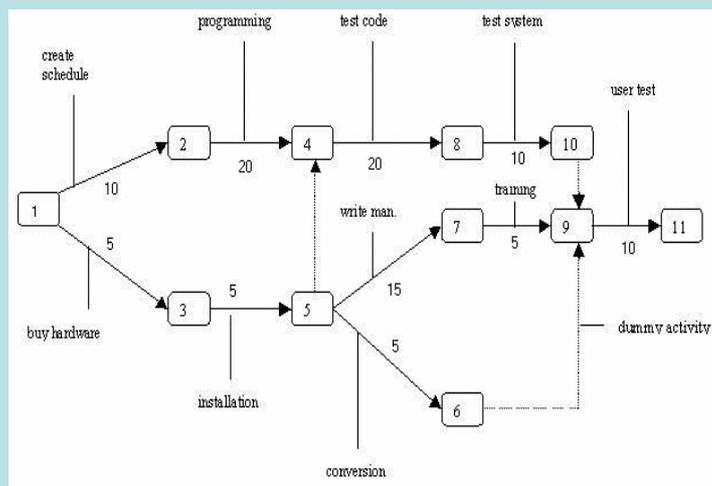
8

Project Evaluation and Review Technique (PERT)

- In its historical process, Gantt usage is foundation of PERT.
- PERT makes no claim to cope with resource usage or activity scheduling. Activity durations are modelled as stochastic variables with an appropriate beta distribution, and a simple approximate method is used to calculate the expectation and the variance of the network event times.

$$t = (a+4*m+b) / 6$$

9



10

The Theory of Constraint (TOC)

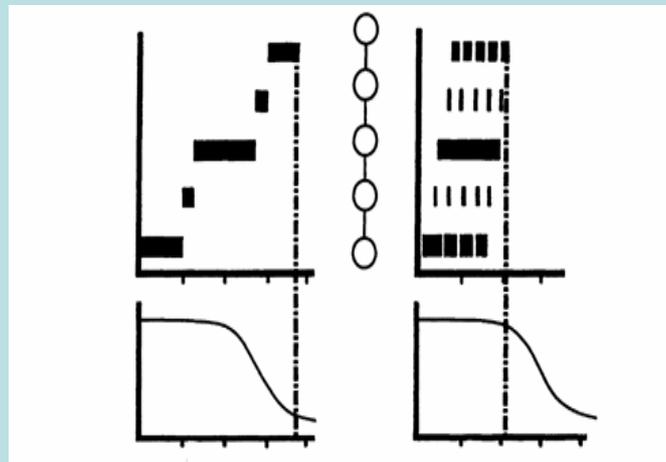
- Proposed by Dr. Goldratt emphasizes on the systematic management of project by discovering the uncertain factors hindering the project implementation, and suggests the global deployment of resources.
- TOC uses the global safety time to schedule the project, and stresses that a system must have a constraint.

11

The Theory of Constraint (TOC)

- Five steps used to apply the TOC skill to the project scheduling is given below
 1. Identify the project constraint.
 2. Exploit the project constraint.
 3. Subordinate everything else to the project constraint.
 4. Elevate the project constraint, and
 5. If, in the previous step, a new constraint has been uncovered, repeat the process. Do not let inertia become the project constraint.

12



13

Implementation Procedures of TOC

- Step 1. Determine the critical path and project length (T_1) without considering the resource constraint, and obtain the critical chain and project length (T_2) using heuristics when the resources are limited.
- Step 2. Compute the duration cut ratio ($C.R. = T_1 / T_2$), where T_1/T_2 and modify the critical chain when no other resource utilization alternatives are feasible.
- Step 3. Use the strategic project flexible coefficient (k_p) and the practical activity flexible coefficient (k) to modify the revised critical chain (R.C.C.).

$$R.C.C(p) = T_{FIN} + k_p$$

$$\text{If } k_p > 0, T_1 < T_{FIN} + k_p \quad T_2$$

$$\text{If } k_p < 0, 0 < T_{FIN} + k_p \quad T_1$$

14

Evaluation of Project Planning Methods

15

Description of Project Area

➤ In this study, as mentioned above, a tourist area with fewer than 100 000 population is studied for establishing TIS by TOC, Gantt, CPM-PERT. 55 weeks are accepted as a total duration for the TIS.

16

| Activity number | Duration | Name of activity | Symbols | Proceeding activity | Gathered | Following activity |
|-----------------|----------|--------------------------------------|---------|---------------------|----------|--------------------|
| 1 | 3 | Taking decision | A | | | B |
| 2 | 3 | Technical Research | B | A | | C |
| 3 | 3 | Form of studying unit | C | B | | D |
| 4 | 3 | Software research | D | C | | E |
| 5 | 3 | Buying software | E | D | F | F |
| 6 | 4 | Education | F | E | E, G | G |
| 7 | 8 | Collecting of data | G | F | F, H | H |
| 8 | 4 | Establish Photographs and image bank | H | G | G, I | I |
| 9 | 8 | Preparing of related data for query | I | H | H, J | J |
| 10 | 4 | Preparing intelligent maps | J | K | I, K | K |
| 11 | 4 | Design of query kiosks | K | J | J, L | L |
| 12 | 4 | Establishment os system | L | K | K, M | M |
| 13 | 4 | Submit of system and update. | M | L | L, M | |
| | 55 Weeks | | | | | |

17

Application

- After designation the durations and relationship between them are seen. Critical path has been found of 45 weeks by CPM and Gantt.
- Table shows trio durations and expected durations for each activity in PERT Method. In Pert method, by equation Critical path is calculated 44,07 weeks.

18

| Activities | The most optimistic durations (a) | The most probable durations (m) | The most pessimistic durations (b) | Expected durations (t) |
|------------|-----------------------------------|---------------------------------|------------------------------------|------------------------|
| A | 1,43 | 2,00 | 3,00 | 2,08 |
| B | 1,43 | 2,00 | 3,00 | 2,08 |
| C | 1,43 | 2,00 | 3,00 | 2,08 |
| D | 1,43 | 2,00 | 3,00 | 2,08 |
| E | 1,43 | 2,00 | 3,00 | 2,08 |
| F | 2,86 | 3,43 | 4,00 | 3,43 |
| G | 5,71 | 6,42 | 8,00 | 6,57 |
| H | 2,86 | 3,43 | 4,00 | 3,43 |
| I | 5,71 | 6,42 | 8,00 | 6,57 |
| J | 2,86 | 3,43 | 4,00 | 3,43 |
| K | 2,86 | 3,43 | 4,00 | 3,43 |
| L | 2,86 | 3,43 | 4,00 | 3,43 |
| M | 2,86 | 3,43 | 4,00 | 3,43 |
| | | | | 44,07 |

19

Application

- By TOC method;
- Step 1. From activity table and flow diagram derived from activities $T1 = 33$ and $T2 = 55$ ($TFIN = 55$)
- Step 2. Computation of the duration cut ratio, $C.R. = T1/T2 = 33/55 = 60\%$ is used.
- Activity table is formed by using k values from Table for each point at critical path.

20

| | | | |
|------------|---------|-----------|---------|
| Importance | K_A^m | Easiness | K_A^m |
| Very high | 0 | Very high | 0 |
| High | 1/4 | High | 1/4 |
| Moderate | 1/2 | Moderate | 1/2 |
| Low | 3/4 | Low | 3/4 |
| Very low | 1.0 | Very low | 1.0 |

| | | | | | | | |
|------------|-----|-----|-----|-----|-----|-----|-----|
| Activity | A | C | E | G | I | J | M |
| Importance | 0 | 1/4 | 1/4 | 0 | 1/4 | 1/4 | 1/4 |
| Easiness | 1/2 | 3/4 | 3/4 | 1.0 | 3/4 | 1/2 | 3/4 |

21

Application

- By TOC method;
- $R.C.(A) = 33 + [0 + (9-6) \cdot 1/4 + (14-10) \cdot 1/4 + 0 + (32-22) \cdot 1/4 + (35-26) \cdot 1/4 + (45-30) \cdot 1/4] = 43,25$ week values have been calculated.
- The using of TOC completely duration has been calculated as 43,25 weeks.

22

Results

- In the TIS's applications, Gantt and CPM methods are not suitable for calculating duration and critical path at the point, of certain duration, certain time designation and long duration.
- It is observed that although the results of PERT are more suitable than those of Gantt and CPM because the planning duration is calculated by trio duration time, if time estimations are not accurate, the project will be delayed. The using of TOC completely duration has been calculated as 43,25 weeks.
- The shortest duration has been obtained by TOC. TOC's advantage over other methods is a shorter number of activities, so it will be more rapid.

23

| Methods | Advantage | Disadvantages |
|---------|--|--|
| Gantt | <ul style="list-style-type: none"> • Easy preparation • All steps can be seen with execution data and all elements. | <ul style="list-style-type: none"> • Does not show the interdependencies of the activities. • Cannot show the result of either an early or a late start in activity. • Does not show the uncertainty involved in performing the activity and, therefore, does not submit itself to sensitivity analysis. |
| CPM | <ul style="list-style-type: none"> • The activities on the critical path have no float time, therefore limited resources must be first assigned to those activities to avoid project delay. • Here the user is required to think through a project logically and with sufficient detail to establish firm, clear, project objectives, activities and specifications. This minimizes the chance of overlooking necessary activities and goals of a project. | <ul style="list-style-type: none"> • Considers only logical constraints during planning, which is not the real world of a construction process. • Duration is estimated once only. |
| PERT | <ul style="list-style-type: none"> • It serves as a necessary tool when the condition is changed to administration. It researches diverse effects. It lists all effects before executing other steps, so precautions can be taken. • Helps how sources can be transferred critical activities, which affects result duration. All helps are served to administration from non critical to important critical activities. Makes multi-estimation a possibility so indefiniteness can be accommodated. | <ul style="list-style-type: none"> • Probability distribution which assumed in beta curved is not based on theoretical foundation or investigation. • Calculates duration variance between the beginning and end of the projects and deals with independence of activities. • Estimation of the most optimistic and pessimistic and probable duration is not easy and all activities are dependent on subjective ideas. |
| TOC | <ul style="list-style-type: none"> • Uses systematic approach to find critical chain and establish related buffers. • Emphasizes both strategic (global k_c) and practical (local k_A^m) aspects to control the project schedule. • Proposes guidelines to establish various buffers and activity duration cut to shorten the project length rationally. • Focuses very much on how senior management deal with human behavior. | <ul style="list-style-type: none"> • Lack of guidelines to establish project, feeding and resource buffers. • All dynamic factors, the activity duration and project length should be included for correct management of the Project Schedule. |

24



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