Diagnostic System for Preparing Decision Tree Model to Identify the Constructive Acceleration in Construction Projects.

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Abstract:

Acceleration involves many changes in the allocation of resources which may lead to loss of productivity. In the case of the extension of time is uncertain, the contractor is faced with difficulties in resolving this problem. Acceleration measures involve additional costs to speed up the construction process. Contractor should always ensure that there is either an agreement or an express instruction to pay such costs.

This research aims to identify the major elements of acceleration and find the causes lead to give the decision to take order of acceleration, and this research also aims to build model tree to identify the types of acceleration and cases of taking the possible compensation of costs. The researcher presents decision making tool by using diagnostic system developed by using (Vanguard software system) to enable engineers giving an appropriate decision by using Decision Tree Model. The vanguard system is specifically designed to perform a wide range of tasks required in business decision analysis. Vanguard combines decision-making technology with analysis methods to create diagnostic system applications.

الخلاصـــــــة:

يَتضمّنُ التعجيلُ العديد مِنْ التغييراتِ في تخصيص المصادر التي قدْ تُؤدّي إلى خسارةِ معدل الإنتاج. في حالات تمديد الوقتِ غير المؤكدة ,المقاول يُواجهُ بالصعوباتِ في حَلّ هذه المشكلةِ. تَتضمّنُ إجراءاتُ التعجيل كلفَ إضافية لتَسْريع عمليةِ البناءَ. المقاول يَجِبُ أنْ يَضْمنَ بأنّ هناك دائماً أمّا إتفاقية أو أمر سريع لدَفْع مثل هذه الكلفِ.

يُهدَفُ هذا البحثِ لتَمييز العناصر الرئيسيةِ للتعجيل و ايجادُ الأسبابَ التي تؤدّي إلى اعطاء القرارَ لإستِلام أمر التعجيل، ويُهدَفُ هذا البحثِ أيضاً لبناء الشجرةِ النموذجيةِ لتَمييز أنواع التعجيل وحالاتِ أخْذ التعويض المحتمل للكلفِ

يُقدّمُ الباحثُ أداةَ إتّخاذ القراراتِ بإستعمال النظام التشخيصي طوّرَ بإستعمال (Vanguard software System) لتَمْكين المهندسين أن يَعطي قرارا ملائماً بإستعمال نموذج شجرةِ القرار.أنّ نظامَ (Vanguard software) يُصمّمُ بشكل مُحدّد لإداء تشكيلة واسعة من المهامَ تتطلب في تحليل قرار العمل. يدْمجُ (Vanguard software) تقنية إتّخاذ القراراتِ بطرق التحليل لخَلْق تطبيقاتِ النظم التشخيصيةِ

1. Introduction:

Acceleration may be achieved by a change in the deployment of resources. In some cases it may be achieved by simply changing the order or sequence for carrying out the work and may therefore not cause additional cost. More usual, acceleration is achieved by adopting longer working hours or additional days of working with same resources. In many cases acceleration involves employing resources additional to those originally planned either for the same hours or days of working, or in additional shifts or days of working. . It is very difficult to encompass with all factors and the reasons of acceleration in the project, because of the differences in each project in many things; so, **the author adopts the factors below to explain this issue;**

Differing Site Conditions

The nature of the

Time of acceleration occurrence

The quickness in resolving the problems

The experience of the contractor

The acceleration/delay relationship

2. The Research Methodology

It is hereby concluded that there are several considerations to be taken into account in identifying the acceleration in project such as;

1. The real events which lead to submit a request for time extension such as delays claim.
2. The real causes of owner to refuse the demands for time extension.
3. The owner's order for acceleration in the project.

Therefore, the author presents the research methodology explained in Fig (1):

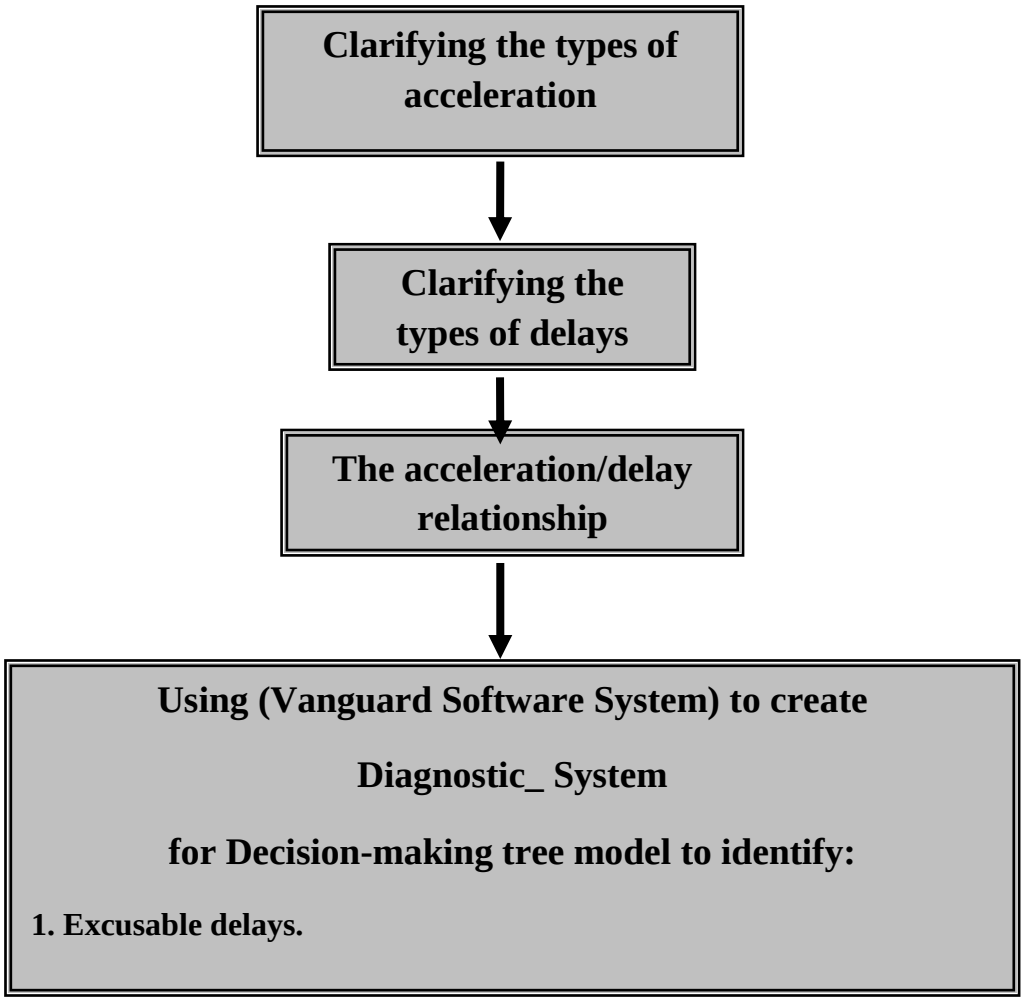


Figure (1) The research methodology

3. Types of Acceleration:

There are two types of acceleration [Ref.1], [Ref.2]; actual and constructive. Actual acceleration occurs when the owner demands that the contractor complete the project a head of the originally submitted completion schedule. Constructive acceleration occurs when the contractor is delayed by some action normally an involved change order, or by an owner or architect's delay in reaching a decision on a question posed by the contractor.

If the contractor then requests a job extension and not granted one and the owner subsequently demands that the contractor complete the project according to the original contract schedule, a condition of constructive acceleration has been created. By claiming the condition of constructive acceleration, a contractor can attempt to get monetary relief because of the owner's actions.

4. Constructive Acceleration Claim:

A claim of acceleration is a claim for the increased costs that result when the owner requires the contractor to complete its performance in less time than was permitted under the contract. The claim is that the owner has modified the contract by shortening the time for performance, either expressly (in the case of actual acceleration), and that under the changes clause, the owner is required to compensate the contractor for the additional cost incurred in effecting the change.

A claim of constructive acceleration ordinarily arises when the owner requires the contractor to adhere to the original performance deadline set forth in the contract even though the contract provides the contractor with periods of excusable delay that entitle the contractor to a longer performance period. Although different formulations have been used in setting forth the elements of constructive acceleration, the requirements are generally described to include the following elements, each of which must be proved by the contractor ; [Ref. 1], [Ref.3], [Ref.4], [Ref.5]

1. The contractor encountered a delay that is excusable under the contract.

2. The contractor made a timely and sufficient request for an extension of the contract schedule.

3. The owner denied the contractor's request for an extension or failed to act on it within a reasonable.

4. The owner insisted on completion of the contract within a period shorter than the period to which the contractor would be entitled by taking into account the period of excusable delay.

5. The contractor notified the owner that it regarded the alleged order to accelerate as a constructive change in the contract.

6. The contractor was required to expend extra resources to compensate for the lost time and remain on schedule.

5. The Legal Elements of Acceleration Measure:

The legal elements of acceleration measure are as follows; [Ref. 1], [Ref.4], [Ref.5], [Ref 6]:

1. Increased resources : to reduce the time taken for critical activities. The increase may at some level have the effect of reducing productivity and thereby increasing unit cost of construction.

2. **Increased man hours:** is a means of increasing resource input, but will introduce inefficiency and both quality and health and safety issues.

3. **Incentive:** will motivate labors to increased productivity.

4. **Changed method of working**: may open up additional workforces of workplaces as well as introducing economic in the use of plant and equipment**.**

The contractor must recognize delays for which there is contractual entitlement to a time extension and formally request the time extension. The owner must recognize that any failure to take prompt and appropriate on a time extension request may result in an expensive constructive acceleration claim. [Ref. 7]

Cost of acceleration may include premium pay such as shift different and overtime, additional resources applied (labor, material, machinery and equipments).

The author presents the figure below to explain the occurrence of acceleration.

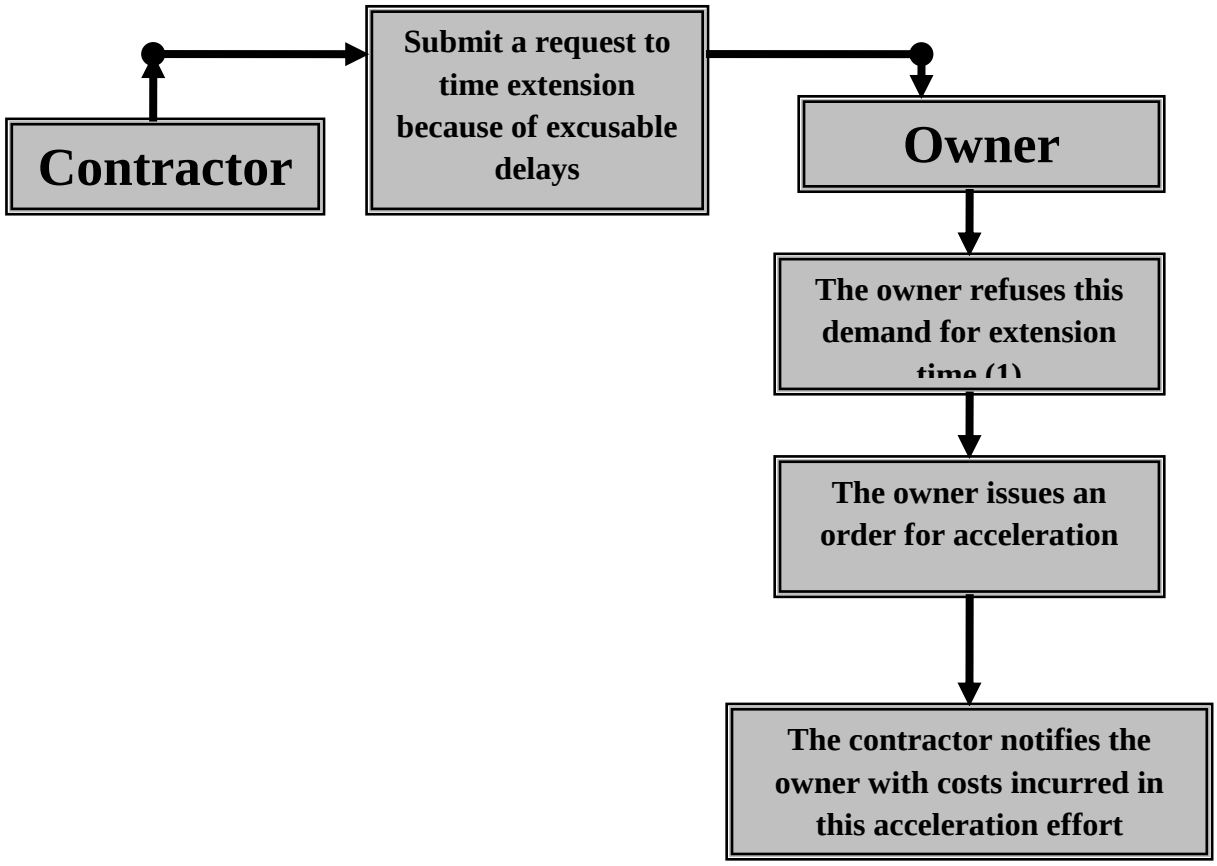


Figure (2) The legal elements of acceleration

6. Delay and Acceleration Claim

Delays and acceleration issues in disputes are probably the most complex issues in contract claims. The complexity arises mainly due to the factual criteria of assessment of whether an issue is excusable or no excusable, whether the issue occurs in isolation or concurrently.

In the event of a delay, to establish an entitlement to time extension and delay damage, it must be substantiated that the delay impacted the contract completion date and that loss and expense had been incurred arising thereof from the instructions which cause delay. [Ref. 8]

Classifying delays are complex and difficult as delay may be such as that the owner and contractor are each responsible for delaying different activities during the same or overlapping time periods, and both of these activities may be critical to the completion of the project as a whole.

7. Types of Delays

The time allowed for execution a project is usually an important consideration for both the owner and the contractor. The delays may be caused by the contractor, the acts of God, or a third party, or several different kinds of delays may happen concurrently so that the time delays can be divided into four major types as. [Ref.9] and [Ref.10];

1. Compensatory delays.

2. Excusable delays.

3. Non excusable delays.

4. Concurrent delays.

Furthermore, Levy [Ref.1], Ahuja, [Ref.11] and Wilson [Ref.12] classified the time delays into three basic categories: -

1. Excusable delays.

2. Concurrent delays.

3. Compensatory delays.

8. Excusable Delays

These delays occur when the contractor is delayed by occurrences, which are not attributed to either the contractor or the owner. Excusable delays will allow the contractor to extend the completion date of the contract, but may not allow him to recover the extra costs associated with these delays. The followings constitute excusable delays. [Ref.1]: -

1. Acts of God.

2. Fires.

3. Floods.

4. Transportation delays over which the contractor has no control.

5. Strikes.

6. Unusual severe weather.

The newer classification of excusable delay can be shown as follow, [Ref. 13]:

1. Acts of God.
2. Public enemy.
3. Government acts.
4. Weather.
5. Strikes.
6. Labor supply.
7. Financial difficulty.
8. Sub-contractor delays.

The failure to perform a specified date, is often excusable because the defaulting party may be contractually excused for the delay, since it is entitled to an extension of time, so that, most contracts contain clause permitting the contractor to seek extension of contract time for specified excusable delays.

Iraqi Contract conditions for civil works include a clause relating to parties entitled to an extension of time due to excusable delays, which include. [Ref.14]

1. Unexpected conditions (inclement weather).
2. Special risks.
3. Acts of sub-contractor.
4. Acts of government.
5. Ambiguity or discrepancy in contract documents.
6. Adverse physical conditions and artificial obstructions.
7. Unavailability of the construction equipment and materials.

8. Harm or damage to any person.
9. Any increases in taxes and duties.
10. The event that the contract is frustrated.

9. The Additional Costs Associated With an Acceleration Claim

When acceleration occurs the contractor typically will incur additional direct and indirect costs. While direct costs are relativity easy to quantify, indirect costs are difficult to identify and quantify, as follow; [Ref. 15]

***A. Direct Costs include*:**

1. Additional equipment rental costs and equipment ownership expenses (measured through rate manuals, depreciation, taxes and insurance)

2. Additional filed labor if the contractor increases crew size (and/or) adds extra shifts as a direct result of the acceleration.

3. Increases labor costs due to work inefficiencies that result from the acceleration.

4. Additional material costs resulting from rushed delivery times.

B. *Indirect Costs include:* job site overhead, extended general conditions or extended or unabsorbed overhead, job shack, job site power and water that can be tied to the acceleration.

An agreement to accelerate normally takes the form of a supplemental agreement between the owner and the contractor. Such an agreement should set out clearly its full terms including the level of liability for acceleration costs and how and when they will be paid. [Ref. 16]

10. Definition of Vanguard Software System

Vanguard is a powerful system used for decision _support analysis and business modeling.

The system combines all of the basic quantitative methods in management with features of spreadsheets, artificial intelligence tools, and math application to produce an advanced business modeling system.

The vanguard system is specifically designed to perform a wide range of tasks required in business decision analysis. These tasks include; [Ref. 17]:

1. General modeling and problem solving.
2. Collaborative modeling.
3. Data analysis.
4. Advanced analysis.

Using one or move of the vanguard Add_in products can be build models that perform decision making analytic methods such as:

1. Forecasting.
2. Decision tree analysis.
3. Sensitivity analysis.
4. Monte Carlo simulation.
5. Optimization.
6. Application development.

11. Steps for Preparing Decision Making Tree Model

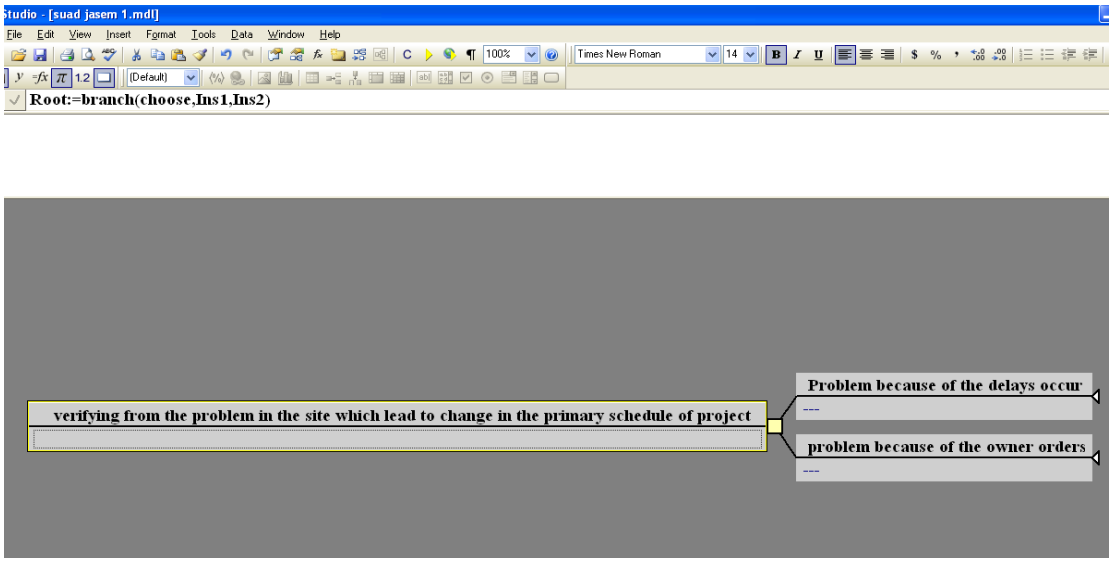
The current research considers the system as a diagnosis system in order to represent the basic information of the whole work.

Diagnosis system offers the most obvious use of expert systems, the list of possible faults that causes a problem forms the natural list of goals for a system [Ref.18, 19] .

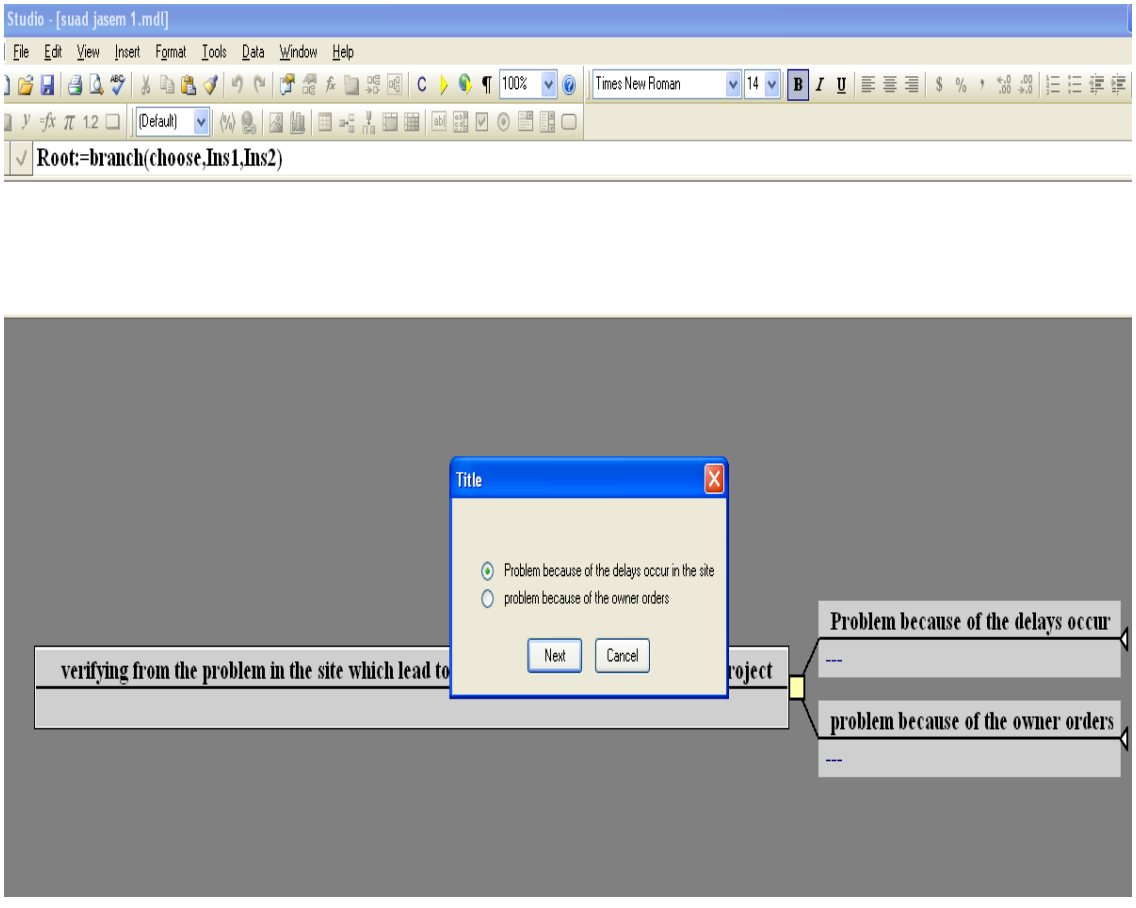
The Decision Tree Model to Identify the Constructive Acceleration in this research explained in figure (3).

The author decides to verify each part in this tree in more detail as shown in the below steps to explain each branches of tree in print screen of the program.

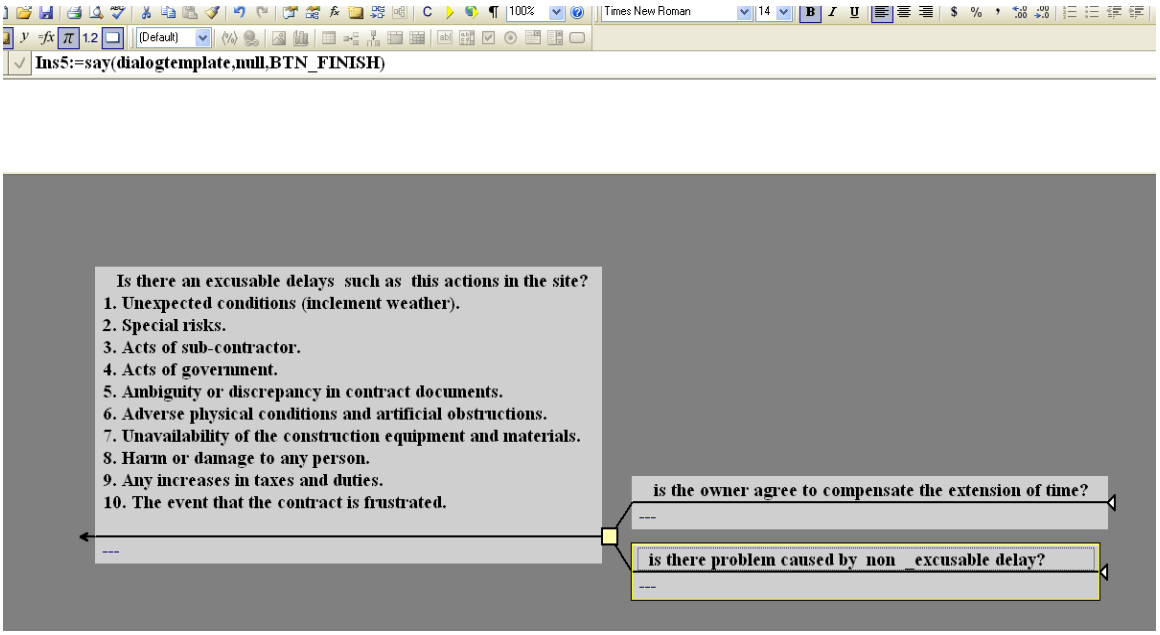
1. the program explains the problem in the site which leads to acceleration, as shown below in the basic root of the tree model of the diagnostic system:



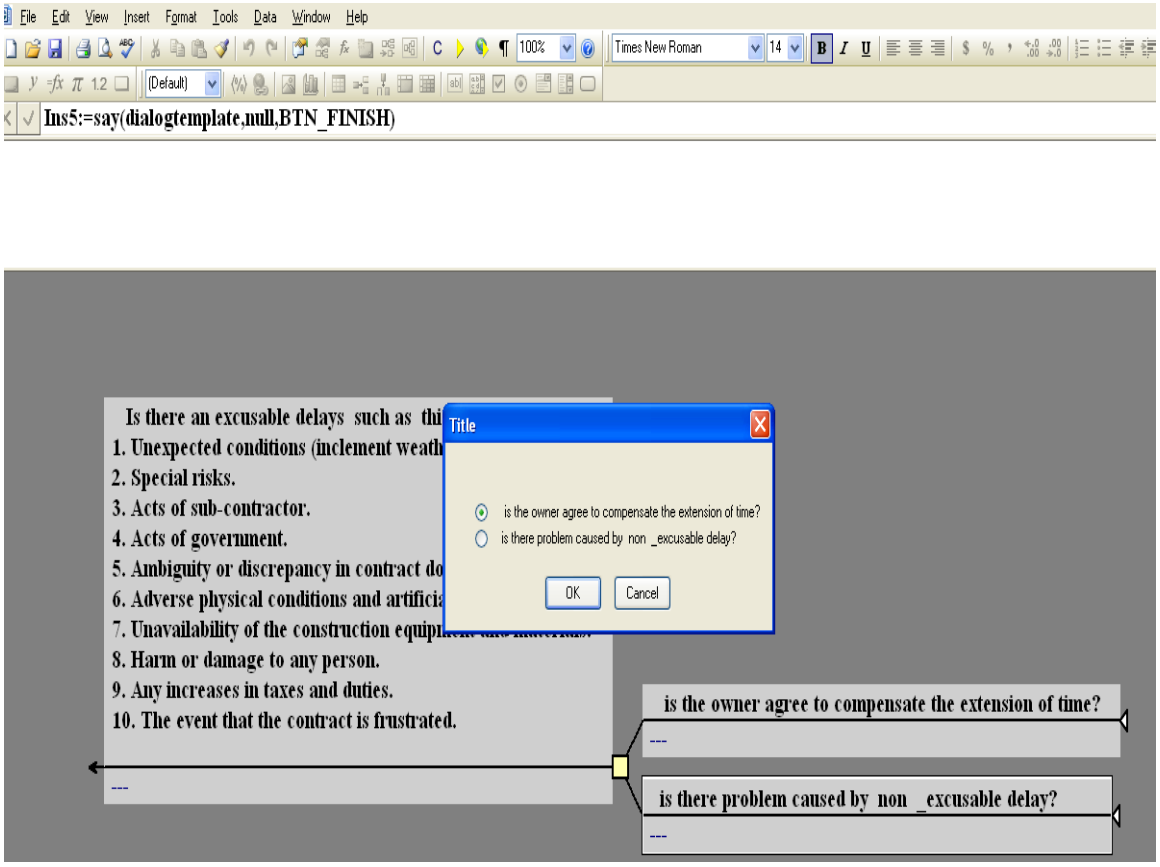
2. The carrying out of this basic root as shown below:



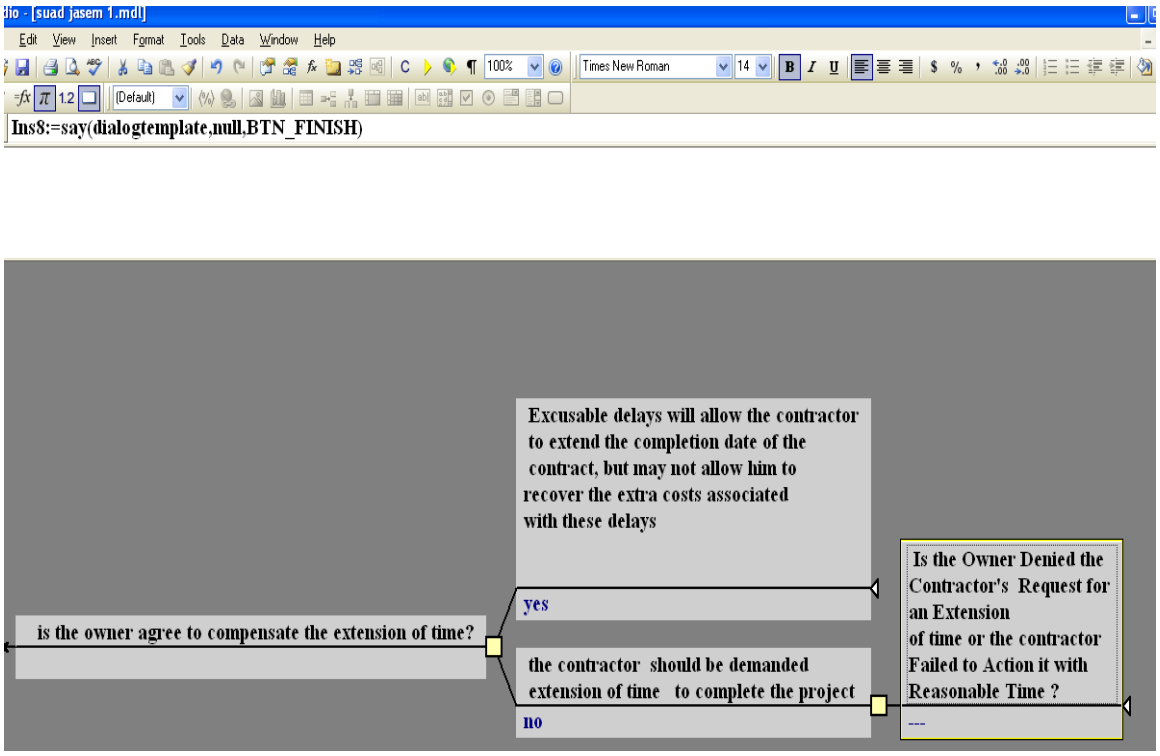
3. The importance of excusable delays has been collected from review of the references and the clauses in the Iraqi Contract Conditions for civil work.



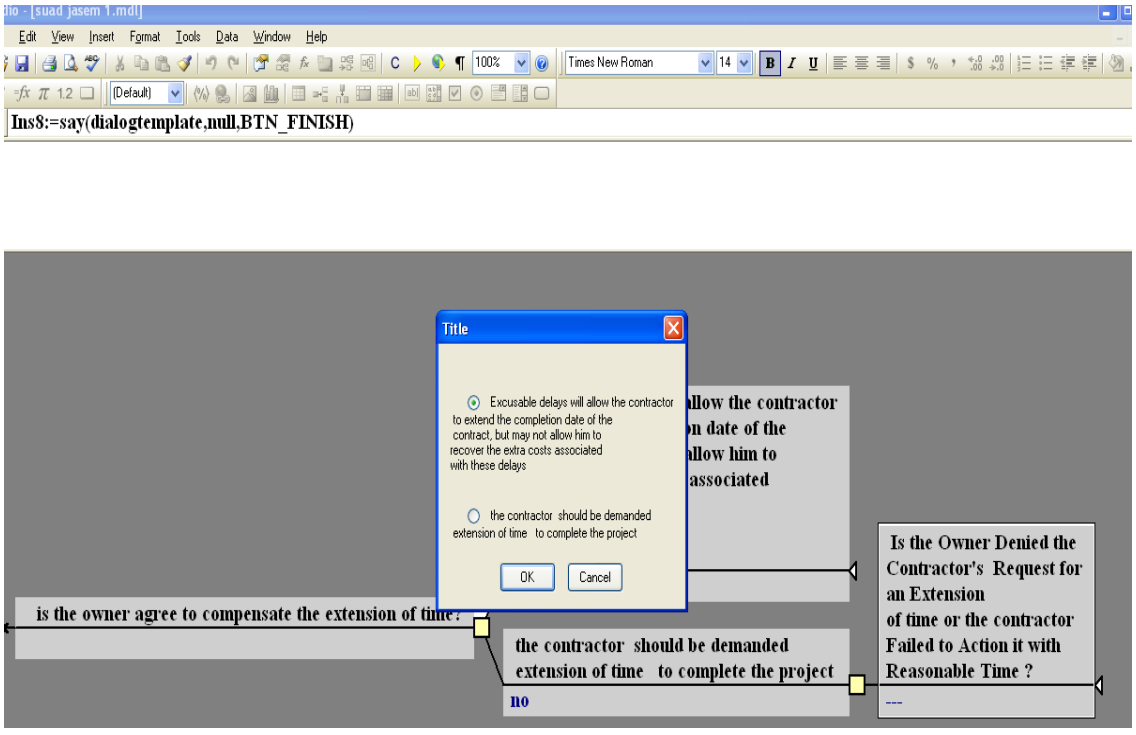
4. The carrying out of the previous screen as shown below:



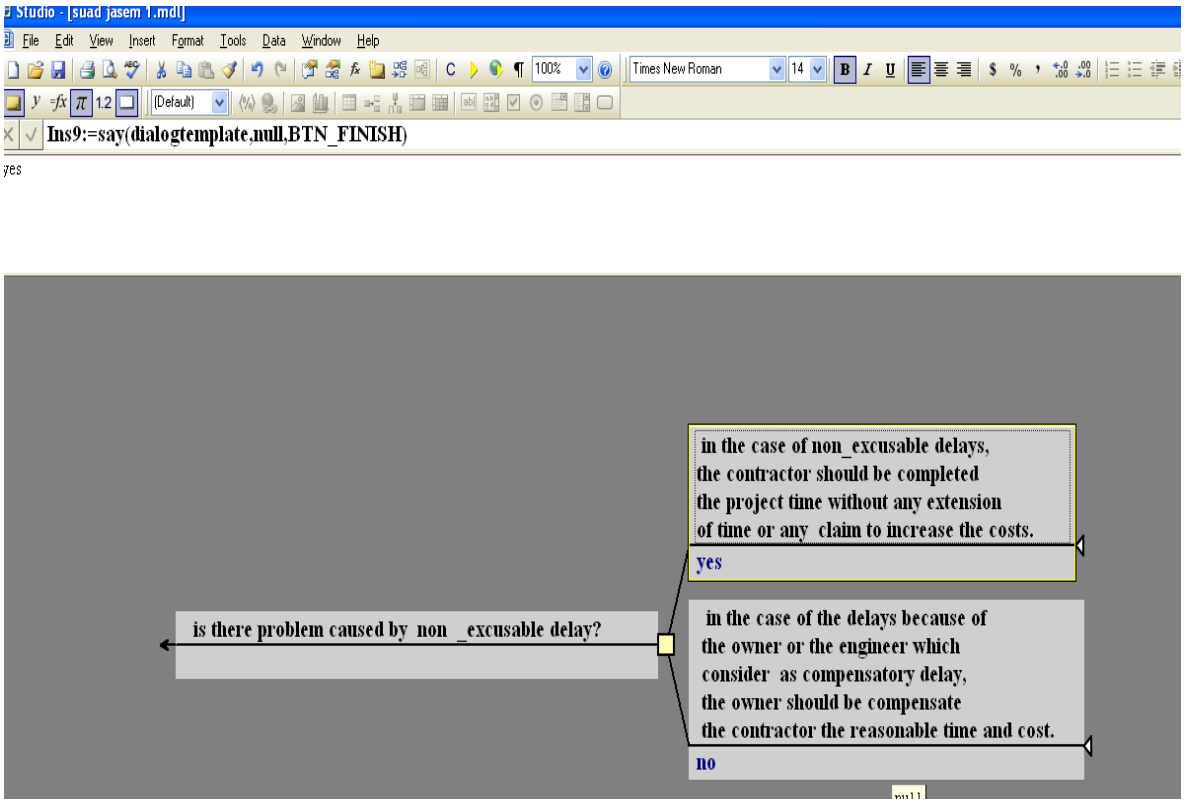
5. In this stage the program clarifies the situation of the excusable delay which leads to acceleration.



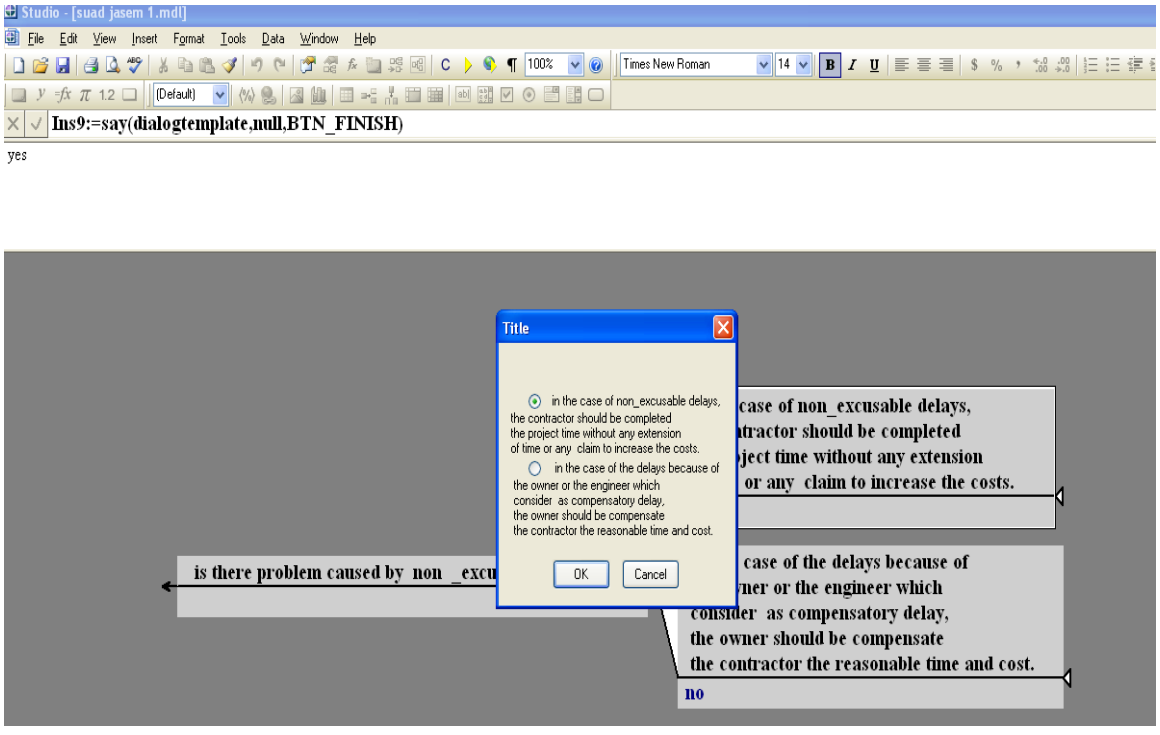
6. The carrying out of the previous branch of the tree as shown below:



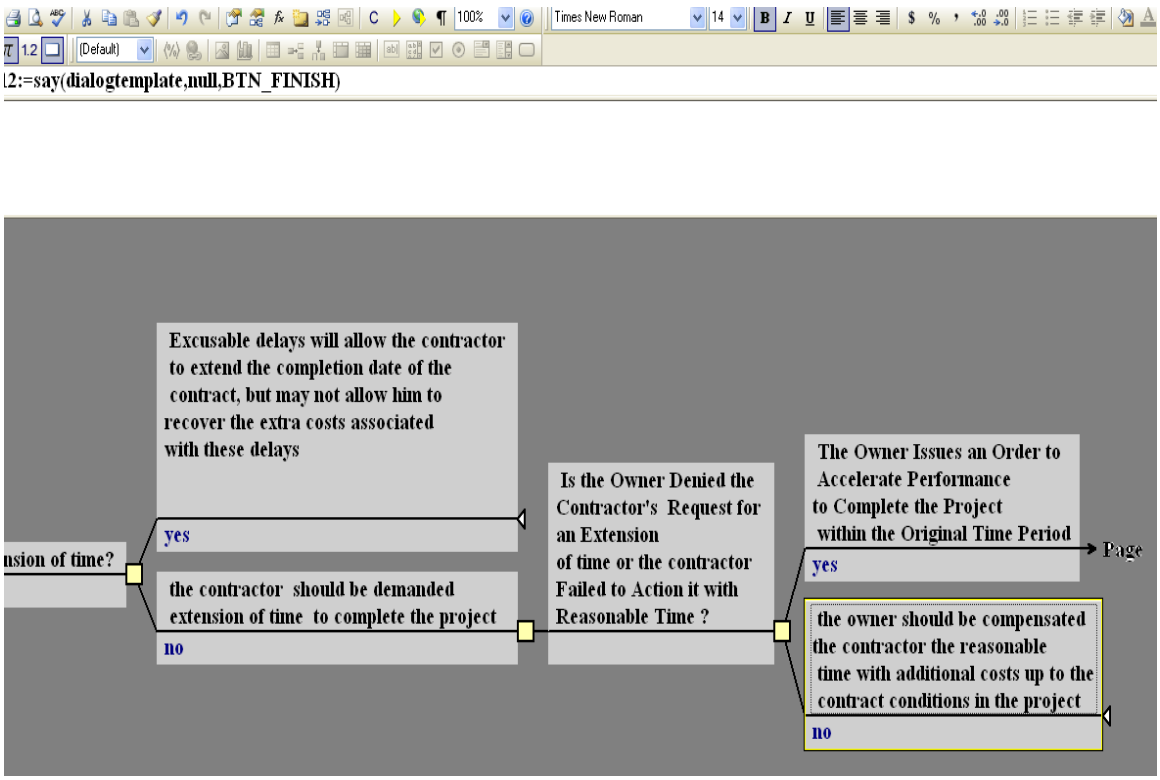
7. The program verifies the cases of acceleration because of non_excusable delays.



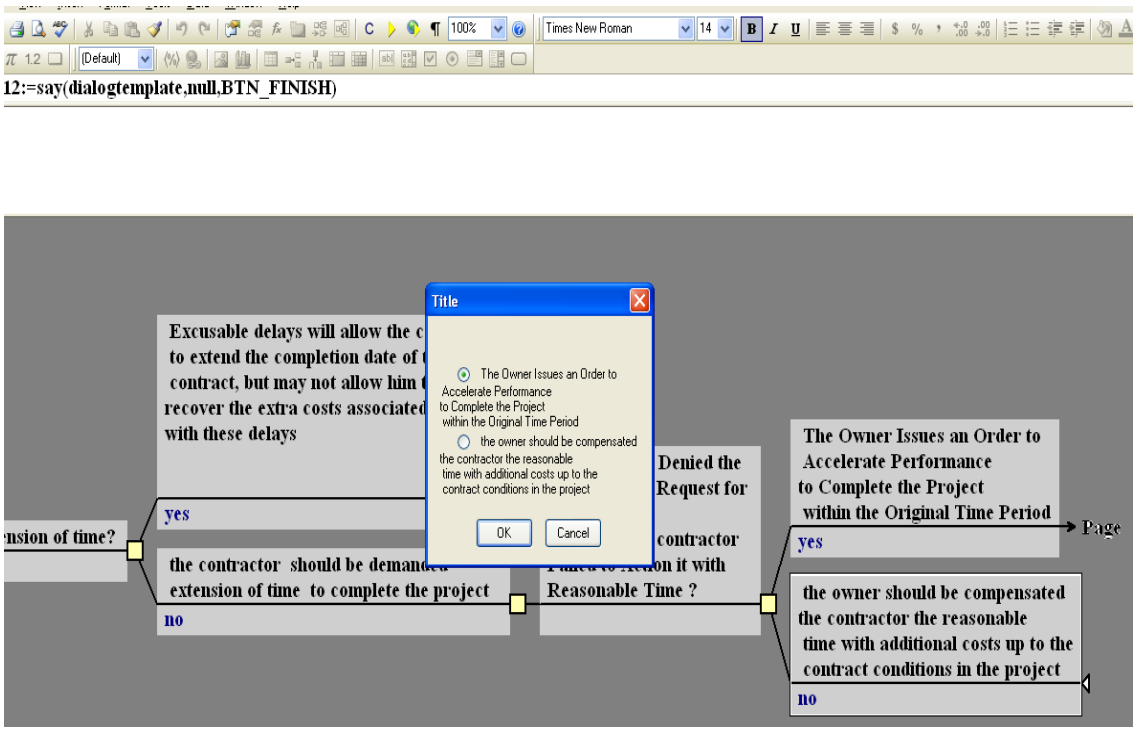
8. The type of selection as below:



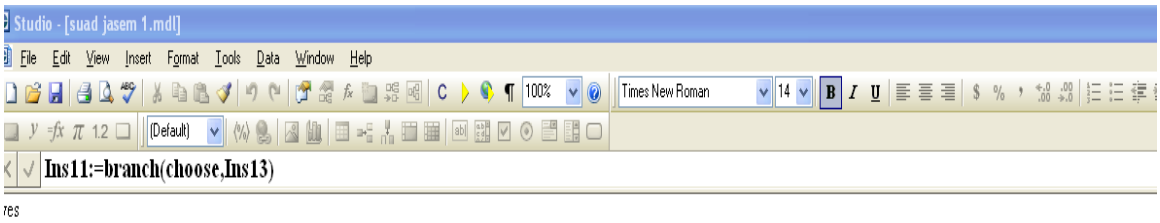
9. More branches of the diagnostic tree to explain the compensation of time in case of acceleration and delays.

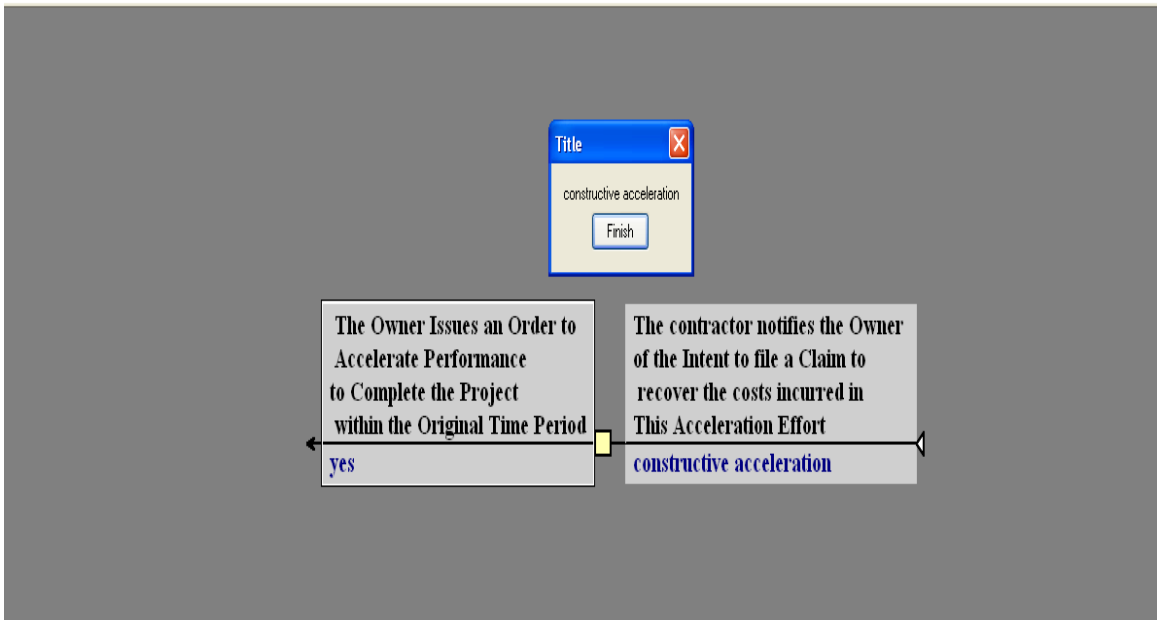


10. The choosing of these branches as shown below:



11. The typical output of the tree model as diagnostic system to justify the constructive acceleration as shown below:





12. Recommendations

The resolving of the constructive acceleration as the following suggestion has been prepared, as follow:

A. Most contracts have change order and time extension clauses that are applicable when there are project delays.

B. The failure to comply with these contract notification clauses constitutes the owner's primary defense to this type of construction claim.

C. The contract also must be reviewed to determine whether the delay is an excusable delay as to the contractor.

D. In the case of an excusable delay, the contractor is entitled to an extension of time and compensation for costs associated with the delay.

E. If the owner refuses to grant an extension, the contractor must thoroughly document all of its acceleration costs. Ideally, the costs should be tracked as they are incurred.

F. Project diaries and other reports should indicate the impact to the acceleration on the workers productivity.

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