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CLAIMS ON CONSTRUCTION PROJECTS – QUANTIFICATION AND PREVENTION

Abstract: *The claims represent a very important topic because their monetary value can be very high while their quantification is not exact and it ranges from 1:3 in practice, depending on the methods applied. The methods have been explained in this paper. A prerequisite for the objective quantification are quality, transparent schedules with clearly visible links, floats, flows and performance. For the calculation of the extension of time, it is best to apply the windows method for smaller, and re-planning for major disturbances. Within the quantification of costs, the methods of calculating overhead costs and their overlapping were explained. Particular emphasis was given to the original approach to the costs of idle equipment.*

Prevention of claims on construction projects requires a proactive approach to project management in the early project stages - design, tendering and contracting procedures. Recommendations for claim prevention are given, from the perspective of the investor and of the contractor, according to the project phases. Designing is crucial for investors, while planning and control are key for the contractor. In the construction phase, written communication and early settlement of disputes before escalating to external mediation are important. Applying the proposed prevention measures significantly reduces the likelihood of claims. If, however, they do occur, the application of the proposed method of quantification will accelerate the settlement process and reduce the probability of ending up in court. For claims quantification and prevention, it is crucial that engineers take an active part in writing and agreeing on the articles of the contract for whose implementation they will be in charge.

Key words: *claim, extension of time, cost quantification, claim prevention*

1. INTRODUCTION

The claim is a legitimate request for additional compensation in time and/or costs due to the changes that occurred related to the conditions defined by the contract. The claims are very important because their monetary value can be very large and can decisively influence the final financial result of the project. Considering the fact that quantification is not completely exact, it is necessary to have the knowledge of the methods used to calculate the extension period and the corresponding costs. By analysing the claims on projects from practice, it can be noticed that the contractor`s and investor's view of the same dispute usually diverge in a ratio of 3:1. In order to realize the claim, first, it is necessary to meet the legal-procedural requirements that are defined in the contract. This refers to the necessary written documentation that must be submitted within the necessary deadlines, forms, and contents, as well as to the legal basis for the compensation claim that must be recognized in the specific contractual provisions. This aspect of the claims is very important, but it is out of the scope of this paper.

In this research, the focus is on quantifying the claims regarding time and money, which follows the verification of the fulfilment of the legal-procedural basis. This paper is designed to explain all the essential elements of the quantification of claims, to present the existing methods for quantification, and to provide recommendations for implementation on projects.

The second part of this paper deals with the prevention of claims. Considering the claims are mainly the manifestations of previously made mistakes, a proactive approach to project management in the early project stages will be explained, particularly during design, tendering and contracting procedures. Key aspects of the prevention of claims from the perspective of the investor and of the contractor as well as their joint responsibility for quality communication and early settlement of disputes in the construction phase will be addressed in this paper.

2. CLAIMS TYPES

Claims are closely related to contract documents as they may arise due to any change in relation to a contract that causes material consequences (time or cost) for one of the contracting parties. The claim can be defined as a result of the disputed or unresolved change that occurred on the project. The overview of claims can be carried out in different ways, depending on their nature and the causes they arise from. At this point, an overview of the most common claims by cause was made, based on the part of the consulted literature [1], [2], [3]:

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- Delay and schedule extension claims,
- Acceleration, compression, impact and ripple claims,
- Inefficiency and disruption claims,
- Formal and constructive change order claims,
- Quantum meruit claims,
- Wrongful termination claims,
- Breach of contract claims.

It can be said that there are as many claims as there are types of contract disruptions, and therefore it is difficult to include them all through a single review.

Particularly common in practice are the claims that result from delays. They occur in case of exceeding the deadline or increasing the volume of work so that it cannot be completed within the deadline. Delays can be further subdivided into:

- Direct delays,
- Concurrent delays, and
- Serial delays.

From the perspective of the contractor, the outcomes of the claims caused by delays differ in the justification and type of compensation:

- Excusable/Compensable. Due to the fault of the investor,
- Excusable/Non-compensable. Caused by force majeure, mostly due to climatic conditions, archaeological works, strike, etc.,
- Inexcusable. Incurred by the fault of the contractor, the investor has the right to reimbursement of expenses and to apply for delay damages.

In this paper, the focus is on quantifying delay claims because they are very common in practice and at the same time they are the most difficult to quantify because before calculating the costs, the impact of delays on the programme of works must be examined.

3. QUANTIFICATION OF CLAIMS

For the successful realization of the claims, 3 elements are necessary:

1. Determining the harmful event and proving that there is responsibility of other parties, i.e. that there is a legal and procedural basis for the reimbursement of costs.
2. Conducting a correct „cause-effect“ analysis, i.e. proving that the adverse event caused delays and costs.
3. Conducting a correct calculation of damages - quantification of time and cost.

Within the first step, it is analysed: how established is the claim regarding the applicability of the articles of the contract which the claim is referring to and the fulfilment of the procedure regarding the necessary deadlines, forms and contents of the submitted documentation. The second step is most often related to the analysis of the impact of a delay on the programme of works. The third step is the quantification of time and the corresponding costs. The identification of harmful events and the right to compensation are usually not controversial. However, quantification is always controversial.

In practice, it is necessary to approach the claims in a balanced way, or to harmonize the procedural and engineering approach in the interest of the project. There are cases in practice that a justified claim of a good contractor will be denied because of the minimal delay in sending the notice, which is not fair and not in the interest of the project. Conversely, there are bad contractors who ignore the works and whose primary goal is to submit claims. In this case, any compensation to the contractor is unjustified, and it is in the interest of the project to terminate the contract. As for the quantification itself, the claims are determined by two categories to which specific chapters of this paper will be dedicated:

- EOT - Extension of Time.
- Different Costs categories, most often directly dependent on the time (number of EOT days).

4. QUANTIFICATION OF TIME – EXTENSION OF TIME

Quantification of time includes the analysis of the impact of the disruption on the programme of works, and determining the number of days of the extension of time (EOT). It directly affects total costs, since most categories of costs are calculated on a daily basis, so the total amount is obtained by multiplying with the number of days of extension of time. In procedural terms, the claim for an extension of time is often submitted first, and after a decision on this issue, a request for reimbursement is submitted.

It is often difficult to quantify the impact of the disruption on the project's completion date. The main issue is to determine the impact of disturbances on the remaining activities, primarily on a critical path. It is additionally complicated to determine whether it is possible to compensate for the delay by acceleration of works. Quantification is subject to manipulation because there is no sufficiently clear standard on the content and form of programme of works. Critical path impact analysis requires expert knowledge because there are different methods in use.

Particularly sensitive is the issue of the sequence of management decisions when the schedule is disturbed. In fact, as long as the annex to the contract does not determinate the extension of time, the previous schedule is in force, which practically ceased to be usable. The contractor avoids making a new programme without an approved EOT, to which he would then adjust the programme. This is not good for the project because the very process of solving the claims is long and the construction site is practically without a functional programme for that period. It would be better to execute and reconcile together the re-planning, and on the basis of this, establish a new deadline, if the original deadline cannot be achieved by other measures. The only solution is to write a special article in the contract documents that would allow re-planning without a previously approved EOT.

The following chapters will address the most important concepts related to the extension of time, as well as the methods for calculating the EOT number of days.

4.1 Float

The first important question that arises when analysing the programme is: to whom belongs the float for activities outside the critical path? The importance of this issue is reflected in the fact that the delay in the beginning can be compensated by consuming floats and after a time project deadline is definitely shifted.

The problem for practice is that there are different interpretations. One of the recognized documents referring to the topic of claims is SCL (Society of Construction Law Delay and Disruption Protocol) [3]. According to this document, the float is available to the investor and the contractor (it belongs to the project), and the EOT is only granted when the float is exhausted. The principle is called "first come, first served“.

The second approach is that the float belongs entirely to the contractor and serves to correct his own mistakes or work strategy, which means that the investor is not entitled to the float.

FIDIC is relatively undefined, but it inclines to the contractor.

Although it can be said that a more honest interpretation is that the float belongs to the contractor, it should be considered that the disputes can end up in a diverse way for similar disputes. In order to avoid misunderstandings, the contract should specify the ownership of the float.

The recommended approach is for a contractor to "extract" float into specific activities that are referred to as "contingency" or "buffer" in literature. Buffers are usually set before time critical activities and key flows. A typical example is a buffer placed at the end of underground works, which are particularly risky in terms of duration. The use of buffers is in accordance with the theory of constraints and the critical chain method. Thus, disputes about float are avoided, because it undoubtedly belongs to the contractor, the activities are not artificially extended, performance can be realistically perceived and the project control is facilitated.

4.2 Extension of time calculation methods

Methods for time analysis serve as a basis for calculating the number of days of EOT, based on defined delays. This topic is also ambiguous, i.e. there are different methods for proving and calculating EOT. The most known methods are [3], [4], [5]:

- Comparison of the planned and realized programme (*as-planned vs. as-built*),
- Impact analysis of the delay (*impacted as-planned or time impact analysis*),
- Adding delay to the as-planned programme (*as-planned expanded*),
- Subtracting delay from the as-built programme (*as-built collapsed*)
- Time slice method (*snapshot or windows method*).

The methods are based on analysing the impact of a delay on the critical path in a programme. Prospective methods are based on the planned programme, adding delays and assessment of the new deadline for completion of works. Retrospective methods are based on the as-built programme from which the delays are subtracted and delay impacts evaluated.

Comparing the as-planned and as-built programme implies a simple comparison. The difference between the end dates determines the total delay. Investor and contractor responsible delays are summed separately. The positive difference between the total delay and the sum of delays of one party defines the responsibility of that party. The remaining time to the total delay is the responsibility of the other party. It would be better to use a proportion instead of a difference, as different results are obtained in the described manner. Extremely imprecise method that does not take into account the dynamics of delays. Simple, cheap and fast method.

Time impact analysis involves examining the impact of a delay on the critical path of contractual programme. Delays are inserted into the schedule, linked with other activities, and the resulting completion of work is compared to the planned one. Delays are defined on the basis of site documentation. This method is not precise, it is possible to get more days than the actual delay. There is also an approach of continually inserting disturbances to form a continually innovated as-built programme. The problem arises in the case of multiple delays and the case of incomplete site documentation, because it is difficult to objectively determine delays and their interaction. In the case of illogical schedules, illogical results are obtained, so that the delay can cause an extension of the time that is longer than the delay itself (e.g., the impact of the winter season).

Adding a delay to the planned programme (as-planned expanded) is based on a contractual (as-planned) dynamics in which the consequences, caused by delays so that their duration is extended, are added to the activities. The consequences of the delays and their duration are determined by an expert on the basis of material evidence, so it can be subjective. If the original programme is poor or the technology has changed, one comes to the wrong conclusions. It works well if the critical path does not change, which rarely happens.

The subtraction of a delay from the achieved programme (as-built collapsed) is based on the actual, as-built programme from which real delays are subtracted by reducing the duration of activities. The aim is to evaluate the earliest possible date of completion of the works in the event of no delay. It requires a lot of effort in the production of the as-built programme with correct technological links that realistically reflect the sequence of activities. Sometimes the links are assumed, so the method is subjective. The quality of the results is proportional to the quality of the site documentation and material evidence.

The window method represents an advanced method of time impact analysis. The total duration of the project is divided into consecutive time segments - windows, which may correspond to accounting periods or key events. The smallest window is a one-delay period and in this case it corresponds to the time impact analysis. The schedule is innovated at the end of each window. Delays are analysed and the responsibility for them is assigned to the investor or to the contractor, for each individually analysed window. This method is considered to be the most objective because it is the only method that encompasses the dynamic change of the critical path during project realization in each window.

Examples of applying these methods can be found in the literature [4], [5], [6]. The presentation of the application of the methods on a case study is too broad for the scope of this paper.

Regarding the comparison of these methods, one can say that none is always the best and most appropriate. Prospective methods are theoretical because they give an assessment of the future. They must be applied if the project is not completed at the time of the analysis. Retrospective methods are, in principle, better provided that the as-built programme is well established. If there is a quality programme but the site documentation is not reliable, then as-planned expanded is the appropriate method. On the contrary, if there is good site evidence but the programme is not reliable, then as-built collapsed is a suitable method. Window method is the only method that monitors the dynamics of changing the critical path of the project. This method is the most complicated and most precise.

The existence of different methodologies indicates that this area is not completely exact and standardized. Specificity of Serbian construction projects are major disruptions, non-transparent schedules and lack of expert knowledge. All this requires the establishment of a specific methodology, because the methodologies mentioned provide illogical results, i.e. too long extensions of time, resulting in huge costs. In the case of long delays, it is suggested that the remaining works be rescheduled with identical resources and performance with which the schedule is formed. Mutually adjusted re-planned schedules would give the most realistic new completion date. It is recommended that the contract prescribes the use of the window method for a minor and re-planning for major disruptions.

4.3 Concurrent delays

Concurrent delays occur when both sides simultaneously cause a delay, so the right to EOT and compensation should be assessed. In principle, if delays are simultaneous, the contractor is entitled to an extension of the time, and neither party has the right to compensation. The situation is complicated if delays are not simultaneous and/or not both are on a critical path. In this case, it is possible to apply the already mentioned methods of calculation. There is a good interpretation that delays are simultaneous if their effects are simultaneous.

Figure 1 shows an example of concurrent delays of the investor (5 days) and of the contractor (3 days) [7]. In this case, the contractor should receive an EOT of 5 days and a compensation costs for 5-3=2 days.

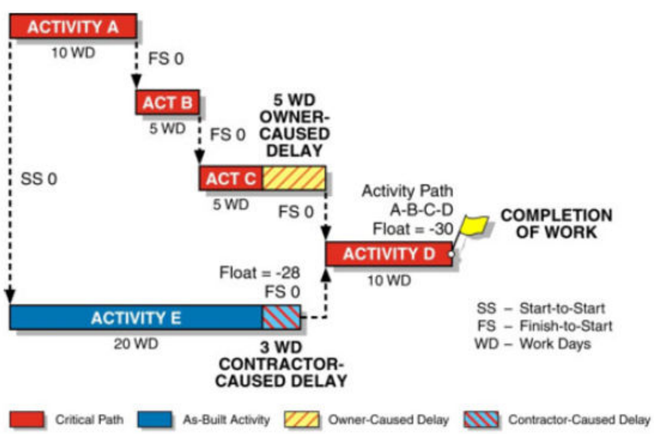

Figure 1. Concurrent delay example [7],

A special case is so-called pacing that arises when one party consciously and deliberately reduces the pace of works due to a delay created by another activity. This is allowed under the following conditions:

- The primary delay must precede pacing,
- The ability to perform the work at the planned pace must be verified,
- It must be verified that consciously and deliberately a decision was made to slow down the work due to another delay.

If all conditions are met, the other party is not entitled to compensation.

4.4 Acceleration, compression and other impacts on the programme of works

Various terms are in use describing a similar phenomenon (Inefficiency and Disruption Claims; Acceleration, Compression, Impact and Ripple). It is about acceleration, compression and other negative impacts on the planned programme. Costs arise due to changes in the order of activities, engagement of additional labour, overtime work, accelerated material procurement, additional inspection of works, engagement of additional equipment, etc.

The three most common reasons for acceleration of works [1] are:

- The direct order of the investor. It is easily identified, and documented evidences of increased costs should be prepared continuously.
- Constructively accelerating when an investor puts the contractor in a position of being forced to accelerate. Typically, the investor does not allow EOT and requires additional works. The contractor is obliged to expedite the work and must immediately submit an appropriate notice to reserve the right to claim.
- Voluntarily acceleration of contractors due to their own delay in realization. In this case, the contractor estimates that the costs of acceleration are less than liquidated damages.

The logic of the claim is clear, but the problem for the contractor arises when it comes to proving costs that largely depend on the quality of planning.

Figure 2 shows the planned and realized resource histogram for a particular resource. An increased workload that makes the difference between the surface of the yellow and the blue diagram can be clearly seen. However, since harmful events are always bounded by the opening and closing dates, only a fraction of the difference is really chargeable. Proving can be indisputable only in the case of precise and transparent short-term planning, where the daily performance and calculated crew productivity would clearly be seen, which is very rarely found on projects. Provided that the contractor has proven that in a certain period prior to the harmful event he managed to achieve such planned productivity, then proving the costs due to reduced productivity is indisputable and irrefutable.

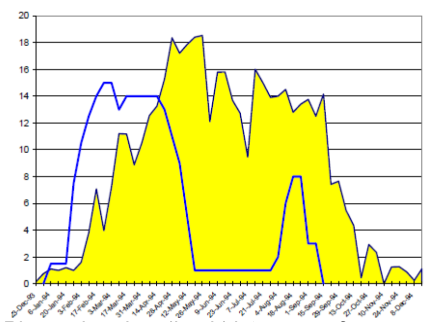

Fig. 2. Planned and realized histogram of engagement

4.5 Mitigation of delay damages

Mitigation is an important concept often present in contracts under which the contractor is obliged to try to reduce the impact of an adverse event and must not force it. For example: if a certain work area is unavailable, the contractor is obliged to work where possible; in the event that the delay will obviously last, the overheads should be rationalized. The problem in practice is that the measures for mitigating the damage are not exact, they are difficult to measure and the outcomes are uncertain.

The purpose of the concept is to avoid that the injured party (the contractor entitled to compensation) passively waits for compensation. Any damage that could have been avoided or reduced by reasonable measures would not be compensated. It cannot be expected for the contractor to undertake costly and long-term measures. On the other hand, increasing damage that could have been avoided by reasonable measures is not tolerated. The concept primarily relates to limitation of damage when it is evident that the problem will last for a long time, as well as deliberately increasing damage (forcing an adverse event).

This concept has its limitations, as the contractor does not have to be successful in reducing damage. The investor can successfully call mitigation as defence only if he can prove that this is the only reasonable procedure that the contractor could implement. The contractor has the right to reimbursement of costs for the measures he has taken to prevent an alternative major damage. It is crucial to prove the possibility of quantifying measures through a programme. So mitigation is another reason for quality planning.

Most importantly, the contractor must realize that the fact that he is not guilty and he did not violate the contract is irrelevant. The focus is on what the contractor, although he did not cause a problem, did from the time when the contract was interrupted or terminated, which a good investor consultant will carefully analyse. If mitigation measures are not taken and the case goes to litigation, contractor can be left without part of otherwise legitimate compensation.

4.6 Planning strategy and consequences on claims

As part of the bid forming process, contractors can apply different strategies when developing a programme of works. It is often the choice of the contractor to artificially extend the duration of works in the initial period for certain activities, in order to allow himself initial delays until full mobilization. However, if the start of the programme is planned with low performance so as not to get delayed immediately, then it should be kept in mind that the delay can be easily overcome by acceleration of work to normal performance, and the compensation of damage is unlikely. A programme should be made with floats in order to reduce the risk of exceeding the project deadline and paying delay damages. But then it should be known that there is a risk that the extension of the time due to a delay will not be allowed until the reserve is consumed [2].

The optimal and recommended approach is to create a schedule with maximum performance and productivity per key flows [8]. In such a forced plan, insert the aforementioned buffers at the beginning of key flows or at the end of uncertain technological activities in terms of duration. Crews should not be aware of buffers so as not to slow down the work. The buffers are managed by the responsible planner.

4.7 The impact of Engineer’s work on claims

The impact of engineer's work on claims can be very significant. In case of problems with realization, the engineer can play a crucial role in preventing claims by giving adequate instructions to the contractor. An engineer has the right to give instructions, but often avoids it because it assumes responsibility for some other problems that might possibly happen due to the instruction. Engineers rather take on the role of an impartial "notary" of events on the project, rather than a proactive role. The investor can provide the proactive role of the engineer only when contracting by defining the appropriate articles that would motivate the engineer to work more actively in the interest of the project. The existing approach of paying the engineer on a monthly basis regardless of the outcome of his work actually is in favour of the extension of the project.

5. QUANTIFICATION OF COSTS

After determining the extension of the time, the cost quantification follows, often in a special claim. In order to be compensated, costs should be justified (realistically acquired), reasonable (realistic) and provable. The categories of costs that most often appear in the claims are [2]:

- Site Office Overhead,
- Home Office Overhead,
- Idle equipment,
- Delayed cash-flow,
- Lost profit,
- Preparation of the claim, etc.

The first three categories of costs are indisputable and make the most of the costs. Often, claims have excessive demands only for the purpose of creating a better negotiating position.

5.1 Site Office Overhead – SOOH

Site office overhead includes overhead of the building site that cannot be directly included in unit prices. This overhead category can be:

- One-time: facilities (offices, workshops, fences, kitchens ...), installations, sanitary facilities, computers, office equipment, cars, landscaping, or
- Time-dependent: salaries for managers, engineers and support staff, energy bills (electricity, water, telephones, internet, etc.), site security, insurance, travel expenses, laboratory tests (regular), accommodation, office supplies (consumables) small repairs, etc.

Site office overheads are in the order of 5% of the agreed amount. Often, these overheads are defined in the contract as a percentage (for example, in case of variations), but the contractor should know their exact amount on the basis of the price analysis in order to manage his own costs. As for claims, the site office overhead cannot be charged as a lump sum, but only as a proven real cost.

When it comes to compensation, only time-dependent costs can be reimbursed. Costs include salaries for employees who are not included in unit prices with appropriate proof of payment and time related costs. One-time purchases that could have been made outside the period of delays cannot be compensated. Compensation is exact and relatively simple, provided the contractor keeps records of costs. The compensation procedure implies that the proof (invoice) for each individual cost is submitted. The invoice must relate precisely to a delay period. The aggravating circumstance is that sometimes the actual cost and the invoice date are not identical, and maybe one or the other does not belong to the delay period. It would be logical to observe the time when the cost was originally acquired and not the date on the invoice.

As a rule, the engineer performs a triage of submitted invoices and accepts or rejects individual items. Rejects: one-time costs, costs incurred outside the delay period, costs charged elsewhere (IPC), costs without adequate evidence, etc.

It should be considered that the question of the reality of costs can be raised if they exceed the usual values (~ 5%) and/or within the application of mitigation measures. In the case of claims, unrealistically high overhead costs sometimes may not be reimbursed.

5.2 Home Office Overhead – HOOH

By definition, this category represents the costs of the contractor's company that are linked to all current projects, that is, the costs that cannot be allocated to just one project. Typical categories of home office overheads are: managerial and administration salaries, lease/property taxes, insurance, telephones, computers, means of transport, travel costs, equipment and depreciation costs, costs related to bids and tenders, legal services, marketing, costs of common services (HR, quality, etc.).

The same as for SOOH, the contractor should know, as a part of cost management, the exact amount of these costs. Especially because the home office overhead is relatively fixed on a year level and should be allocated to a variable number of facilities.

The home office overheads are in the order of 5-8% of the contracted amount. They cannot be charged as a lump sum, but must be calculated using recognized formulas. There are dozens of formulas used to calculate the daily overhead. None of the formulas is exact. The best known formulas, named by authors, are shown in Table 1 [9], [10]:

Table 1. Home office overhead formulas

EMDEN	$\frac{TotalOverhead\ \&\ Profit}{TotalCompanyTurnover} \times \frac{GrossContractSum}{PlannedContractPeriod}$
HUDSON	$PlannedOverhead\ \&\ Profit(\%) \times \frac{OriginalContractSum}{OriginalContractPeriod}$
EICHLEAY	$\frac{TotalCompanyOverheadDuringActualContractPeriod}{TotalBillingsForActualContractPeriod} \times \frac{ContractBillings}{ActualDaysOfContratPerformance}$

It can be noted that formulas have a similar concept. The first part of the formula refers to the calculation of the overhead percentage. Depending on the author, this is the planned percentage, the realized percentage at the company level or the ratio of total overhead and turnover during the project. The second part of the formula is the planned or real daily monetary value of the contract. The resulting daily overhead value is multiplied by the days of delay. These formulas return different results and therefore are more or less popular with contractors and investors. The results are not always the largest according to one formula, and the smallest when calculated by other formula, but depend on the relationship of the specific input values, and above all on the relationship between real and planned overhead. In one study [9], a comparative overview of the obtained results was performed for a given set of data. The differences between the results are ± 30%, indicating the importance of knowing the different formulas and the need for the contract to specify the use of a single formula or an average value using multiple formulas.

It should be considered that in practice there were adjudications that do not recognize the application of formulas. Instead of applying a formula, the contractor must prove the costs through the actual engagement of the company's resources on a specific project, which is difficult to prove.

5.3 The cost of idle equipment

The cost of idle equipment is very important because it is often the largest individual cost within the contractor's claim due to delays resulting from the fault of the investor. In practice, different methodologies for calculating these costs can be found based on empirical formulas [11], manufacturer's manuals [12], [13], [14], experiential data and scientific literature [15], [16]. Depending on the applied methodology, the calculation of the total cost of idle equipment in practice varies in a ratio of 1:3. This problem is presented in detail in [17]. In this paper only the most important conclusions are presented. The costs of idle equipment are equal to the costs of ownership and include depreciation, interest and insurance costs.

Depreciation is the cost that accumulates in time, by continuously charging the working hours of the machine and in order to purchase a new machine. Depreciation as a physical category arises because, over time, the use of the machine becomes uneconomical. Depreciation is at the same time an annual accounting cost. There are different formulas for calculating depreciation costs [15]. The formulas are based on the purchase value of the machine (V), the economic life and the salvage value. The economic life is the number of years in which the use of the machine is profitable to the owner. Salvage value (SV) represents the value of the machine at the end of its economic life. Salvage value can be: 20% of purchase value, scrap metal value, zero value, etc. It can be concluded that, according to any methodology, depreciation is a finite process that is completed after a certain number of years, which means that funds have been accumulated for the purchase of a new machine. In other words, the cost of depreciation for old equipment does not exist or has been reduced multiple times due to the extended economic life.

Interest cost represents interest that the company regularly pays (or would pay) for the purchase of the machine through a loan. It can also be defined as the cost of capital tied at the value of the new machine [16]. Similar to calculating depreciation, different formulas can be found in literature. All formulas are correct and return relatively similar results. However, from the nature of the formulas, it can be perceived that they relate to the economic life, i.e. to the time period from the purchase of a new machine until the depreciation to salvage value. Similar to depreciation formulas, the question of the value of this cost arises after the depreciation period or after the loan is paid completely. For old machines, this cost does not exist if the machine is repaid or the cost is minimal, since the tied capital is equal to the residual value.

Insurance is a cost that relates to the case of fire, theft and accidents and is calculated as premiums on an annual basis [16]. In this type of cost, all fees related to the ownership of the machine, including storage costs (which are usually not recognized in the context of claims, but are realistically present), must be calculated. The cost of insurance is the most exact cost associated with the ownership of the machine, because it can be proved by the specific payments made for this purpose. Another method of calculating the cost of insurance is conducted using similar formulas as for the calculation of interest, while the percentage for interest in the formulas is replaced by the percentage for the insurance. This percentage is usually around 2% on an annual basis.

The problem that appears on projects is that the formulas found in the scientific literature are not used, but the popular empirical "BGL" formula is in use. BGL ("*BauGeräteListe*") is a German national service and database for construction machinery with technical and financial data on certain types of machines [11]. The reason for the widespread use of this formula is very simple, BGL procedure returns the highest values for the cost of idle equipment, so it is very popular with the contractors. The BGL procedure of the calculation implies the use of the following empirical formula:

$$K = \frac{100}{v} + \frac{p*n*100}{2*v} = \frac{100}{v}(1+\frac{p*n}{2}) \qquad (1)$$

Where: K-monthly percentage; v-economic life in months; p-percent for interest rate on the annual basis (6.5%); n-age of the machine. The total monthly cost expressed in money is K*V.

The first addend of the formula refers to the depreciation calculation and represents the percentage value of depreciation on a monthly basis. The problem is that this percentage does not depend on the age of the machine and is also valid for machines in which the process of depreciation has already been completed.

The second part of the formula refers to the empirical value for the combined value of interest and insurance. The problem is that in the formula, the age of the machine *n* is located in the upper part of the fraction, and the cost value increases with the age of the machine. This returns illogical results: with the greater age of the machine, the cost of interest and insurance is higher. This is in contrast to the logic and the recognized formulas from literature.

It can be concluded that the BGL calculation procedure is not appropriate because it favours contractors. Indirectly this is confirmed by the fact that there were arbitration rulings when only part of the calculated cost according to the BGL procedure (about 70%) was given to the contractors, with the emphasis on the fact that the arbitration did not determine the causes, but only indirectly admitted that something was wrong. Even the authors themselves indirectly admitted that there is illogicality by modifying the formulas in a recent version of the BGL procedure. Correction was introduced as follows: from the first to the tenth day of delays, full costs are charged according to the formula (1); from the eleventh day onwards, 75% of depreciation and interest and 8% of depreciation and interest on maintenance costs are charged. It should be noted that the values obtained by applying the BGL formula are correct for machines that are within their economic life. The problem is with the older machines that can often be found on projects in Serbia in a significant number.

In [17], a different approach is proposed, which consists of the following: rejecting the use of empirical formulas, since there are correct analytical formulas in literature, and further defining the formulas that are missing for the period after the economic life of equipment. This avoids the cost that does not actually exist and is included in most of the claims - the cost of depreciation and interest for machines that have passed the economic life. From the author's experience, in this manner, the costs of idle equipment are reduced to about a third. Those additions are shown in Fig. 3 in the form of recommended formulas. Input data are defined in the figure.

It can be noticed that there are two branches for the calculation, which depend on the age of equipment. The left branch refers to machines that are still in the economic life (M = 0), with appropriate formulas for calculation of depreciation, interest and insurance on an annual basis. Interest and insurance formulas vary only in annual percentage (i stands for interest rate; k stands for insurance).

The right branch refers to machines older than the economic life. Within the depreciation period, the period until full depreciation (M> M ') and after it (M <M') is different. In the first case there is no depreciation (D = 0), while in the second case, the depreciation is continued by the straight line method and calculated according to the duration of the delay (t / 365) and the salvage value remaining to be depreciated.

For the calculation of interest and insurance on an annual basis, an identical formula with an appropriate annual percentage (i 'and k) is proposed.

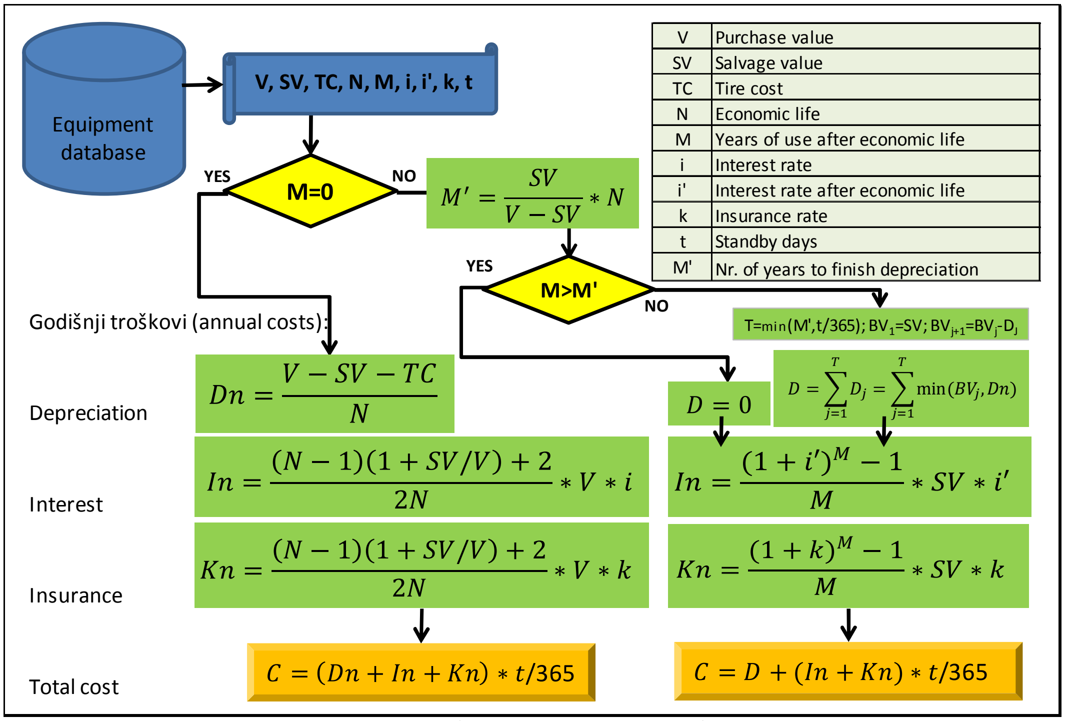

Fig. 3. Proposed procedure for calculating the cost of idle equipment

By applying the proposed methodology, the costs of idle equipment can be objectively and impartially calculated. If we take for an example the claims on the Corridor 10 project, the costs of idle equipment are reduced to about a third of the costs obtained using the BGL procedure, according to the ratio of newer and older machines on that project.

The engineers` approach made on an individual project within Corridor 10 project is also correct. This approach equates the economic life of the machine with the age of the machine and thus proportionally reduces depreciation and interest costs.

In any case, by defining the appropriate articles of the contract, the disputes about the cost of idle equipment, unnecessary arbitration processes and additional costs that accompany them can be avoided.

5.4 Overlapping of overheads and variations

As a rule, overlapping and double counting should not occur in a claim. A typical example is overlapping overheads in case there was a variation in the delay period. During the period of normal work and according to the contract it is usually allowed to collect overhead cost within the variation. However, when the delay occurs and the claim due to the delay arises, then the contractor is allowed for the reimbursement of the real costs only, not their duplication.

In Fig.4 different cases of overlapping of variations and contracted works are shown. The first period shows the normal flow of contracted works. In the second period contracted works and variations were taking place. In the first case, the overhead charge is justified (3), whereas in case of a variation double counting exists (1). The overhead should be proportionally subtracted in accordance with the formula in Fig.4. In the third period, the costs are overlapping (2), but this is usually granted by the contract, although there is at least the duplication of the major part of the overheads. Double counting does not occur only when completely new resources that do not use the existing site capacity are engaged for the variation. The greater the volume of variations, the more important this issue is. In any case, overlapping of the overheads and variations should be more precisely regulated in the contract in order to prevent double counting.

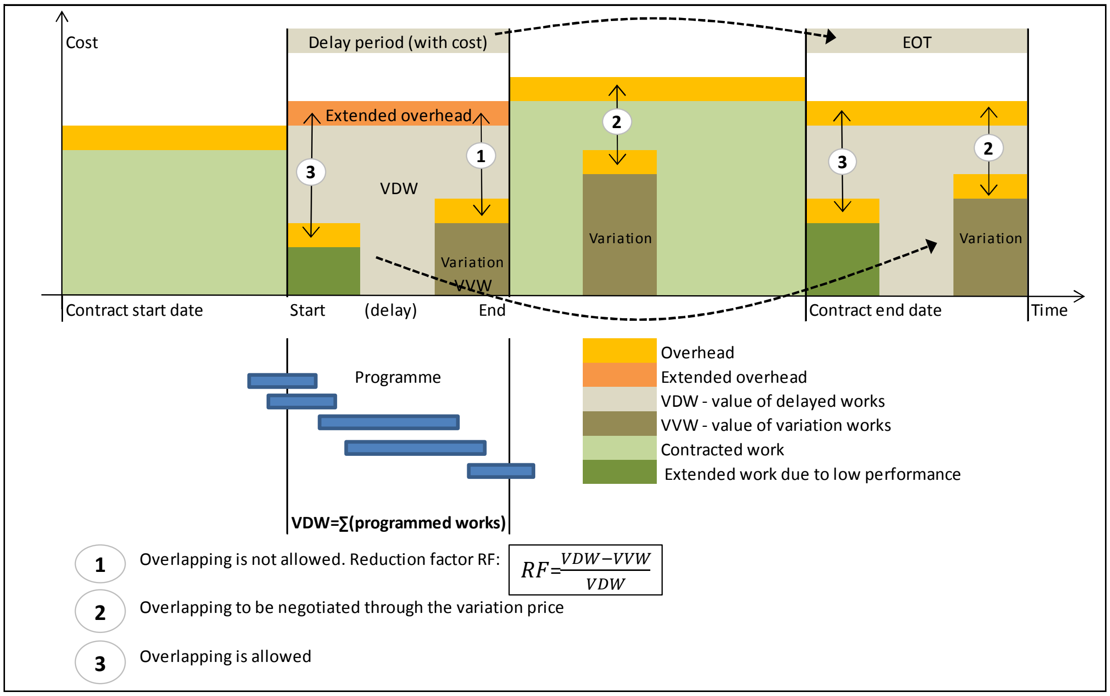

Fig. 4. Variations and contracted works overlapping

5.3 Special categories of costs

In addition to the already discussed categories of costs, special categories of costs that are speculative or often difficult to prove are often included in claims. These are:

Delayed cash-flow. The damage is based on the assumption that the contractor could make profit in case the works were executed as planned. In the claim, monthly differences of planned and realized inflows are multiplied by a certain interest rate. Usually, this cost is dismissed because it is speculative.

Lost profit due to delay. The damage is based on the assumption that the contractor would make a profit on another project in case the project was completed as the planned. Although there is logic in this claim, its proving is very difficult. The claim must: prove that there were tenders in which the contractor would participate, show the ratio of obtained projects and tenders, average profit on previous projects, etc.

Preparation of the claim, consulting, legal and other similar services. They are usually rejected as regular project management costs.

There is a possibility of some specific costs due to delay on the construction site, for example, replacing certain elements of construction due to the occurrence of rust, prolonged rental of temporary structures, land clearing operations after the delay, the cost of lighting and signalization, retesting, etc. If these costs are not covered by the contract in some other way, usually the costs of this type are recognized.

6. CLAIM PREVENTION

The claims are, in most cases, the manifestation of various omissions and mistakes made in the previous phases of the project, which are visible in the construction phase only. Even the problems related to the construction itself often have a root somewhere else: contract conditions, poor planning and preparation for work, etc. Bearing this in mind, for the prevention of claims, a responsible and quality management of the project is required. First of all, a proactive approach is needed to anticipate future problems and implement measures that will prevent them. By linking current decisions with future events, the integration of project phases is carried out in order to eliminate one of the biggest problems in construction projects - job fragmentation (focusing on tasks that are currently ongoing independently of previous and future ones).

The main objective of managing claims is to prevent or reduce the likelihood of their occurrence. Thinking ahead and anticipating potentially bad scenarios are a need, as well as the analysis of the most common causes of claims and implementation of preventive measures at an appropriate phase of the project, with simultaneous analysis of cost-effectiveness of applied measures. It is too late to wait for the execution of the works, then it is only mitigation of the already caused damage.

A good starting point for analysing the prevention of claims is an overview of their most common causes, from the perspective of investors and contractors. Common causes of claims - Investor responsibilities [2]:

- Delays in obtaining the construction permit and other necessary legal requirements,
- Late access to site,
- Delayed expropriation,
- Defects in the design documentation (changed soil conditions, errors, design detail, etc.),
- Inadequate involvement in the execution of works (sequence, technology ...),
- Non-decision and non-approval making (on drawings, proposals ...),
- Instructions for changes - variations,
- Delayed payments,
- Delay of the previous contractor,
- Poor coordination of multiple contracts,

Common causes of claims - the contractor's responsibility:

- Poor project management (planning and control),
- Poor productivity of people or machines (or insufficient number of those),
- Poor quality of works (repairs),
- Unavailable resources (materials, people or equipment) due to poor planning or procurement,
- Poor work of the subcontractor,
- Poor cost estimation (overhead, materials, transportation, customs, etc.), or poor time estimation.

Such an overview can serve as a basis for preventive measures planning in the initial phases of a project. It is important to understand that all participants have their share of responsibility for the emergence of claims, in accordance with their roles in certain phases. Fig. 5 shows the desirable level of engagement of the most important project participants on the prevention of claims, which is rarely found in practice. It can be noticed that the most can be done at the design phase by achieving the technical quality of the design for which the designer and project manager are responsible, as well as in the tender phase and contracting through the functional quality of contracts [18]. It can also be noticed that it is desirable to include the expert knowledge of the contractor in the design phase. This can be done through the implementation of tenders at the level of preliminary design or through the consulting service that the contractor can provide in that phase. In the tender and contracting phases, it is the responsibility of all participants to avoid problems with the appropriate contract articles or, at least, to prescribe a dispute resolution procedure that would lead to an earlier settlement of disputes.

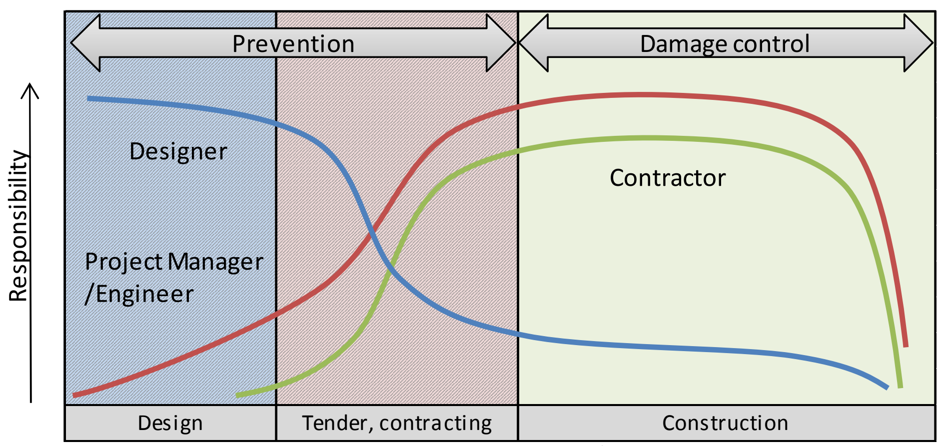

Fig. 5. Key project participant's responsibility for claim prevention

One of the problems is the avoidance of investors to choose an optimal and balanced contract strategy, bearing in mind the interest of a project that cannot be achieved „by force“ and by placing the contractor in an unfavourable position, as this significantly increases the probability of future problems and disputes. Another problem is the functional quality of the contract, i.e. the possibility of resolving disputes objectively and quickly by the application of the articles of the contract. In order to do this, engineers should take an active part in writing contract articles for which they will be in charge. For both parties it is important that the procedures are defined.

Early problem solving is very important for the quality of relationships between participants, because the project should be continuously realized in the best possible way, regardless of ongoing disputes. Delay of dispute resolution and the growing uncertainty of the final outcome inevitably cause negative consequences for current works. In Fig. 6 it can be seen that it is incomparably better to solve problems at the very beginning, by amicable settlement. It is precisely the lack of clear procedures for calculating the extension of time or for calculating costs that gives a false impression that better results will be obtained on arbitration. However, with the later resolution of the dispute, it is getting harder and more expensive, and the participants are more stubbornly holding their initial positions. They are often supported by consultants who profit from longer and more expensive disputes because they charge their services through time sheets or through a percentage of the settled dispute. In doing so, the interest of the project is sacrificed, that is, the works, despite disputes, should end as quickly as possible. As a rule, an agreement is better than mediation. It is necessary to realistically look at the costs and chances of success in arbitration. The costs of the dispute board (DB) amount to approximately € 200,000 and are borne by both parties in the amount of 50%. Arbitration is a process worth in millions and costs are borne by a losing party.

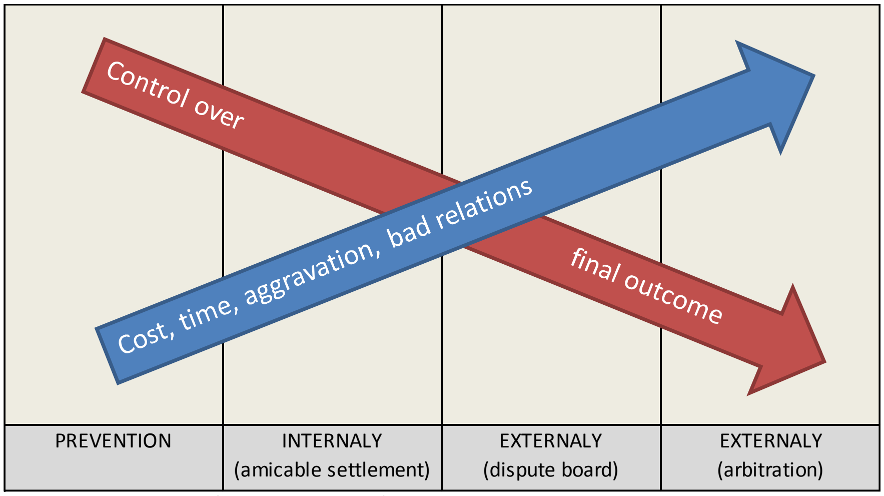

Fig. 6. Consequences of earlier and later claim resolution

6.1 Prevention of claims from the perspective of investors

From the perspective of the investor, the project is best protected from claims in the phases preceding the construction. Considering that the investor is the only one in the position to prescribe "rules of the game" on projects, he also has the greatest responsibility in claims prevention.

At the design phase of the project, risk management is most important because a claim can be considered as a consequence of the realization of a risky event. If it does not start at this phase, risk management loses its practical meaning. By applying known risk management techniques, potential adverse events can be defined by assessing the likelihood that they will occur and the extent of the damage they will cause. For recognized high-risk events, prevention measures and/or mitigation measures should be anticipated if they do occur. The logic is simple - put effort at the beginning to reduce the likelihood of damage (claim) occurrence. The implementation of preventive measures is the essence of risk management. After the implementation of the measures, it is necessary to estimate the level of residual risk, which must remain at acceptable levels (low or moderate).

The Table 2 shows a possible format for risk analysis. As an example, the last row refers to the risk associated with unrealized expropriation that can easily be converted into a claim. If controlling responsible institutions is carried out as a preventive measure, the risk will fall from the category of very high to moderate level. This form is of a qualitative nature because probabilities and damage are described at certain intervals. If specific percentage is assigned to the probability, and the monetary value is assigned to the damage, the risk analysis becomes quantitative. Risk quantification is, in fact, the calculation of the required contingency, which exists in some types of contracts as a special lump sum at the end of the bill of quantities.

Table 2. Qualitative risk analysis

Adverse event	Cause	Consequence	Probability	Severity	Risk level	Prevention measures	Remaining risk
Late permit	Late design	Claim	B	V	High	Design control	Moderate
Differing site conditions	Exploratory works	Claim	D	IV	Very high	Separate design and exploratory works	Moderate
Variations	Bad design solutions	Variation or claim	C	III	Moderate	Value engineering	Low
Late access to site	Late expropriation	Claim	D	V	Very high	Agency control, postpone contract	Moderate

In the design phase it is necessary to take into account the creative and technical quality of the design.

Creative quality is an optimal combination of design solutions that gives the best compromise in a technical, technological, economic, aesthetic or any other sense. In order to achieve creative quality, it is necessary to examine and compare different options and optimize design solutions in order to achieve the maximum ratio of invested money and the resulting value (or profit). For this purpose, it is necessary to avoid the practice of contracting the main design as soon as possible (design required for a construction permit). Instead, it would be better to examine several options at the level of conceptual solutions and optimize the selected option at the level of preliminary design. An ideal tool for optimizing the conceptual design is a value engineering study. Such an approach is supported by the Law on planning and construction through the Preliminary feasibility study (conceptual designs of options) and feasibility studies (preliminary design of the selected option) but is rarely used in practice in a proper way. By investing in better design, optimized and reliable budgets and quality individual solutions are provided that will not change in the phase of works execution, which usually causes negative consequences - additional works that are usually more expensive and can become a claim if there is no price agreement. The main design in this case is only the elaboration of previously defined solutions to the technical level that this level of design requires.

Technical quality of the main design is the precondition for the success of the tender procedure, obtaining quality bids and the undisturbed execution of works on the construction site [18]. Technical quality implies clearly described technology, uniformity of information (drawing-bill of quantities-technical descriptions), completeness of design details, bill of quantities accuracy, etc. Among other things, the technical quality is significantly influenced by the precision of the design briefs and the quality of the design input data which depends on exploratory works.

As an illustration of the importance of this topic, the correct procedure of contracting and delegating exploratory works is shown in Fig. 7. Design and exploratory works must be separated and contracted with individual firms. The design brief for exploratory works should be written by designers who would also control the exploratory works. In this way, it is ensured that the money is spent appropriately and purposely. The State of Serbia had high costs (and still has) because it entrusted design and exploratory works on Corridor 10 highway project to the same company while prescribing unrealistic short deadlines. As might have been expected, a minimum of funds was spent on exploratory works. That had catastrophic consequences because on a large number of locations a completely different soil has been found, which resulted in changes in technology, changes in design, delays, variations and claims.

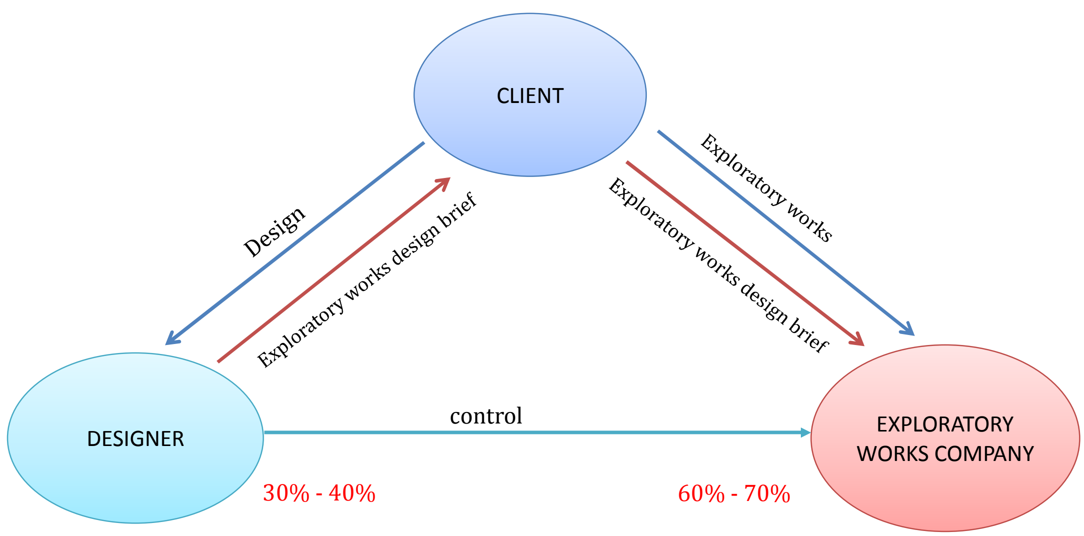

Fig. 7. Correct procedure for contracting exploratory works

The technical quality of the design would be positively influenced by using BIM for easier clash detection. The bill of quantities accuracy could be increased by commissioning two independent bills of quantities with the obligation of compliance. It would be useful to reduce the volume of design that was not elaborated when the tender was issued. Although it seems that this saves time, the uncertainty and the possibility of additional work is potentially much more harmful than time savings.

According to Fig. 5, the designers should be kept engaged on the project in the construction phase too. This can be achieved by arranging design supervision, and taking into account that it is not done arbitrarily but to functionally harmonize the procedures for amending the design documentation so as not to jeopardize the timing of construction works.

In the tender and contracting phase, it is necessary to select the optimal contract strategy first. It should be known that transfer of risk to the contractor is not a solution because it will lead to higher prices and increase the likelihood of disputes [2]. The choice of a contract strategy that is not natural (unit prices and measured quantities) will only temporarily delay the problems that will manifest during the construction phase through payment certificates, variations and claims. Therefore, it is recommended to avoid contracts with a lump sum and turnkey system (e.g.“yellow FIDIC“). Instead, it is better to take time to perform adequate preparation for a natural, traditional type of contract. Investors should be aware that the quantities and unit prices cannot be completely avoided by any type of contract, because they inevitably occur in disputes over progress measurement, payment certificates or the final settlement.

For the selected type of contract, the next job is to elaborate potentially bad scenarios (most frequent causes of claims) with the corresponding contractual provisions. Under the FIDIC contract, particular conditions have this role. The general conditions are absolutely insufficient; they just set the framework for the realization of the contract. There are other types of standard contracts that are more oriented on participant collaboration and risk sharing than the FIDIC approach that is based on resolving inevitable disputes [19]. Some of the newer types of contracts are: New engineering contract, Integrated project delivery, Construction management at risk, etc. It should also be noted that there are different approaches to tendering procedures that are not based on the lowest price. For example, performance-based tendering as opposed to a price-based tendering.

When establishing a contract strategy, as well as the strategy of realization, one should have in mind the results of a characteristic survey in which the most common causes of claims are identified [20]: increased pressure on the contractor's profit, poorly designed and implemented contracts, too much risk transferred to the contractor, inadequate involvement of investors, short deadlines or all listed above. In this regard, the investor must prepare and understand the project and the consequences of certain decisions. The following is needed [20]:

- Preparing for aggressive projects (33% chance for a claim, 7% if the project is not aggressive),
- Selection of an adequate contract strategy, restrain from transferring risk to the contractor,
- Ensuring an expert team for monitoring, controlling realization and proactively problem solving,
- Understanding field conditions, technologies and potential construction problems,
- Forcing amicable settlement, limiting the value of claims that go to the DB and to arbitration,
- Defining the burden of proving the justification of claims,
- Controlling the realization, requesting up-to-date and meaningful progress reports.

A particularly important topic in this regard is the level of investor engagement regarding the quality of the contractor's programme. Most standard contracts do not give enough importance to schedules. In practice, there is a problematic attitude of the investor that the programme is a matter for the contractor and that the contractual date of the completion of the works is only important. However, it can be said that it is correct only in the event that the project is completed on time and without any disputes, which almost never happens. As soon as changes occur in the project, or there is a dispute, a claim or delay, the schedule becomes the only basis for making a decision or judgment. Therefore, it is important for the investor to realize that it is important, in the evaluation of bids, to insist on a transparent schedule in order to understand the logic and reason behind the contractors' plans and provide the appropriate basis for resolving disputes [18]. It is necessary to prescribe the necessary data structure within schedules in the tender documentation:

- Strategy, technology, resource dynamics, key flows, short-term plans, daily performance, etc.,
- Equipment data (performance, cost, economic life, etc.),
- Subcontractor's schedules,
- EOT due to delays (procedures, making up for delays, mitigation measures, etc.),
- Ownership of floats, use of the buffers in front of key flows,
- Form of monthly reports, control of works (progress measurement, trends, corrective measures),
- Innovation of programmes (a procedure that allows re-planning before granting an EOT).

In the construction phase the investor should take a proactive role and anticipate future problems, instead of responding to problems when they occur [1]. First of all, the investor needs to fulfil his obligations under the contractual programme: expropriation, obtaining licenses, access to site, financing according to the contract, etc. In addition, it is necessary for the investor to: perform the administration of the contract, not make decisions outside the framework of the contract, keep up-to-date written communication, quickly respond to the correspondence of the contractor, quickly make decisions and control the realization.

In case of claims from the contractor, the investor must know all the quantification methods described in the previous sections because of the large differences that can occur in the calculations. In general, it is best to resolve the claims in an early phase by amicable settlement in order to minimize the impairment of relationships on the construction site due to uncertainty about the final outcome of the dispute.

6.2 Prevention of claims from the perspective of contractor

From the perspective of the contractor, the prevention of claims also begins with **risk management** that takes place in the same way, only the risks and measures of prevention are different. The most important task for the contractor is to review the tender documentation and make the most important decision on the project: whether to participate and how the bid should be formed taking into account the potential risks. The decisions made by the investor regarding the model of the contract and the quality of the design play a major role in this phase. Poor design and the turnkey contracts will have a completely different impact on the performer's bid in relation to traditional contract and technical quality design. Risk analysis is also influenced by the anticipated procedures for EOT and reimbursement of costs, the type of costs that can be compensated and the method of calculation, the level of the necessary site documentation that serves as material evidence, the manner in which mitigation is defined, the rights and obligations of supervision, etc. In the contracting phase the contractor should try to negotiate on poorly defined or missing articles.

In the context of the formation of a feasible and reliable bid, **planning** plays a key role in the development of a programme with price analysis, the dynamics of resource engagement, the cyclogram and the dynamics of the necessary and available funds arising from a contractual anticipated method of payment and the required guarantees. For its own needs it is necessary for the contractor to carry out a short-term planning (daily and weekly) with the calculation of work force productivity. The schedule, as a measure of prevention, should contain the key activities of the investor: access to site, licenses, design details, etc.

In the **construction phase,** regardless of the contractual provisions, for its own success on the project, it is important for the contractor to establish a **proper control cycle** that includes: a short-term plan, progress measurement, establishing trends (e.g., earned value method) and the implementation of corrective measures to alleviate possible disturbances of planned performance. Control of the work of subcontractors is equally important. Another aspect of preventing claims is related to the administration of contracts, written communication and up-to-date site documentation. Contract administration means its detailed understanding, performing activities strictly under the contractual procedure and refraining from any activities without adequate documentation. Communication refers to the prompt submission of appropriate notices (requests for information, notice to claims, etc.) which provides a procedural basis for future claims. Construction documentation (site log, receipt for site overheads, monthly reports, etc.) is the necessary material proof for the quantification of claims.

In the event of a claim, the contractor, as well as the investor, must know all the quantification methods described in the previous sections because of the large differences that can occur in the calculations. As for the investor, it's also best for the contractor to settle the claim in an early phase with amicable settlement so as to establish the foreseeable rhythm of the works as soon as possible on the construction site.

7. RECAPITULATION AND RECOMMENDATIONS

Quantification of time, which is determining the number of days of EOT, is important because it directly determines the total monetary value of the claims as the costs are calculated at the daily level and multiplied by the number of days. The calculation is complex, there are more legitimate methods that are not completely exact and return different results. The best, most complicated and most precise method is the window method, because it only monitors the dynamics of the change of the critical path on the project. It should be borne in mind that for large disturbances, no methods give the right picture, so in that case it is best to perform re-planning of the remaining works. It is recommended that the contract specifies the use of window method for minor disruptions, and re-planning in case of major disruptions.

In order to further reduce the uncertainty about the outcome of the claims, it is necessary to define in the contracts the ownership of the float, the measures for mitigating the damage and to encourage the proactive role of the Engineer. To this end, it is recommended to use special activities in schedules as temporary reserves (buffers) that are undisputedly owned by the contractor, that the contractor and Engineer commit at the beginning of a delay to harmonize the mitigation measures and to add articles in the contract which commit or motivate the Engineer to a proactive approach in giving instructions to mitigate the consequences of disruption in the realization.

It is mutually beneficial to insist in the tender documentation on a transparent and mutually agreed programme that contains key elements of short-term planning and control mechanisms, as this reduces the possibility of manipulation, uncertainty and unnecessarily long exhausting disputes about the impact of the disruption on the critical path.

Cost quantification also requires that appropriate methods be prescribed in contracts. For the site overheads, it is necessary to have regular supporting documentation for time-dependent costs. One of the acceptable formulas or the average value of the three most commonly used formulas should be prescribed for the head office overheads. Special attention should be paid to the contractual definition of the calculation of the costs of idle equipment. This paper presents an original and impartial calculation method that eliminates the drawbacks of existing approaches in the case of older equipment. It is necessary to define the unallowed and unauthorized overlapping of overheads with variations.

The most important elements of quantification, to be regulated in contracts, are shown in Table 3.

Table 3. Quantification of claims – the most important elements

TIME precondition			COST			
Programme	Small impact	Big impact	SOOH	HOOH	Idle equipment	Variations
links, flows, performance, buffers	window method	re-planning	proof criteria	average of 3 formulas	formulas for older equipment	prevent overlapping
DEFINE CONTRACT CLAUSES						

Prevention of claims requires a proactive approach to project management in the early phases of project execution: project concept, design, tender procedures and contracting.

From the perspective of the investor, the initial phases of the project are crucial. In the conception phase, quantified risk management should be carried out, including the implementation of preventive measures. In the phase of conceptual design, creative quality should be achieved by examining multiple options and optimizing the selected one. The main design should insist on technical quality as a precondition for quality bids and uninterrupted execution of works. The specific contractual provisions should allow the availability of expert knowledge of the contractor at the design stage as well as ensuring the functional presence of the designers in the construction phase. The investor should avoid forced deadlines and prices, risk transfer and contracting strategies that deviate from the traditional (unit price and measured quantities) because it will only temporarily delay the problems that will manifest in the construction phase through payments, variations and claims.

From the perspective of the contractor, the claim prevention is also a matter of project management. In this case, risk management is in the phase of reviewing the tender documentation and bidding. The most important job for the contractor as part of forming a bid is quality planning, and in the construction phase it is the control of the execution of works. In the construction phase, written communication is important for both participants. The contractor should promptly deliver the notices and requests, and the investor should respond quickly to them. Disputes need to be resolved at the very beginning before they escalate. The most important elements of the prevention of claims are shown in Table.4.

Table 4. Claim prevention – main elements

<table>
<tr><th></th><th colspan="2">CLIENT</th><th colspan="2">CONTRACTOR</th><th>ENGINEER</th></tr>
<tr><td>PROJECT CONCEPT</td><td colspan="2">Risk management</td><td colspan="2" rowspan="3"></td><td rowspan="4"></td></tr>
<tr><td rowspan="2">DESIGN</td><td colspan="2">Creative quality, options, VE</td></tr>
<tr><td colspan="2">Technical quality</td></tr>
<tr><td rowspan="3">TENDERING, CONTRACTING</td><td colspan="2">Contracting strategy</td><td colspan="2">Risk management</td></tr>
<tr><td></td><td colspan="3">Project planning</td><td rowspan="5">Involved proactively</td></tr>
<tr><td colspan="3">Contracting</td><td></td></tr>
<tr><td rowspan="3">CONSTRUCTION</td><td></td><td colspan="3">Project control</td></tr>
<tr><td colspan="4">Written communication</td></tr>
<tr><td colspan="4">Amicable settlement</td></tr>
</table>

8. CONCLUSION

Claims are a very important topic because their monetary value can be very large and the quantification is not exact and ranges in practice in 1:3 ratios depending on the applied methods. Therefore, they can decisively affect the final financial result of the project. This paper presents an overview of the most important elements of time and cost quantification and the prevention of claims and its contribution is reflected in the recommendations for application on projects. It should be emphasized that all the recommendations given in this paper must be incorporated into the contractual provisions so that they can be applied, so it is one of the most important messages that engineers should have to take an active part in writing contract documents, which is otherwise rare case on construction projects. The application of the proposed prevention measures significantly reduces the likelihood of claims occurring. If, however, claims occur, the application of the proposed quantification methods will accelerate the process of settling claims and reduce the likelihood of ending in court arbitration.

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