SMART CONTRACTS TECHNOLOGY AND AVOIDANCE OF DISPUTES IN CONSTRUCTION CONTRACTS

Cristian Răzvan RUGINĂ[*]

Abstract

Claims and disputes had become endemic in the construction industry and, in spite of the continuous developments of the standard forms of contracts and consensual dispute resolution schemes from the past years, there is no indication that the incidence of claims and disputes is decreasing. Traditionally it is considered that the most often contractual disputes result from inappropriate or unclear risk allocation in the contract, or from breach of contract. However, recent studies suggest that these are only the apparent causes of disputes, the most profound one being the improper behavior of the parties involved in the contract determined by their asymmetric information and conflicting interests regarding the contract. This paper analyzes the most popular disputes avoidance methods and techniques currently used in construction industry, the most common causes of construction disputes, the behavioral risk as the main source of construction disputes, and how the available information and digital technologies would be embraced in the near future to prevent the disputes in construction contracts in an efficient manner.

Keywords: *construction contracts, avoidance of disputes, technology, smart contracts, blockchain, Building Information Modeling (BIM).*

1. Introduction

Prevention of claims and disputes is a constant preoccupation of the professionals involved in the construction industry, an industry known, *inter alia*, for its adversarial culture. In spite of the continuous development of methods and techniques used for avoidance of such claims and disputes, their number remain significant, involving substantial resources for their settlement.

This paper analyses the methods and techniques currently used in the construction industry for avoidance of contractual disputes, the most common causes of these disputes, and how the information technologies developed in the recent years may help the contracting parties to prevent the disputes in construction contracts in the near future.

2. Methods and techniques currently used in the construction industry for avoidance of contractual disputes

2.1. Standardisation of construction contracts and balanced allocation of risks

The practice of using standard forms of contract for construction and engineering projects is credited to have its origins in the nineteenth century in England. The early editions of *Hudson"s Law of Building, Engineering and Ship Building Contracts,* such as the one published in 1895, contained standard forms of construction and engineering contract prepared by the War

[*] Ph.D. Candidate, Faculty of Law, "Nicolae Titulescu" University (e-mail: razvanrugina@gmail.com).

Department, the Builders" Association and the Institute of British Architects, and the London County Council[1].

In the UK standard forms of construction and engineering contracts are produced by a number of industry bodies. The most widely used form of construction contracts are the contracts in the Joint Contract Tribunal ("JCT") suite, the New Engineering Contract ("NEC) suite, and the suite of contracts published by the Institution of Civil Engineers ("ICE")[2]. Standard forms of contract are also produced by other English industry bodies including the Association for Consulting and Engineering ("ACE"), the Royal Institute of British Architects (the "RIBA"), the Institution of Chemical Engineers ("IChemE"), the Institution of Mechanical Engineers ("IMechE"), and the Royal Institute of Chartered Surveyors ("RICS"). Domestic government contracts are often in a form from the General Conditions for Works Contracts suite ("GC/Works")[3].

In international construction and engineering projects it is common for parties to use standard forms of contract produced by the International Federation of Consulting Engineers ("FIDIC"). Moreover, in several countries from Central and Eastern Europe (including Romania), the FIDIC standardised conditions of contracts became mandatory elements of local public procurement law[4].

In addition to the standard forms produced by the aforementioned entities, it may be noted that there are a number of institutional bodies or governments which produce standard form construction and engineering contracts that are used widely in those jurisdictions. These include (among many others) the European International Contractors ("EIC"), the Canadian Construction Documents Committee, the Swiss Society of Engineers and Architects, the Swedish Construction Contracts Committee, the Danish Construction Association, the German DVA, the Joint Contracts Working Committee (Hong Kong), the Hong Kong government itself, the Singapore Institute of Architects ("SIA"), the Engineering Advancement Association of Japan ("ENAA"), the International Chamber of Commerce, and the World Bank.

The most widely used form of construction contracts in Romania in both private and public projects are the contracts in the FIDIC suite. For a certain period the use of FIDIC conditions of contracts for public works was mandatory for the public authorities[5]. However, the FIDIC standardised forms were replaced in 2018 by

[1] J. Bailey, *"Construction Law"*, Routledge, 2011, page 116.

[2] In August 2010 ICE announced that it is withdrawing from the ICE Conditions of Contract following the ICE Council's decision in 2009 to solely endorse the NEC3 Suite of Contracts.

[3] J. Bailey, *op. cit.*, page 123.

[4] L. Klee at al., "International Construction Contract Law", Wiley Blackwell, 2015, page 93.

[5] The obligation for public authorities to use the FIDIC conditions of contracts for public works was firstly introduced in the Romanian public procurement law by the Common Order no. 915/465/415/2008 for the approval of general and particular conditions of contracts at the conclusion of the contracts of works issued by the Ministry of Economy and Finance, Ministry of Transporation and Ministry of Development, Public Works and Houses, subsequently abrogated by Order no. 1059/2009 issued by the Romanian Ministry of Public Finance. The obligation to use the FIDIC conditions of contracts was reintroduced by the Government Decision no. 1405/2010 regarding the approval for the use of some conditions of contract of the International Federation of Consulting Engineers (FIDIC) for the investment objectives from the field of transportation infrastructure of national interest financed by public funds.

the national standard construction contracts conceived by the Romanian Government[6].

The common purpose of standard construction and engineering contracts is to provide a coherent and predictable framework for the performance of the contract works, the making of payments, the administration of the contract and the project, and the determination or adjustment of the parties" respective rights and obligations. In this regard the issuing professional bodies put a great emphasis on the clarity of contractual provisions and procedures concerning such matters as the contractor"s scope of works (and the quality of works required), the contract price and the timing and amount of payments, the contractor"s time for completion and the effects of delay, the ordering and performance of variations, insurance, taking-over, guarantees and dispute resolution.

The cornerstone of the said standard construction and engineering contracts is the idea that a clear and balanced pre-allocation of responsibilities between parties in respect of certain risks that may transpire during the contract"s execution is determinant for the avoidance of prolongation of construction completion times, of wastage of resources, and of disputes.

In this respect in the construction literature it was emphasized that[7]: *"Proper risk identification and equitable distribution of risk is the essential ingredient to increasing the effective, timely and efficient design and construction of projects. If the parties to the construction process can stop thinking in an adversarial manner and work in a cooperative effort towards obtaining an equitable sharing of risks based upon realistic expectations, the incidence of construction disputes will be significantly reduced."*

In the same manner, pursuant to another opinion[8]: *"In practice, an inefficient allocation (of an unclear risk or of a risk that the party is not able to control) will result in speculative claims, disputes, or even contractor bankruptcy."*

From this perspective, it is considered[9] that, *"provided they are not significantly altered"* by the parties, the standard construction and engineering contracts *"guarantee a balanced and efficient risk allocation"* and, thus, a reduced likelihood of disputes to the benefit of the parties.

Standard contracts provide risk allocation solutions for, *inter alia*, natural risks (such as unforeseeable physical conditions, exceptionally adverse climatic conditions or natural catastrophes such as earthquake, hurricane, typhoon or volcanic activity), political and social risks (such as war, hostilities, invasion, rebellion, terrorism, revolution, insurrection, civil war, riot, commotion, disorder, strike, or lockout), economic and legal risks (inflation, shortage of materials, equipment or labor, changes in legislation), assigning responsibilities and liabilities to each contracting party regarding performance of works, organisation, time frames,

[6] The Government Decision no. 1/2018 for the approval of general and particular conditions of contract for certain categories of public procurement contracts related to the investment objectives financed by public funds replaced the former standardised public procurement contracts based on FIDIC conditions of contract, previously mandatory for the road and railway infrastructure works only, with new ones, extending in the same time their applicability to all the investment objectives financed by public funds.

[7] B. Shapiro, "Transferring Risks in Construction Contracts", 2010, page 5, available at: http://www.shk.ca/wp-content/uploads/2013/02/Transferring-Risks-in-Construction-Contracts-BSS.pdf.

[8] L. Klee et al., *op.cit.*, page 18.

[9] L. Klee et al., *op.cit.*, page 18.

guarantees, insurance, errors in technical documentations and payment.

2.2. Consensual forms of dispute resolution

For a significant period, the disputes resulted from construction and engineering contracts used to be referred to courts or arbitration.

The substantial length and costs related to these dispute resolution processes made the parties to resort to them only towards the end of a construction project, when the works were completed or nearing completion. As it was noted in the construction literature[10]: *"To invoke a formal dispute resolution procedure mid-way through a project has the potential to divert vital resources from the continuation of the project works, at the expense of progress."*

On a different note, in the same time, in the construction projects with a higher degree of complexity, the parties were often confronted with the lack of an efficient tool for the settlement in due course of the various contractual disagreements affecting the contemplated progress of works.

This situation led to the development in the last decades of consensual forms of dispute resolution that seek to achieve a consensual resolution of a dispute, rather than a resolution of a dispute through the determination or assessment of the parties" rights and obligations by a court or an arbitral tribunal. It was believed that a resolution of disputes by non-adversarial means or, at least, by adversarial process of a kind pre-agreed by parties, conducted by experienced construction and engineering specialists instead of persons not so familiar with technical matters (*e.g.* by judges or lawyers), will lead to the voluntary and quick compliance of the parties with the solutions established by consensus and/or with the decisions issued by the said specialists to the benefit of the contract.

In this respect, these days, the construction and engineering contracts contain dispute resolution provisions that regulate the conditions, steps, procedures and timelines which must be observed by parties for settlement of their disagreements. Such provisions commonly involve the notification of a dispute by an aggrieved party, followed by participation of the parties in a non-adversarial process (*e.g.* negotiation, conciliation, or some other form of attempted resolution), and in case the dispute is not resolved by agreement, the dispute is then to be resolved by an adversarial form of dispute resolution (*e.g.* expert determination, dispute board, arbitration or litigation).

For instance, FIDIC conditions of contracts provide that all contractual disputes are to be adjudicated in the first instance by a dispute board. The dispute board, called the "Dispute Ajudication Board (DAB)", "Dispute Board (DB)" or "Dispute Avoidance/Adjudication Board (DAAB)", normally comprises three (3) independent and impartial highly experienced engineers appointed by parties at the beginning of the contract. The scope of the DAB/DB/DAAB is to maintain the awareness of progress and potential problems by regular visits on site, as well as to ensure the resolution of disputes at an early stage. The DAB/DB/DAAB"s decision on a dispute is obtainable within 84 days from reference to decision, is contractually binding with immediate effect, and becomes final and binding unless at least one of the parties challenges it by giving the other party notice of its dissatisfaction with the decision within 28 days from the issue of the

[10] J. Bailey, *op. cit.*, page 1422.

decision. If the decision becomes final, it cannot be further challenged by either party at arbitration.

Thereafter, pursuant to FIDIC conditions of contracts, before commencement of arbitration, the parties shall attempt to settle their dispute amicably. As far as the scope of the amicable settlement stage is concerned, the construction literature[11] noted that this is mainly: "*to ascertain whether there is sufficient common intention to try to avoid the necessity of arbitration by seeking a mutually acceptable settlement.*" Since at this stage the parties have already a determination of their dispute by the DAB/DB/DAAB, it is supposed that they have sufficient elements to negotiate and reach an agreement in good faith.

The final stage of dispute resolution mechanism provided by FIDIC conditions of contracts is the referral of dispute to arbitration.

Last but not least, it is noteworthy that by the Romanian national standard construction contracts, which replaced the FIDIC conditions of contracts in public works in 2018, the dispute resolution provisions switched from the FIDIC philosophy of dispute resolution back to the classical pattern, involving the notification of dispute by the aggrieved party (by a so-called "notice of disagreement"), followed by parties" attempt to settle the dispute by a non-adversarial process (by direct negotiation or by mediation), and in case the dispute remain unresolved, its referral to arbitration.

2.3. Relational contracting. Alliancing contracts

Relational contracting or relationship contracting arrangements aim to minimize disputes by recognizing and developing common interests among contracting parties. Project participants are encouraged to proactively manage and resolve conflicts and problems, targeting common objectives and reduced transaction costs.[12]

One of the most recognized modes of relational contracting is alliancing.

As it was noted in the construction literature[13]:

"In an alliancing model, the parties effectively abandon traditional rights of action, other than in limited circumstances. Their interests are aligned by a preagreed equitable sharing of risks and rewards in such a way that the parties are stimulated to collaborate to achieve maximum profit in relation to the delivered value."

The key difference between traditional contracting methods and alliance contracting is that while the traditional contracting methods are based on the philosophy of fair and balanced allocation of risk to the parties, specific risks being allocated to parties who are individually responsible for managing the risk and bearing the risk outcome, in alliancing all project risk management and outcomes are collectively shared by the participants.

Alliance contracts generally include a so-called "no-blame" or "no disputes" clause where the parties agree not to litigate, except in limited circumstances. The intention of this approach is to avoid the

[11] E. Baker, B. Mellors, S. Chalmers, A. Lavers, *"FIDIC Contracts: Law and Practice"*, Informa Law, 2009, page 541.

[12] M.M. Rahman, M.M. Kumaraswamy, *"Joint risk management through transactionally efficient relational contracting"* in *Construction Management and Economics (online)*, Taylor & Francis (Routledge), vol. 20(1), pages 45-54.

[13] J.S.J. Koolwijk, "*Alternative Dispute Resolution Methods Used in Alliance Contracts*" in *Journal of Professional Issues in Engineering Education and Practice*, January 2006, page 44.

adversarial or “claims-based” culture of the traditional construction and engineering contract, and in turn encourage the parties to find solutions to problems, rather than to deny responsibility and seek to blame others. To give effect to this, alliance contracts have traditionally not included a formal dispute resolution procedure but sets up a model of agreed behavioural principles to drive decision-making processes and issue resolution instead, serving to align the parties” objectives in relation to the project and reduce the risk of litigious disputes between the parties.

Generally, the alliance disagreements and disputes are resolved exclusively by the alliance leadership team, the emphasis being put on resolution by agreement, and not by resolution by reference to an independent person (*i.e.* a judge, arbitrator or expert). In this manner, the absence of an independent dispute resolution mechanism and, in particular, of a dedlock-breaking contractual mechanism compels the members of alliance leadership team to make their best endeavours to resolve disagreements themselves. In the exceptional circumstances in which the alliance leadership team is unable to resolve a disagreement, despite pursuing all reasonable opportunities to remedy it, the parties to the alliance may agree to termination.

The alliance cases analyzed in the construction law literature[14] revealed that parties to a project alliance adopted various approaches in their attempt to prevent disputes and motivate the alliance parties working together to achieve the same goals.

For instance, th*e Acton Peninsula Alliance* was formed for the construction of the National Museum of Australia in the city of Canberra, Australia. In this project the parties have agreed to use a “no-blame” clause, waiving their rights to go to court or arbitration over a dispute. Only in case of an event of willful default by an alliance partner the “no-blame” clause could have been bypassed. However, no disputes were actually brought in front of a court or referred to arbitration in connection with the said project.

Another alliance, the *Waardse Alliantie,* was formed for the construction of a railroad project in the south of the Netherlands. In this project, when a dispute came up it was referred to the alliance leadership team to be resolved by negotiations. Whenever the alliance leadership team was unable to resolve a disagreement, the dispute was referred to minitrial, judged by a panel of “wise men” appointed by the alliance parties. The decision taken in this regard by the panel was non-binding for the parties, yet it was further discussed by the alliance leadership team, which subsequently tried to solve the dispute internally. If one of the alliance parties could not agree with the non-binding resolution, that party could refer the dispute to arbitration, seeking a binding solution. No disputes were referred to arbitration in this project.

Unlike traditional contracting, only a limited number of standard form alliancing contracts are available, including the NEC4 Alliancing Contract, TAC-1 (Term Alliance Contract) and FAC-1 (Framework Alliance Contract)[15], the last two being published by the Association of Consultant Architects and King”s College London.

[14] J.S.J. Koolwijk, *op.cit.,* page 45-46.

[15] TAC-1 (Term Alliance Contract) and FAC-1 (Framework Alliance Contract) are published by the Association of Consultant Architects and King’s College London.

3. The most common causes of construction disputes in the recent years

Claims and disputes had become endemic in the construction industry and, in spite of the continuous developments of the standard forms of contracts and consensual dispute resolution schemes from the past years, there is no indication that the incidence of claims and disputes is decreasing.

In the attempts to identify the most proeminent causes of disputes, exhaustive studies and research into causes of disputes were conducted in the construction literature, being considered[16] that: *"Identifying common causes and consequences of unresolved conflicts and claims would allow for more effective dispute avoidance as well as more efficient resolution of "unavoided and unavoidable disputes""*. The results of these studies were centralized by P. Fenn[17] (please refer to Figure 1 below).

However, as noted by another author[18], the direct comparison of these results is "neither possible nor useful, because of the diverse industry cultures and differing methodologies and terminologies used in data collection, analysis and outcome presentation".

Emphasizing the need for a deeper analysis of the causal connection between conflicts, claims and disputes, in 1997 M.H. Kumaraswamy conducted a questionnaire survey on sixty-one (61) contemporary construction projects in Hong Kong[19], identifying the root and proximate causes of construction claims and disputes (please refer to Figure 2 below). The findings of the survey revealed a new perspective over the causes of disputes, *i.e.* that the behaviour and actions of the contracting parties play a major role in the apparition of disputes.

[16] G. Younis, G. Wood, M.A.A. Malak, *"Minimizing construction disputes: the relationship between risk allocation and behavioural attitudes"* in *Construction Management and Economics (online)*, Taylor & Francis (Routledge), vol. 20(1), page 732.

[17] G. Younis, G. Wood, M.A.A. Malak, *op. cit.*, page 731 (adapted from P. Fenn, *"Rigour in research and peer review"*, in *Construction Management and Economics*, 1997, vol. 15, pages 383-385, and P. Fenn, (2006) *"Conflict Management and Dispute Resolution"*, in D. Lowe, and R. Leiringer, *"Commercial Management of Projects"*, Blackwell Publishing, Oxford, pages 234-269.

[18] M.H. Kumaraswamy, *"Consequences of construction conflict: a Hong Kong perspective, Journal of Management in Engineering"*, 1998, vol. 14(3), pages 66–74, cited in G. Younis, G. Wood, M.A.A. Malak, *op. cit.*, page 731.

[19] M.H. Kumaraswamy, *"Conflicts, claims and disputes in construction engineering"*, in *Construction and Architectural Management*, 1997, vol. 4(2), pages 95-111.

Last but not least, other authors as G. Younis, G. Wood, and M.A.A. Malak[20], and P. Mitropoulos and G. Howell[21] structured the causes of disputes in three (3) basic elements: project uncertainty, contractual issues and opportunistic behaviour.

While the project uncertainty is trying to be mitigated by the pre-allocation of risks between contracting parties, and the disagreements resulted from imperfections of contracts are expected to be mitigated by the multi-tiered contractual dispute resolution schemes, there are little remedies against the opportunistic behaviour of the contracting parties.

Figure 1 - Categorising Causes of Dispute (adapted by G. Younis et al. from P. Fenn)

Al Momani [15]	Causes of delay: poor design, change orders, weather, site conditions, late delivery, economic conditions, and increase in quantity.
Alkass *et al.* [16]	Strikes, rework, poor organization, material shortage, equipment failure, change orders, act of God.
Bristow and Vasilopoulous [17]	Five areas unrealistic expectations: contract documents, communication lack of team spirit and change.
Colin *et al.*[18]	Six areas: payment, performance, delay, negligence, quality and administration.
Diekmann *et al.* [19]	Three areas: people, process and product.
Heath *et al.* [20]	Seven areas: contract terms, payment, variation, time nomination, re-nomination and information.
Hewit [21]	Six areas: change of scope change conditions, delay, disruption, acceleration and termination.
Kululanga *et al.* [22]	Four sources of dispute: (1) errors, defects and omissions in the contract documents, (2) underestimating the real cost of the project in the beginning, (3) changed conditions and (4) stakeholders involved in the project.
Madden [23]	Three categories: legal, technical and quantum.
Molenaar *et al.* [24]	Three categories: people issue, process issue and project issues.
Rhys Jones [25]	Ten areas: management, culture, communications, design, economics, tendering pressures, lay, unrealistic expectations, contracts and workmanship.
Semple *et al.* [26]	Four areas: acceleration, access, weather, and changes.
Sykes [27]	Two areas: misunderstandings and unpredictability.

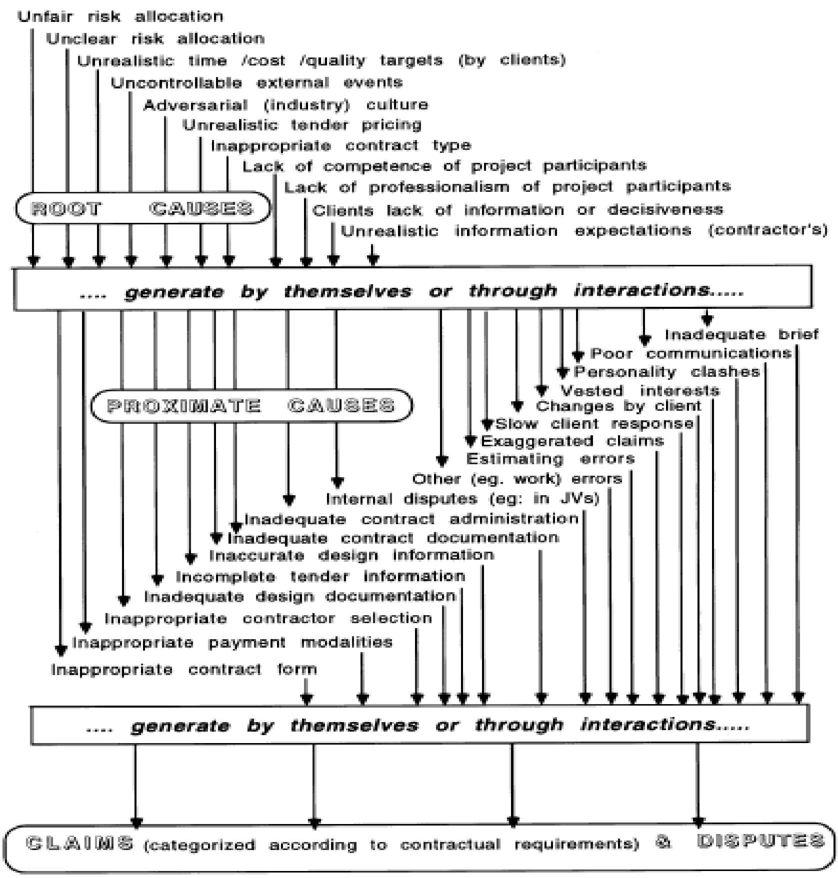
[20] G. Younis, et al., *op. cit.*, page 731.

[21] P. Mitropolous, G. Howell, *"Model for understanding, preventing and resolving project disputes"*, in *Journal of Construction Engineering and Management*, 2001, vol 127(3), pages 223-231, cited in G. Younis, G. Wood, M.A.A. Malak, *op. cit.*, page 731.

4. Opportunistic behaviour in construction contracts. The agent-principal theory

From the legal perspective, the contracts are governed by the principle of *Pacta sunt servanda* according to which any agreement based on the consent of the parties to it, is binding, and must be executed in good faith.

Figure 2 - The Root and Proximate Causes of Disputes (pursuant to M.H. Kumaraswamy)



However, as construction and engineering literature noted[22], once a contract is concluded the situation of the parties changes in one of bilateral dependence. This bilateral dependence together with the cost of using the legal system to arbitrate contractual disputes and the cost of an eventual termination of the contract favours the apparition of opportunistic behaviour whereby the parties pursue to improve their economic position, deviating from the initial understanding from the conclusion of contract[23].

The academic literature defined the "opportunistic behaviour" as "an act or behaviour of partnership motivated by the maximization of economic self-interest and occasioned loss of the other partners"[24], or as "the behaviour when the agent can provide the principal with incomplete or distorted information, can pursue self-interests notwithstanding formal and conventional norms, and make profit regardless the owner"s interests"[25].

The reasons and circumstances that favours the opportunistic behaviour of the contracting parties have been extensively studied by the economic literature within the so-called "principal-agent theory".

Agency relationships, in which one party (the principal) delegates work to another (agent), are the cornerstone of economic life. In construction field common examples of agency relationships include employer (principal) and contractor (agent), employer (principal) and engineer (agent), contractor (principal) and subcontractors (agents), employer/ engineer/ contractor (principals) and their employees (agents).

The principal-agent problem (also known as "agency dilemma" or the "agency problem") typically arises where, due to the contrary interests and information asymmetry of the parties, the agent does not act in the best interest of the principal. The information asymmetry, defined as any situation where "the principal and the agent are not in possession of the same information at the same time"[26], include hidden characteristics, hidden information, and hidden intentions.

Generally, the literature[27] considers that there are two (2) types of opportunism: (i) the "ex-ante opportunism" which may occur when an agent misrepresents its qualifications or abilities, or submit abnormally low bids before entering into the desired principal-agent relationship, normally referred to as "adverse selection", and (ii) the "ex-post opportunism" which may occur after the contract conclusion where the agent is not putting in the agreed effort, typically referred to as "moral hazard".

[22] C.Y. Chang, G. Ive, "Reversal of bargaining power in construction projects: meaning, existence and implications", in Construction Management and Economics, Routledge Taylor & Francis Group, 2007, vol. 25(8), page 846.

[23] H.I. Unsal, J.E. Taylor, *"An empirical investigation of opportunistic behaviour in project networks and its impact on market efficiency"*, in *The Engineering Project Organization Journal*, Routledge Taylor & Francis Group, 2011, page 96.

[24] R. Sönmez, *"Value Creation through Social Alliances: Theoretical Considerations in Partnership Relationships"*, in V. Potocan *et al.*, "Handbook of Research on Managerial Solutions in Non-Profit Organizations", IGI Global, 2017, pages 205-231.

[25] D.A. Zhdanov, *"Agency Cost Management in the Digital Economy"*, in M. Y. Kuznetsov *et al.*, "Challenges and Opportunities of Corporate Governance Transformation in the Digital Era", IGI Global, 2019, pages 130-151.

[26] A. Ceric, *"Strategies for minimizing information asymmetries in construction projects: Project managers' perceptions"*, in *Journal of Business Economics and Management,* 2014, vol. 15(3), pages 424-440.

[27] D.N. Wagner, *"The Opportunistic Principal"*, in *Kyklos,* John Wiley and Sons Ltd., 2019, vol. 72(3), page 4.

In order to cope with the agent opportunism, it is considered[28] that the principal has two (2) main options: (i) to invest in information systems to control the agent opportunism, or (ii) to try to align the interests of the agent with its own interests by providing suitable incentives.

While the economic literature has traditionally analyzed the principal-agent relationship from the perspective of the opportunistic behaviour of the agent only, usually defined as *"self-interest seeking with guile"*[29] , recent studies[30] have also taken into consideration the opportunistic behaviour of the principal, describing it as *"self-interest seeking with dominance"*.

In this respect it was noted[31] that: *"self-interest seeking with dominance is facilitated by the authority relationship between the principal and the agent. It is an asymmetric distribution of power and transaction specific investments which give rise to opportunistic principal behavior, leading to situations where an abuse of authority can be observed, resulting in distorted economic performance"*.

Same as in case of the opportunistic behaviour of the agent, there are also two (2) types of opportunistic behaviour of the principal: (i) the "ex-ante opportunism" may occur when the principal misrepresents the contractual situation, e.g. in terms of the quantum and nature of works, completeness or correctness of design, available permits and authorizations, site and underground conditions, production pressures, adequacy of equipment, construction costs, allocated budget, expected price adjustments, etc., leading to "adverse selection", and (ii) the "ex-post opportunism" where after the contract conclusion the principal illegally interferes with the autonomy of the agent, undermining the performance of the contract by its instructions and control activities.

Even though standardized forms of contracts provide contractual mechanisms and guarantees to limit the opportunistic behaviour of the parties, the enforcement of such mechanisms and guarantees fundamentally depend upon the good faith of the parties as well as the efficiency of judicial system and discretion of courts[32] .

Under these circumstances the questions arises whether the new information technologies developed in the past years may be of use in preventing and mitigating the opportunistic behaviour of parties in construction and engineering contracts, and thus to prevent the disputes that may occur in such contracts.

5. Using information technology to prevent the disputes in construction contracts

5.1. What are smart contracts

"Smart contract" is a concept used to describe a computer code that automatically executes all or parts of an agreement and is stored on a blockchain-based platform[33].

[28] D.N. Wagner, *op. cit.*, page 4.

[29] O. Williamson, *"The economic institutions of capitalism. Firms, markets, relational contracting"*, New York, 1985, cited in D.N. Wagner, *op. cit.*, page 6.

[30] D.N. Wagner, *op. cit.*, page 6.

[31] D.N. Wagner, *op. cit.*, page 6.

[32] C. D'Alpaos et al., *"Time overruns as opportunistic behavior in public procurement"* in *Journal of Economics*, Springer-Verlag Wien, 2013.

[33] S.D. Levi et al., "An Introduction to Smart Contracts and Their Potential and Inherent Limitations", in Harvard Law School Forum on Corporate Governance, 2018, page 1.

In a more comprehensive definition[34] "smart contract" was described as *"a computerized transaction protocol that executes the terms of a contract. The general objectives of smart contract design are to satisfy common contractual conditions (such as payment terms, liens, confidentiality, and even enforcement), minimize exceptions both malicious and accidental, and minimize the need for trusted intermediaries. Related economic goals include lowering fraud loss, arbitration and enforcement costs, and other transactions cost"*.

Utilizing a smart contract, contractual terms agreed by the parties can be converted into a programming language and be verified and enforced by a decentralized verification system, without the intervention of the contracting parties. Thus, during the performance of the contract, the agreed transaction, exchange or contractual action will automatically be executed after the occurrence of an event or after a specified time period, exactly as it was agreed by the parties at the conclusion of the contract.

5.2. Smart contracts and the blockchain technology

A blockchain, sometimes referred to as "Distributed Ledger Technology (DLT)", is essentially a digital ledger of transactions that is duplicated and distributed across a network of computer systems (the "nodes"). Each block in the chain contains a number of transactions, and every time a new transaction occurs on the blockchain, a record of that transaction is added to every participant"s ledger. The records are immutable, meaning that no participant can alter a transaction after it has been recorded to the shared ledger. If a record includes an error, a new transaction must be added to reverse the error, both transactions remaining thereafter recorded in the shared ledger.

As it was noted in the literature[35], the blockchain *"acts as infrastructure for smart contracts to be executed across a distributed network (those nodes validating and updating the distributed ledger) rather than being executed and adjudicated by centralized organizations (such as a judicial system). Furthermore, information stored in blockchains are a new potential trusted source of information to trigger those contracts […]. Because the contractual obligations of smart contracts are written into code - and will be enforced in a decentralized way across a blockchain network -contracting parties can have greater confidence that performance will be carried out."*

5.3. Smart contracts and Building Information Modeling (BIM)

In some situation in order to trigger the execution of contract the smart contracts as computer code might have to refer to external data, provided by a third-party information source (generally referred to as an "oracle"). As it was noted in the literature[36]: "*Preferably those oracles - including temperature readings, prices of other goods or any other event relating to the contract - are reliable and can be predetermined in contract negotiation"*.

In construction industry, the common data environment (CDE) used in Building

[34] N. Szabo, "Smart Contracts", 1994, cited in F. Möslein, "Legal Boundaries of Blockchain Technologies: Smart Contracts as Self-Help?", Philipps-Universität Marburg, pg. 2, available online at: https://ssrn.com/abstract=3267852.

[35] D.W.E. Allen et. al, "The Governance of Blockchain Dispute Resolution", in Harvard Negotiation Law Review, vol. 25:75, 2019, page 79.

[36] D.W.E. Allen et. al, *op. cit*., page 81.

Information Modelling (BIM) might be such third-party information source, playing the role of the oracle for the construction smart contracts.

Building Information Modelling (BIM) is often described as a highly collaborative process that allows architects, engineers, real estate developers, contractors, manufacturers, and other construction professionals to plan, design, and construct a structure or building within one 3D model. The cornerstone of BIM is that all the parties involved in the construction and lifecycle management of constructed assets are brought to the same platform, working collaboratively and sharing data (information).

These data (information) in a BIM model are shared through a mutually accessible online space known as a common data environment (CDE), and can be used to improve accuracy, express design intent from the office to the field, improve knowledge transfer between the involved parties, reduce variation orders and field coordination problems, and provide insight into existing construction for other related projects later on.

Being available in real-time to all the involved parties, these data (information) reduce the information asymmetry and prevent disagreements and disputes resulted from the incomplete or delayed availability of information. Last but not least, BIM is usually seen as an effective tool to support claims and disputes under the contract, being able to provide reliable contemporary records, created, obtained or produced at the same time with the facts or events upon which the claim or dispute is based.

Depending on how much information is being shared and managed throughout the entire construction process, there are different levels of BIM that can be achieved for various types of projects:

a) *Level 0 BIM: Using paper-based drawings and/or digital prints, zero collaboration between parties.*

b) *Level 1 BIM: Using 2D construction drawings and some 3D modelling* - this level implies the electronic sharing of data carried out from a common data environment (CDE) usually managed by the contractor. Level 1 BIM doesn"t involve much collaboration, each party publishing and managing their own data.

c) *Level 2 BIM: Teams work in their own 3D models* - at this level all parties use 3D CAD models but sometimes not in the same model. However, the way in which parties exchange information differentiates it from other levels. Information about the design of a built environment is shared through a common file format.

d) *Level 3 BIM: Teams work with a shared 3D model* - at this level everyone involved in the project uses a single, shared project model. The model exists in a "central" environment and can be accessed and modified by everyone. This is called Open BIM, meaning that another layer of protection is added against clashes, adding value to the project at every stage.

e) *Level 4 BIM: Time* - this level adds to the information model comprised by BIM the element of "time". Thus, this level includes scheduling data that helps outline how much time each phase of the project will take or sequencing of various components.

f) *Level 5 BIM* adds cost estimations, budget analysis, and budget tracking to the information model. When working at this level of BIM, project owners can track and determine what costs will be incurred during the length of the project.

g) *Level 6 BIM* ensures accurate predictions of energy consumption requirements and empowers parties to build structures that are sustainable.

5.4. Using the smart contracts technology in enforcing the contractual will of the parties expressed at the conclusion of contract

The experience acquired so far by the international construction industry shows that the actual tools, mechanisms and procedures used to prevent the disputes in construction and engineering contracts are insufficient, not being any indication that the incidence of claims and disputes would have decrease in the past years as a result of using such tools, mechanisms and procedures. Irrespective of the clarity of contractual provisions regarding allocation of risks and of the multi-tiered contractual dispute resolution schemes, any attempt to prevent claims and disputes by bureaucratic measures (contractual procedures) of which enforcement depend at the end of the day exclusively upon the good faith of the parties, proved to be not enough to ensure the voluntary compliance of the parties with their own contractual will as recorded at the date of contract conclusion.

The adversarial culture of construction industry, the cost of using the legal system and the substantial time needed to arbitrate contractual disputes transformed the tools, mechanisms and procedures initially intended to prevent the claims and disputes in construction contracts into efficient weapons of opportunistic behaviour, used by the parties to deviate from the initial understanding from the conclusion of contract and to dishonestly improve their economic position within the contract.

Illustrative in this regard are the experience encountered in the recent years with the use of contractual adjudication in prevention of construction disputes in civil law countries, including Romania. Initially intended to ensure the speedy resolution of disputes by a board of experienced construction specialists, adjudication shortly became itself a major source of disputes between the contracting parties. Matters as appointment of dispute boards" members, consequences created by this type of dispute resolution mechanism over limitation, the duration and costs of adjudication proceedings, and enforcement of dispute boards decision were opportunistically used by the contracting parties to delay and even block the resolution of contractual disputes by their referral to arbitration for an indefinite period. It is noteworthy that in Romania these problems have been solved only by removal of adjudication as mandatory condition precedent to arbitration from the applicable standardised construction contracts starting with 2017.

From the opportunistic behaviour perspective, the complexity of construction projects is currently given by the number of individuals involved in development of respective projects and, respectively, in management of contractual obligations. The more individuals involved, the more contrary interests, both contractual and personal, that are needed to be harmonized. While theoretically it is widely recognized that establishing a collaborative culture and aligning the involved parties" contrary interests are the best ways to ensure the smooth performance of a contract, implementing these principles into construction projects proved to be extremely difficult and time-consuming.

Under these circumstances the necessity of identifying new ways to ensure the voluntary compliance of the contracting parties with their own will as recorded at the date of contract conclusion, while disciplining their contractual behaviour appears to be evident. In this regard, smart contracts technology, in conjunction with blockchain technology and Building Information Modelling (BIM) present undeniable advantages to become the next generation of dispute avoidance tools and mechanisms used in construction and engineering projects.

As to how these technologies could be implemented in construction projects, it is noteworthy that the construction and engineering industry is currently one of the most prepared for a quick switch to the digital management of contracts. The use of standardised detailed contracts (which may be easily translated into smart contracts/computer codes) is already a common practice in the industry both in common and civil law countries. In the same time the use of Building Information Modelling (BIM) is spreading throughout the industry, many countries already mandating the use of BIM in all major infrastructure projects that receives central public funding.

It is not hard to imagine how these technologies will work in the real life. Once a construction and engineering contract will be concluded in writing, a corresponding smart contract, translating the will of the contracting parties in computer codes will be created. Thereafter, the contract will automatically execute the contractual actions based on the contemporary, real-time data (information) received from the common data environment (CDE) created within the BIM process. The security and immutability of records and contractual actions will be ensured by the blockchain technology.

The most important advantage of smart contracts technology is that, once the required conditions are fulfilled (pursuant to data shared by the involved parties in CDE), the contractual obligations are executed automatically, in seconds, without human intervention. This means that all contractual procedures, which under traditional construction contracts depend by the will of a certain individual, *e.g.* application for an interim certificate, certification of works, determination, payment, contractual notices, etc., and usually take significant time to be concluded, will be executed instantly, without the delays usually generated by human behaviours and their opportunistic interests.

Adoption of smart contracts technology in construction and engineering contracts is not without challenges and risks for the contracting parties.

For instance, one of such challenges would be how quick the amendments made to the text-based version of the contract might be included in the computer codes of the same contract. Having in mind that the blockchains are immutable, amending a smart contract will be far more complicated than modifying a traditional text-based contract, or a standard software code that does not reside on a blockchain. In this regard in the literature[37] it was emphasized that: "*amending a smart contract may yield higher transaction costs than amending a text-based contract, and increases the margin of error that the parties will not accurately reflect the modifications they want to make*".

Other matters of concern may include the allocation of risks and liabilities between the contracting parties for coding errors, and for the situations where the common data environment (CDE) would be unable to supply the data (information) necessary for self-execution of contract, would provide erroneous data or simply it would go out of business.

Last but not least, even though it is expected that implementation of smart contracts technology to discipline the contractual behaviour of the parties, reducing the disputes generated by their opportunistic behaviour, it is also expected that these types of disputes to be replaced by

[37] S.D. Levi et al., *op.cit.*, page 6.

disputes in relation to the computer codes corresponding to the text-based contract.

6. Conclusions

The disputes which occurred in construction projects are usually caused by one or more of the following three (3) elements: project uncertainty, contractual imperfections, and opportunistic behaviour of the contracting parties and their representatives.

While the matter of project uncertainty was traditionally mitigated by the pre-allocation of risks between the contracting parties, and the disagreements resulted from imperfections of contracts by the multi-tiered contractual dispute resolution schemes, so far there were little remedies against the opportunistic behaviour of the contracting parties meant to ensure the voluntary compliance of the parties with their own will as expressed at the conclusion of the contract.

The development in the recent years of new information technology tools like smart contracts, blockchain and Building Information Modelling (BIM) will provide in the near future an efficient remedy against the disputes resulted due to the opportunistic behaviour of the contracting parties.

However, as it was emphasized within this research, this remedy comes with its own challenges and risks which must be taken into consideration by the contracting parties at the conclusion of the contract accordingly.

References

- D.W.E. Allen et. al, *The Governance of Blockchain Dispute Resolution*, in Harvard Negotiation Law Review, vol. 25:75, 2019;
- J. Bailey, *Construction Law*, Routledge, 2011;
- E. Baker, B. Mellors, S. Chalmers, A. Lavers, *FIDIC Contracts: Law and Practice*, Informa Law, 2009;
- A. Ceric, Strategies for minimizing information asymmetries in construction projects: Project managers' perceptions, in Journal of Business Economics and Management, 2014, vol. 15(3);
- C.Y. Chang, G. Ive, *Reversal of bargaining power in construction projects: meaning, existence and implications*, in Construction Management and Economics, Routledge Taylor & Francis Group, 2007, vol. 25(8);
- C. D"Alpaos et al., *Time overruns as opportunistic behavior in public procurement* in Journal of Economics, Springer-Verlag Wien;
- L. Klee et al., *International Construction Contract Law*, Wiley Blackwell, 2015;
- J.S.J. Koolwijk, *Alternative Dispute Resolution Methods Used in Alliance Contracts,* in Journal of Professional Issues in Engineering Education and Practice, January 2006;
- M.H. Kumaraswamy, *Conflicts, claims and disputes in construction engineering*, in Construction and Architectural Management, 1997, vol. 4(2);
- S.D. Levi et al., An Introduction to Smart Contracts and Their Potential and Inherent Limitations, in Harvard Law School Forum on Corporate Governance, 2018;
- D. Lowe, and R. Leiringer, *Commercial Management of Projects*, Blackwell Publishing, Oxford;
- M.M. Rahman, M.M. Kumaraswamy, *Joint risk management through transactionally efficient relational contracting*, in Construction Management and Economics (online), Taylor & Francis (Routledge), vol. 20(1);

- B. Shapiro, *Transferring Risks in Construction Contracts*, 2010, available at: http://www.shk.ca/wp-content/uploads/2013/02/Transferring-Risks-in-Construction-Contracts-BSS.pdf;
- R. Sönmez, *Value Creation through Social Alliances: Theoretical Considerations in Partnership Relationships*, in V. Potocan et al., "Handbook of Research on Managerial Solutions in Non-Profit Organizations", IGI Global, 2017;
- N. Szabo, *Smart Contracts*, 1994, cited in F. Möslein, *Legal Boundaries of Blockchain Technologies: Smart Contracts as Self-Help?*, Philipps-Universität Marburg, pg. 2, available online at: https://ssrn.com/abstract=3267852;
- H.I. Unsal, J.E. Taylor, *An empirical investigation of opportunistic behaviour in project networks and its impact on market efficiency*, in The Engineering Project Organization Journal, Routledge Taylor & Francis Group, 2011;
- D.N. Wagner, *The Opportunistic Principal*, in Kyklos, John Wiley and Sons Ltd., 2019, vol. 72(3);
- O. Williamson, The economic institutions of capitalism. Firms, markets, relational contracting, New York, 1985;
- G. Younis, G. Wood, M.A.A. Malak, *Minimizing construction disputes: the relationship between risk allocation and behavioural attitudes* in Construction Management and Economics (online), Taylor & Francis (Routledge), vol. 20(1);
- D.A. Zhdanov, Agency Cost Management in the Digital Economy, in M. Y. Kuznetsov et al., Challenges and Opportunities of Corporate Governance Transformation in the Digital Era, IGI Global, 2019;
- Common Order no. 915/465/415/2008 for the approval of general and particular conditions of contracts at the conclusion of the contracts of works issued by the Ministry of Economy and Finance, Ministry of Transporation and Ministry of Development, Public Works and Houses;
- Government Decision no. 1405/2010 regarding the approval for the use of some conditions of contract of the International Federation of Consulting Engineers (FIDIC) for the investment objectives from the field of transportation infrastructure of national interest financed by public funds;
- Government Decision no. 1/2018 for the approval of general and particular conditions of contract for certain categories of public procurement contracts related to the investment objectives financed by public funds replaced the former standardised public procurement contracts based on FIDIC conditions of contract, previously mandatory for the road and railway infrastructure works only, with new ones, extending in the same time their applicability to all the investment objectives financed by public funds.