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Causes and effects of contract management problems: Case study of road construction

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Contract management is a crucial component of any project. As construction projects are complex and difficult to manage, adequate attention must be given to the related contract management issues. Inexpert management can bring about serious unfavourable consequences that can even result in a project failure. This study aims to explore a specific case study: A private road construction project implemented in the Czech Republic. The analysis consists in identifying potential problems and discussion of their implications. The problem is investigated on three levels: economic, technical and legal. The paper also considers contrasting attitudes of the contracting parties (buyer and supplier), e.g., from the point of view of the causes of problems. Several recommendations are formulated on the basis of the research findings. The results of this study have an ambition to improve contract management capabilities in the construction sector in order to prevent the occurrence of similar problems in future and contribute to our understanding of long-term effects of contract management problems throughout the life cycle.

KEYWORDS

construction project, contract management, road construction, project documentation, dispute

Introduction

Construction projects typically involve a high degree of complexity. In the theory, complexity is understood as the number and heterogeneity of different interrelated elements (Burke and Morley, 2016). Taking into consideration that construction projects 1) involve a high number of stakeholders, are 2) subject of frequent change orders, 3) of a long-term nature, and 4) affected by various influencing factors such as location, inflation, schedule targets, constrained budget, etc., it is difficult to understand, foresee and keep the under control (Vidal et al., 2011; Vařbuchta et al., 2017; Kermanshachi and Safapour, 2019). In order to cope with the project complexity, the project itself should be supported with good-quality technical, economic, and contractual documentation. Unfortunately, many projects suffer from disputes between the parties involved, leading up to adverse consequences such as significant delays, loss of quality in follow-up work, or lack of future cooperation (Lu et al., 2015). To imagine, National Construction Contracts and Law Survey reported that 30 percent of companies in the Great Britain had been involved in at

least one dispute in the previous 12 months (RIBA Enterprises, 2013). Such disputes are often caused by a misunderstanding of the contractual terms and conditions as well as violation of obligations, no matter if real or only perceived by one of the parties. Given regular occurrence of disputes in construction projects, good negotiating skills are becoming crucial (Chow et al., 2012).

Research problem and aim of the paper

This paper deals with contract management problems and their influence on the construction and operation of a private road. Despite the fact that a wide body of knowledge on causes of claims, dispute resolution techniques, time and costs overruns, and project performance in general is available, there is a lack of studies that monitor these issues from a long-term perspective. In the case of the construction industry, this is essential because the duration of the life cycle of buildings is expected to be in the tens of years. At the same time, it is necessary to be aware that sooner or later the consequences of the decisions made in the early stages of the project will be felt. Although we know what the most common causes of disputes are and how they can be resolved, it is usually unclear to what extent the consequences of failing to resolve the dispute may increase in the future.

Accordingly, this study aims to investigate causes and effects of dispute in different phases of the life-cycle of a building facility. Therefore, the study addresses how contract management problems resulting from insufficient project preparation may affect not just the construction phase, but also the operation phase of the building facility's life cycle. The single-case study analysed in this research points out how a long-term dispute can negatively affect the operation of an owner's business; how it, for many years, has been tying contractor to a project which, from his point of view, had already been finished long ago; and especially how the continuously growing complexity of the problem significantly complicates its resolution.

Literature review

Project management literature provides a substantial body of knowledge concerning the assessment of a construction project's success. The main success criteria are time, cost, and quality, also known as the "iron triangle" (Ljevo et al., 2017). These criteria usually act as contradictive objectives and can be considered as interdependent parameters in a building project (Hu and He, 2014). This mutual interdependency was analysed by many researchers, e.g. in terms of time and cost for water supply systems (Zujo et al., 2017) and the balance of cost, time and quality for reinforced concrete (Hosseini et al., 2017). The aspect of project cash flow is also crucial as it allows the assessment of working capital requirements (Maravas and Pantouvakis, 2012).

The above-mentioned factors are crucial in construction disputes as well. Ilter (2012) deals with three categories of disputes, namely: extension of time, payments, and quality of works clearly corresponding to the iron triangle. Furthermore, study of Ilter (2012) identifies the relations between dispute categories with dispute factors such as late instructions by the employer, inadequate/incomplete specifications or unclear contractual terms. It should be emphasised that the contract is among the most important components of the construction project (Safa et al., 2017) and project documentation forms an integral part of the contract. This importance is documented by Leśniak et al. (2018), who point out that problems with project documentation are among the main causes of delays in both Poland and Slovakia. Disputes may arise for various reasons, in addition to usual ones between client and contractor such as cost and time overruns for ongoing projects (Nahidi et al., 2017; Johnson and Babu, 2020; Shoar et al., 2022; Subramanya et al., 2022), disputes may also be related to inadequate cost estimations for repairing damages caused by large scale natural disasters, such as floods or windstorms (Hanak and Korytarova, 2014).

Construction disputes may be destructive for projects (Ilter and Dikbas, 2009), therefore efforts should be made to prevent them in the first place. This issue is highly topical within the research community; e.g., Lee et al. (2016) found 140 articles dealing with dispute prevention. In this relation, Molenaar et al. (2000) developed a structural equation model for predicting of construction contract disputes. As presented by Naji et al. (2020), structural equation modelling enables to determine a regression model for the dispute occurrence as an output variable in terms of the dispute causes as real variable. However, since it is not possible to prevent all disputes, it is subsequently necessary to resolve them. In the case of systematic violations of one party's obligations, a judicial decision is typically needed (Yaskova and Zaitseva, 2017). This solution is commonplace in modern construction projects (Biering et al., 2016); however, it may take long (Dziadosz et al., 2015)—disputes can drag on for many years, which is why parties also consider alternative dispute resolution (hereinafter referred as ADR) methods, an option that arose as an alternative to lengthy and costly processes of arbitration and litigation (Cheung, 1999). The use of ADR (such as negotiation, arbitration or adjudication) depends on the nature of claims that are to be decided and also on the parties' perception of fairness and outcomes of win and losses in claims (Lee et al., 2016). The list of factors that affect the selection and use of ADR provided by Lee et al. (2016) is comprehensive, involving–apart from fairness and outcomes–e.g., bindingness, cost, confidentiality, control over the proceedings, lawyer's influence, perception of risk, and complexity of disputes. Regarding related costs, disputes resolution carries explicit costs such as lawyer's fees, court fees, consultant costs etc., however, other types of costs (so-called hidden costs) should also be considered, e.g., reduced project working efficiency,

damaged reputation, or the aspect of future cooperation (Lu et al., 2015).

The frequency of disputes occurrence was analysed by Ilter and Dikbas (2009). They have revealed that *design and build* causes 8 precent more disputes in contrary to the *build* method and also that the frequency is positively correlated with the size of the contractor. According to Tazelaar and Snijders (2010) there is an 84 percent probability that at least some problem will occur within the project and 81 percent probability that the problem will be discussed successfully with the other party. However, if the problem involves a delayed payment or claim of damage, then there is 10 percent probability that the case will lead to arbitration or other legal steps.

The case study analysed in this paper deals with road construction. Road construction projects also involve the iron triangle; however, it should be noted that problems and risks are higher due to the duration and size of such projects, as well as unforeseen economic and other conditions such as material and energy prices. In the case of road construction, increased energy costs influence material costs and may slow down projects significantly (Hashem Mehany and Guggemos, 2015). An example of the procedure of contractor's claims management in a road works project is provided by Rybka et al. (2017). Mishmish and El-Sayegh (2018) have reported causes of claims in road construction projects in the UAE. Based on their findings, the most likely causes consist in variations initiated by the client or engineer, delays caused by the contractor (e.g., as a consequence of lack of resources and machinery on the construction site), and inadequate site investigation before bidding.

Providing sufficient background materials for each dispute is crucial. Typically, contractors lack documents such as adequate photographic evidence, time sheets, site diaries and revised drawings to pursue their claims (Vidogah and Ndekugri, 1998). Therefore, an experienced supervisor (Kongsong and Pooworakulchai, 2018) as well as the use of modern technical devices and solutions on the construction site (Banaszek et al., 2017; Acosta et al., 2019) are essential.

Materials and methods

The dispute analyzed in this case study was settled in court. Since authors of the paper participated in the preparation of the expert opinion for the court, they had at disposal complete documentation from the court file. Detailed documentation that has been available for the selected case study has been carefully studied. This documentation includes the following: contract for work, technical documents including initial road design, relevant documents provided by both parties to the dispute, and materials obtained during personal investigation of the site. All sensitive information and materials are published in an anonymised form (incl. location, time, name of the parties involved, the amount of costs, name of the technology used). The article contains only the facts that are relevant to the achievement of the paper's objective, i.e., to identify dispute factors and the related consequences.

After examining the textual and graphical documentation in the court file (analysis no. 1), an additional set of information was obtained during personal investigation of the site that took place in 2018 (analysis no. 2). Due to the long duration of the dispute, 6 years passed before the revision expert opinion was ordered and processed. On the other hand, it enables to explore evidentiary material covering the whole six-year period. This investigation primarily involved physical documentation of visible damages, the extent of which progressively evolved over time (when compared to previous evidence available in the court file). Subsequently, the disputed matters were discussed with both parties (investor and supplier) in order to obtain the widest possible material for the subsequent assessment of responsibility for the occurrence of defects. When all the defects have been identified, the causes of problems were investigated. Then, cause-effect relations were assigned and graphically presented in multi-dimensional diagram. In addition, the entire analysis has been performed in the context of the iron triangle (i.e., time, cost, and quality issues). The case study research methodology is graphically presented in Figure 1. Based on the findings, several lessons learnt are provided at the end of the manuscript.

Regarding scientific methods use, analytical-synthetic cognitive procedures have been applied to achieve an understanding of the qualitative data. Of these, a causal analysis was particularly important as it helps identify causes of phenomena. It is crucial to ensure objective and deep insight into the problem, especially in situations when observer just see certain process, but its manifestations are dependent on a very complex causal chain of causes and effects (Molnar et al., 2012, p. 22). For graphical interpretation for casual models, different types of casual diagrams are used, e.g., mind mapping and casual loop diagrams. Mind maps provides nonlinear graphical interpretation of data and casual loop diagrams are used to analyse qualitative data (Milen et al., 1997). Generally speaking, casual diagrams help to predict how the system would respond to hypothetical interventions (Pearl, 2000). For this reason, casual diagram was used as a graphical tool to present and understand causes and effects in analysed case study and, in the second stage, to facilitate the formulation of lessons learned. Project life cycle as well as the perspectives of both parties to the dispute in view of dispute categories are considered within the performed analysis.

Case study of a road construction project

The subject of the analysis consists in construction of a road on a privately-owned plot of land and its connection to the

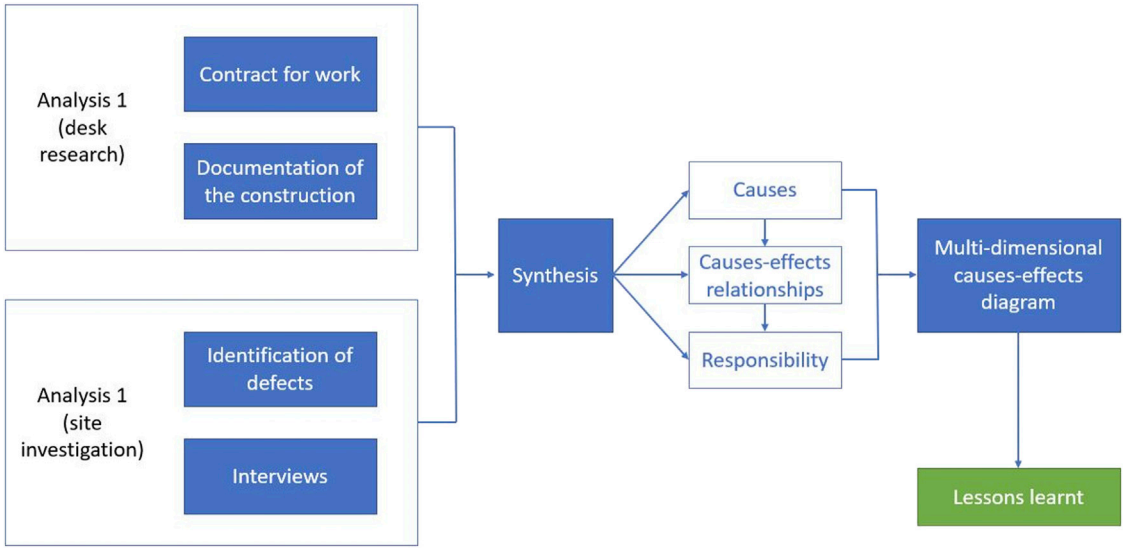

FIGURE 1
Case study research methodology.

TABLE 1 Basic characteristics of the analysed project.

Scope of the project	Bituminous road, 947 m^2
	Concrete interlocking pavement, 391 m^2
	Concrete drainage pavement, 233 m^2
Duration of the construction phase of the project	7 days (October/November 2012)
Structure of the bituminous road	asphalt concrete (50 mm)
	bituminous infiltration spraying (0.9 kg/m^2)
	base layer and subsoil stabilization (cement 55 kg/m^2)
	Subsoil - clay with medium plasticity (250 mm)

existing public asphalt road. Specifically, the road was to be used for transport to and from company premises. The road thus enables the entrance to the investor's premises, parking and the connection of the public road to the storage hall. The investor needed to bring the premises into operation quickly and, for this reason, it began to consider a change in the originally envisaged technological solution for the road. The investor and the contractor reached an agreement where the contractor proposed to use a non-standard construction process which promised to shorten the construction period and reduce price. The technology lacked binding rules in the Czech Republic and there was no demonstrable experience with its use in other projects in the country. The basic characteristics of the project are provided in Table 1 and a cross-section drawing is shown in Figure 2.

The investor and the contractor entered into a contract for work, but the contract unfortunately contained serious shortcomings consisting, e.g., in the absence of proper project documentation concerning the new technological solution attached to the contract as its integral part. All the above-mentioned facts subsequently led to disagreements and disputes between the contractual parties.

The road was built by the contractor, but defects and faults appeared during handover, resulting in the investor's refusal to accept the road and its request for a repair of these defects and faults (consisting, e.g., of incorrectly implemented drainage). Although the work was neither officially accepted nor paid for, the investor started using it for its business activities, which involved heavy freight traffic on the road which had not been designed for that purpose. Consequently, the defects and faults deteriorated further, manifesting as faults on the road near the drainage sites, ruts in the covering layer, cracks and unevenness in the road and area deformations. Figures 3–5 show examples of defects on the analysed road and view on its structure.

Since the parties were unable to agree on a solution to their dispute, they referred the matter to the court. As part of the

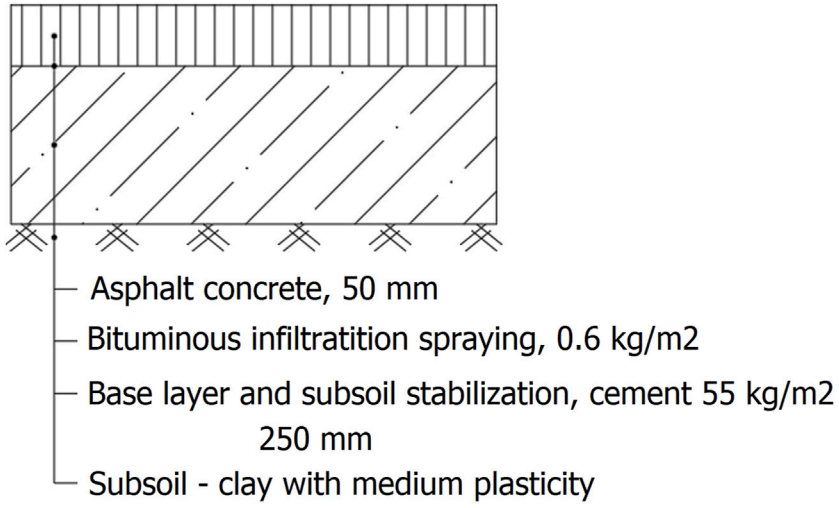

FIGURE 2
Cross section drawing of the road.

FIGURE 3
Cracks and deformations.

investigation of the causes of the defects and faults and the liability for them, the following factors were identified: inadequate preparation of the ground plane, incorrectly implemented drainage, uneven thickness of the asphalt layer, partially insufficient compaction of the underlying structure, insufficient binding between the covering and the supporting layer, and overloading the road by heavy freight traffic.

The situation was further worsened by the increasing number and scope of faults as time progressed, the fact that there was no building diary, as well as the absence of as-built documentation. Selected most serious faults and defects were provisionally repaired by the investor on the spot, yet documentation was again not made with respect to these repairs. As a result, the entire dispute became fairly complex, especially with regard to the assignment of liability for the individual defects and faults.

Figure 6 provides a lucid two-dimensional overview of the above facts. The individual factors at play and their consequences

FIGURE 4
Road surface irregularities.

FIGURE 5
View of the road structure.

are divided based on their time sequence into three life cycle stages, i.e., preparation, construction and operation. The second dimension consists in dispute categories (time, payment and quality). Colours indicate the decisions/activities/requirements of the parties in the dispute (blue = investor; orange = contractor; colour gradient = both).

The previous analysis showed that the project failure was caused by four main general factors: 1) selection of the contractor, 2) selection of the technology, 3) insufficient documentation, and 4) unsuitable use of the structure. The interaction of these factors made solving the dispute by agreement of the parties practically impossible.

The contractor selection process should generally be conducted in a way that results in implementation of the work by a construction company that has sufficient technical, managerial and economic qualifications to deliver the work in the required quality. Although the entire process of selecting the contractor was not part of the analysis, the authors note that a proper verification of the contractor's qualifications is crucial in this regard. Only qualified contractors should be selected to

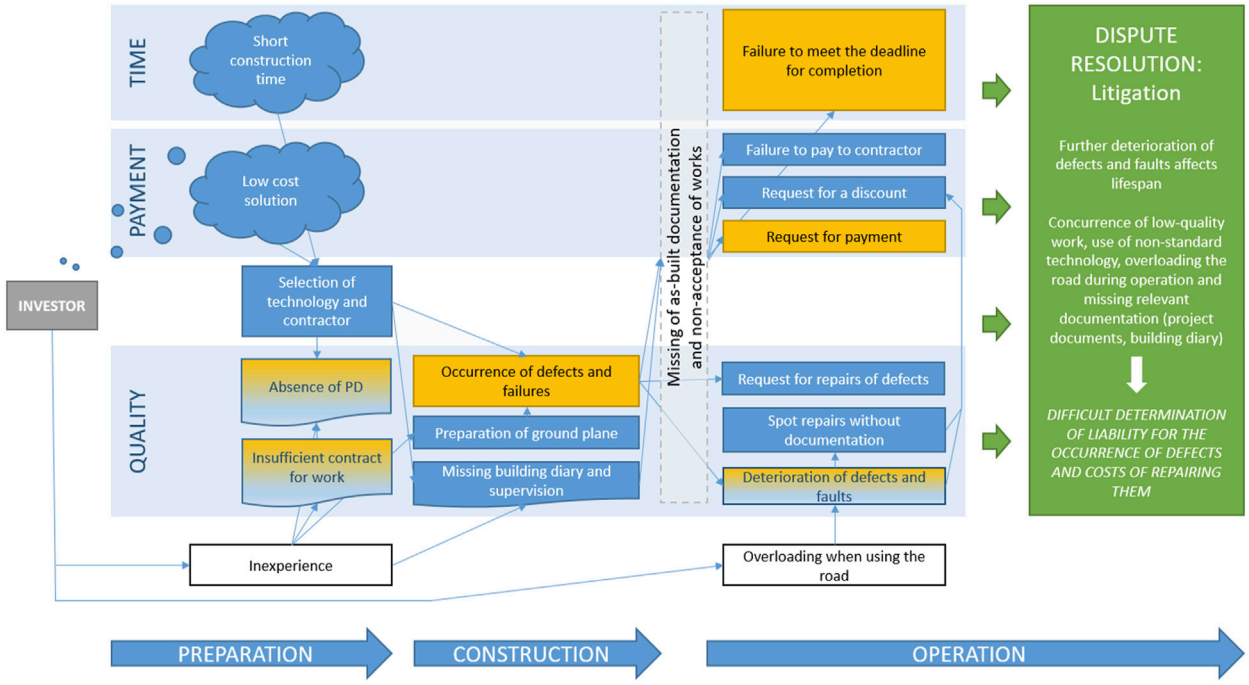

FIGURE 6
Causes and effects diagram.

TABLE 2 Recommendations resulting from the case study analysis.

Problem	Measure	Effect
Selection of an unsuitable solution	Clear specification of parameters of the work according to operational requirements	Elimination of adverse effects of operation on the quality of the work and its lifespan
Selection of the contractor	A proper assessment of qualifications incl. verification of references	Proper completion of the work in the desired quality
Contract for work	Consulting the contents of the contract for work with an expert in construction contract management	Clear definition of rights and obligations following from the contract and elimination of potential disputes
Handover of the construction site	Record of the handover of the construction site	Written confirmation that the investor handed over the construction site in a condition agreed in the contract for work
Supervision over the construction process	Keeping of building diary and the presence of a supervisor	Supervision over the quality of the construction and record-keeping for documenting the scope of the works carried out, defects and liability for potential future defects
Handover of the work	Provisions in the contract for work	Specification of potential defects and non-performances preventing proper use of the work, as well as other defects and non-performances

implement the contract, which means contractors who are competitive, competent and capable (Lam et al., 2010). A part of the qualifications should have consisted in documented (and verified by the investor) references proving that the contractor was competent and capable.

The above requirement for submission of references is also related to the selection of the technology to be used. The investor did not verify if other projects using this technology had been implemented in the Czech Republic. This fact is especially important since this construction technology was not tried and proven in the Czech Republic and lacked relevant generally binding standards.

The dispute escalated and was difficult to resolve particularly due to the absence of relevant documents. This means both design documents for construction and as-built documentation. Since the contract for work concluded in this particular case

study did not contain the usual provisions concerning construction contracts and the investor was not experienced in this area, no building diary was made during the construction and the investor did not arrange for adequate supervision of the work. These factors significantly hindered the possibility for determining qualitative shortcomings of the construction, e.g., in relation to bad binding of the covering and supporting layers since these structures are not visible.

Finally, another important factor consisted in the fact that the investor started using the road and overloaded it with heavy freight vehicles for which the surface was not designed. This brought about a situation where both parties to the dispute bore some responsibility for the occurrence of certain defects and faults. For instance, as regards the road cracks, it is not clear to what extent they were caused by, e.g., insufficient drainage of the site as opposed to heavy traffic. Determining the exact degree of liability for the individual defects and faults is thus nearly technically impossible, taking into consideration the fact that the scope of the faults grew as the time progressed.

Finally, several lessons learnt from the analysis of the case study can be presented. Firstly, it is necessary to choose a technical solution suitable to the structure's operational requirements. In this relation, a detailed project documents must be drawn up.

Secondly, the contractor selection process should take place on the basis of sufficient qualifications. The qualification requirements should enable a selection from a sufficient number of bidders with the aim of ensuring sufficient competition within the selection procedure and, simultaneously, exclude from the procedure such potential contractors that lack the qualifications for successful completion of the project or who have previously developed reference projects that had quality issues.

Thirdly, contractual provisions in the contract for work should be consulted with experts in construction contract management in order to minimise the possibility of disputes in the course of the project's implementation and afterwards.

Fourthly, handover of the construction site to the contractor has to be properly recorded in order to ensure that the investor has met all its obligations as agreed in the contract for work.

Fifthly, during the course of the construction, the investor should arrange for oversight of the works by a supervisor; keeping a building diary including photographic documentation by the contractor is also necessary. These measures enable timely identification of low-quality work and achieving appropriate remedy; potentially, the same documents can serve as evidence for determination of the scope and liability for defects appearing during operation, which is especially important with regards to structures that are covered and cannot be visually inspected.

Sixthly, defects and shortcomings found during delivery of the completed work should be recorded with participation of both contractual parties and the supervisor. The defects and faults should be classified into two categories based on their severity, i.e., defects preventing the use of the work and defects not preventing the use of the work. This categorisation should be supported by the provisions of the contract for work; material defects preventing proper use of the work are generally considered to constitute grounds for non-acceptance of the work by the investor. A list of these lessons is provided in Table 2 showing the relationships between the problem, the measures adopted, and their desired effects.

As a result, the impact of this dispute is negative mainly for the investor, but also for the supplier. For investor, the effects consist mainly in the limited possibility to use built communication and in additional incurred costs for carrying out local repairs. Since the supplier consistently and completely rejects its liability for defects, its main burden consists of attending court hearings and the related costs of legal representation.

Conclusion

This study aimed to identify dispute factors and the related consequences on a case study involving the construction of a road to commercial premises. The subject of the analysis involved a critical evaluation of the interaction of individual factors both in terms of the dispute categories and the life cycle of the project. The mutual interactions are depicted in casual diagram (Figure 6), which shows the process in which a dispute becomes increasingly more complex and thus more difficult to resolve by reaching a mutually acceptable compromise solution.

Presented research is not without limitations. As this is a case study of one particular project, the observations and conclusions reached herein cannot be generalised to the entire construction sector. However, due to the high level of complexity of the analyzed case in the perspective of the life cycle, substantial implications can be derived not only for practice but also for theory.

This paper provides two main managerial implications. Firstly, the discussion of the case study brings several recommendations on how to avoid potential problems based on lessons learned from the situation that occurred in the studied project. Secondly, the conducted analysis shows that in case of protracted disputes arising from insufficient documentation, determining the party responsible for defects becomes extremely difficult.

From a theoretical perspective, performed analysis contributes to the current body of knowledge by highlighting potential undesirable growth in project complexity in relation to inexpert and controversial steps of the parties to the dispute. Furthermore, the findings presented extend our understanding of the long-term effects of contract management problems within

individual stages of the project life cycle on both parties involved in the dispute and within iron triangle dimensions.

In order to reach generalisable findings in the area of transport construction projects, further project case studies should be analysed; in aggregate, they would have the potential to identify recurring negative scenarios, project inflection points and possibilities for general improvement in the area of contract management.

Data availability statement

The data analyzed in this study is subject to the following licenses/restrictions: business case of dispute. Requests to access these datasets should be directed to hanak.t@fce.vutbr.cz.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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