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Assessment of Contract Change Orders and Their Impact on Contractor Performance in Construction Projects

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Abstract.

Contract Change Orders (CCOs) are a major challenge in construction projects, directly impacting cost, time, and quality. Contract changes can occur at various stages of project implementation and are influenced by a variety of technical and non-technical factors. This study aims to identify the causes, impacts, and control strategies for CCOs by analyzing 30 scientific articles from Google Scholar. The method used was a literature review, selecting relevant journals based on keywords, topic suitability, and completeness of research information. The analysis results indicate that the main causes of CCOs include mismatches between design and field conditions, planning errors, incomplete technical specifications, additional owner-scope of work, and external factors such as weather, material price increases, and policy changes. The impact of CCOs appears significant on cost overruns and time overruns, with some projects experiencing contract value increases of more than 25% and delays of more than 30%. In addition, CCOs also affect productivity, work quality, and the potential for disputes between parties. This study emphasizes the importance of thorough planning, high-quality design documents, inter-stakeholder coordination, and the use of analytical methods in change management as mitigation strategies to minimize the frequency and impact of CCOs. These findings are expected to serve as a reference for academics and practitioners seeking to improve the effectiveness of construction project management.

Keywords: Construction Project Management; Contract Change Order; Cost Overrun; Time Overrun; Variation Order.

1. Introduction

Construction activities are highly complex and involve many parties, including project owners, consultants, and contractors. This complexity increases the likelihood of changes during project implementation, which are formalized through a Contract Change Order (CCO). A CCO is a change in the value, volume, specifications, or time of work compared to the initial contract. This phenomenon almost always occurs in construction projects, whether for buildings, roads, bridges, or other public facilities (Martanti, 2018; Sayfuddin & Syakirin, 2024; Wibowo et al., 2023). Various studies have shown that CCOs can occur in all project phases, from pre-construction, implementation, to post-construction. The causative factors are very diverse, such as design changes, mismatches between working drawings and field conditions, project site characteristics, the need to optimize building functions, and unforeseen events such as extreme weather or pandemics (Elssyadiana et al., 2024; Firdaus Alrizal et al., 2023; Mangampa et al., 2022; Martanti, 2018; Nurisra et al., 2024). In addition, several studies also confirm that administrative problems and the low quality of planning documents are dominant triggers for the emergence of CCO (Khosro et al., 2019; Rezouki, 2022; Sukardi & Biantoro, 2025).



The impacts of CCO are generally directly related to project performance, particularly in terms of cost, time, and quality. Changes in work volume, design revisions, or additional work items often lead to cost overruns, extended durations, cash flow disruptions, and decreased labor productivity (Alzara, 2022a; Maulana, 2016; Msiska & Mashwama, 2022; Putri et al., 2020; Setyawan et al., 2020; Wibowo et al., 2023). In some cases, CCO also causes disharmony in working relationships between the parties involved and gives rise to potential contractual disputes (Hansen & Nindartin, 2022; Khalim et al., 2021).

On the other hand, several studies have shown that not all CCOs are negative. Changes can be a solution to field conditions that do not align with planning, thus improving the alignment of work with actual project needs (CCO, n.d.; Devedo & Lestari, 2025; Nusantara, 2022). However, without proper change management, CCOs can trigger budget overruns and significant project delays.

The diverse causes and impacts of CCO underscore the importance of a comprehensive understanding of CCO patterns, trends, and characteristics, informed by previous studies. Therefore, this study used a literature review, analyzing 30 scientific articles on the causes, impacts, and strategies for handling Contract Change Orders across various types of construction projects. This review is expected to provide a comprehensive overview of CCO dynamics and serve as a basis for formulating mitigation strategies to improve project performance in the future.

2. Method

This study employed a qualitative approach using a literature review, collecting, reviewing, and analyzing 30 scientific articles on Contract Change Orders (CCOs) in construction projects. This method was chosen because it provides a comprehensive understanding of the causes, impacts, and strategies for managing CCOs, based on previous research.

2.1 Data source

All data in this study comes from a literature review, comprising 30 scientific articles obtained through the academic search engine Google Scholar. Google Scholar was chosen because it provides broad access to scientific publications from various national and international journals and facilitates article searching based on relevance and keywords.

2.2 Data Collection Procedures

The data collection process is carried out through the following stages:

a. Keyword Identification

- The literature search was conducted using the following keyword combinations:
- “Contract Change Order.”
- “Change Order in Construction Projects.”
- “Variation Order.”
- “Change Order Cost and Time Impact.”
- “Factors causing change orders.”



These keywords were used to ensure that the articles found were directly relevant to the research topic.

b. Inclusion Criteria

Articles were included in the analysis if they met the following criteria:

- 1) Discussing CCO or Variation Order in construction projects.
- 2) Describes the causes, impacts, or strategies for handling CCO.
- 3) It is a published scientific article or research report.
- 4) Provides complete research abstracts and information.

c. Exclusion Criteria

Articles were excluded from the analysis if:

- 1) Not directly related to the CCO topic.
- 2) Does not contain research data that can be analyzed.
- 3) It is just an opinion without any methodological basis.

d. Literature Selection

From the initial search results, various articles were found and then selected based on title and abstract. This process resulted in 30 articles deemed relevant and meeting the inclusion criteria.

2.3 Data Analysis Techniques

Literature analysis is carried out through the following stages:

a. Information Extraction

Each article was reviewed to extract the following data:

- Factors causing Contract Change Orders
- The impact of CCO on project time, cost, quality, or performance
- The analysis method used by each study
- Proposed mitigation strategies

b. Thematic Categorization

All extracted information was then categorized thematically into three main groups:

- 1) Causes of CCO
- 2) The impact of CCO on project cost, time, quality, and performance
- 3) CCO management or mitigation strategies

The thematic analysis method was chosen because it can identify recurring patterns across various research results, for example, consistent findings regarding the dominance of design change factors, mismatches between field images, and owner requests.

c. Narrative Synthesis

After grouping themes, a narrative synthesis was conducted to connect the findings across studies. This approach helped formulate comprehensive conclusions regarding trends, similarities, and differences in findings across articles.



2.4 Data Validity

The validity of the research is strengthened through:

- Triangulation of literature sources by taking data from various country contexts and project types (roads, buildings, bridges, public facilities).
- Consistency of results between journals showing recurring patterns.

3. Result and Discussion

An analysis of 30 journals reviewed shows that Contract Change Orders (CCOs) are a phenomenon that almost always occurs in construction projects, whether for buildings, bridges, roads, or other public facilities. All studies confirm that CCOs arise due to planning dynamics, mismatched field conditions, suboptimal project management, and strategic decisions by project owners. Through a comprehensive review of the abstracts and core findings from each journal, recurring patterns emerge regarding the causes, impacts, and strategies for handling CCOs.

Table 1 provides a comprehensive overview of the characteristics of the 30 journals analyzed. A summary table is presented below, listing the brief title, research focus, primary causes, and primary impacts for each study. This table serves as the basis for the thematic synthesis discussed in the following sections.

Table 1. Literature articles

No	Title	Research Focus	Main Causes of CCO	Main Impacts of CCO
1	Analisis Faktor Penyebab Contract Change Order Dan Pengaruhnya Terhadap Kinerja Kontraktor Pada Proyek Konstruksi Pemerintah (Martanti, 2018)	Causes & impact factors	Image-field mismatch, design error	Material, cash flow, and labor disruptions
2	Analysis Study Of Change Contract Order (CCO) Management On Construction Project Implementation Performance In Central Lombok Regency (Sayfuddin & Syakirin, 2024)	Causal & Influential Factors	Need for additional volume	Increased production, disruption of implementation
3	Analysis Of Contract Change Order (CCO) Costs In Building Construction Projects (Wibowo et al., 2023)	COR, CORA, CORS analysis	Design changes, BQ inaccuracy	26% increase in contract value
4	Analisis Pengaruh Penyebab Change Order Pada Pembangunan Apartemen Bess Mansion (Firdaus Alrizal et al., 2023)	Factors & influences	Owner's decision, design error	62.4% influence on project quality
5	The Causes Influencing The Occurrence Of Variation Orders In The Construction Of Buildings (Rezouki, 2022)	Three-way perspective	Financial, material specifications, and technical	Owner–contractor–consultant conflict



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No	Title	Research Focus	Main Causes of CCO	Main Impacts of CCO
6	Exploring The Impacts Of Change Orders On Performance Of Construction Projects In Saudi Arabia (Alzara, 2022a)	Impact & solutions	Poor coordination, design changes	Dispute, specification changes
7	Impact Of Variation Orders On Construction Project Cost And Time (Msiska & Mashwama, 2022)	Project performance impact	Number of variation orders	Cost, time, and logistics are disrupted
8	Factors Affecting Project Performance Of Building Construction Projects In Federal Capital Territory (FCT) Abuja, Nigeria (Simon-Eigbe et al., 2022)	Project performance factors	Material prices rise, designs change	Time overrun, quality decline
9	Analisis Contract Change Order Terhadap Waktu Pada Proyek Pembangunan Stasiun Kereta Api Makassar-Pare Pare (Mangampa et al., 2022)	Causes & impacts	Force majeure, design revision	Delay & overhead increases
10	Investigating Variation Orders Causes In Iraqi Building Construction Projects (Alhilli & Rezoqi, 2021)	Identify the cause	12 factor groups (CBS)	Potential dispute
11	Evaluating The Pricing Strategy For Change Orders Between General Contractors And Subcontractors Using ET-SD Model (Lin & Lai, 2020)	CO pricing strategy	Contractor–subcontractor payoff strategy	Price inefficiency
12	Assessment Of Change Orders Attributes In Preconstruction And Construction Phase (Khoso et al., 2019)	Phase comparison	Specification & design errors	Delay in work
13	Analisis Faktor Penyebab Contract Change Order (CCO) Terhadap Proses Pelaksanaan Pembangunan Gedung Rumah Sakit Kabupaten Bangli (Wardani et al., 2023)	Dominant factors	Volume increase	Influence 7.74%
14	The Potential Causes Of Contractual Change Orders Sourced From The Construction Phase Of The Building Project	Causes of CCO	Bad weather, soil conditions	Time disturbance
15	Study On Change Order Impact On Project Lifecycle (Nurisra et al., 2024)	Lifecycle influence	Scope change, field conditions	Significant cost increases
16	Causes Of Variation Order And The Impact On Project Cost Building In Sudirman (Putri et al., 2020)	Causes & impacts of costs	Design changes	Costs increased by 4.78%
17	Analysis Of Contract Change Order (CCO) Factors, Which Affect The	Dominant factors	Image–field mismatch	Significant influence



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No	Title	Research Focus	Main Causes of CCO	Main Impacts of CCO
	Fly Over Work (Case Study Of The Cisauk Fly Over Development Project (Sukardi & Biantoro, 2025)			
18	Evaluasi Penerapan Contract Change Order Sebagai Solusi Permasalahan Perubahan Lingkup Kontrak (Nusantara, 2022)	Causes & value analysis	Consultant, owner, contractor	CPI low, SPI changes
19	Analysis Of Contract Change Order (CCO) In The Samarinda Road Preservation Project (Devedo & Lestari, 2025)	Causes & management	Price fluctuations, design revisions	COR & CORA 2.54%
20	Analysis Of The Effect Of Contract Change Order Factors On The Performance Of Road Facility Projects (Qomariah & Susetyo, 2024)	Cost-time performance	Specification changes	Cost performance increased by 59%
21	Analysis Of The Influence Of Change Contract Order, Labor, Materials, And Tools On The Performance Of The Implementation Time Low-Rise State Building Project (Tobing, 2025)	Influence of energy/material	CCO + manpower + material	Time performance dropped 74%
22	Profiling Contract Change Order Disputes: An Empirical Validation Study (Hansen & Nindartin, 2022)	Dispute	Factors causing disputes	Recurring dispute profile
23	Risk Evaluation Causes Of Contract Change Order To Improve Cost Performance On Railway Construction Project (Setiawan & Riantini, 2021)	Risk identification	Technical, legal, environmental	Cost performance impact
24	Faktor Penyebab Terjadinya Contract Change Order (CCO) Dan Pengaruhnya Terhadap Pelaksanaan Proyek Konstruksi Pembangunan Bendung (Maulana, 2016)	Budget & time	Design changes	Contract value increased by 25.11%
25	Development of a Model For Controlling Contract Change Orders in Pier Project (Case Study In North Sulawesi, Indonesia) (Waney et al., 2017)	CCO Control	Construction factors, admin	Prediction model
26	Evaluasi Faktor Penyebab Terjadinya Contract Change Order (CCO) Pada Proyek The Hava Villa (Setyawan et al., 2020)	Causes & impacts	Design changes	Time +35%, cost +9.47%
27	Analisis Contract Change Order Pada Pelaksanaan Proyek Apartemen Alton Semarang (Khalim et al., 2021)	Factors & strategies	Imperfect design	Cost & time not achieved



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No	Title	Research Focus	Main Causes of CCO	Main Impacts of CCO
28	The Contract Change Order Analysis Of Bridge Construction Employees Of Big Hall Projects Implementation Of National Road Which Influences The Time Performance (Kartini & QA, 2024)	Dominant factors	Weather, job mismatch	Influence on time
29	Identifikasi Dan Analisis Sebab Akibat Contract Change Order Terhadap Biaya Dan Waktu Pada Proyek Konstruksi (Kurniawan & Garside, 2021)	Cause and effect	Different field conditions	Time & cost impact
30	Analisis Pengaruh Dan Penyebab Contract Change Oreder (CCO) Terhadap Waktu Pelaksanaan Pada Proyek Pembangunan Gedung Kantor (DPMPTSP, Disnaker, Diskes, Dan Capil) Kabupaten Gianyar (Elssyadiana et al., 2024)	Causes & impacts	Scope addition/reduction	Costs up 2.6%

After examining the table, it is clear that the pattern of CCO causes across the literature is relatively consistent. Nearly all journals note that CCOs arise from three major categories: technical, administrative, and external. Technical causes are most frequently found in building, road, and bridge projects, primarily in the form of inconsistencies between drawings and field conditions, differences in work volume, and design errors detected during the work (Elssyadiana et al., 2024; Firdaus Alrizal et al., 2023; Khalim et al., 2021; Martanti, 2018; Sukardi & Biantoro, 2025). In some journals, design errors are listed as the largest driver, contributing to more than half of the number of contract changes, particularly in urban infrastructure projects (Putri et al., 2020; Setyawan et al., 2020).

From an administrative perspective, numerous journals reveal that inaccurate planning documents, such as incomplete specifications, inaccurate Bill of Quantities (BQ), and an unclearly defined scope of work, are the dominant causes of CCO (Khoso et al., 2019; Qomariah & Susetyo, 2024; Rezouki, 2022; Wibowo et al., 2023). These deficiencies lead to multiple interpretations and the need to add or change work items mid-project. Furthermore, weak coordination among contractors, consultants, and owners contributes to the increased frequency of changes.

Regarding external factors, various studies have shown that extreme weather, unexpected geotechnical conditions, rising material prices, changes in government policy, and even force majeure, such as the pandemic, contribute to contract changes (Devedo & Lestari, 2025; Kartini & QA, 2024; Mangampa et al., 2022; Nurisra et al., 2024; Simon-Eigbe et al., 2022). These factors are generally unavoidable, leaving contract changes as the only realistic option to maintain project continuity.

A review of the impacts shows that CCO almost always results in cost overruns, time overruns, and decreased quality performance. In many studies, the cost increases caused by CCO range from relatively small (around 2–10%) to very large, exceeding 25% of the initial contract value (Maulana, 2016; Putri et al., 2020; Setyawan et al., 2020; Wibowo et al., 2023). The impact on time is even more significant; some projects have reportedly experienced delays



of more than 30% due to rework and increased work volume (Setyawan et al., 2020; Tobing, 2025). In some cases, even though the cost increases are not significant, delays still occur because the change approval process is lengthy or requires repeated design revisions (Elssyadiana et al., 2024).

The research “Exploring The Impacts Of Change Orders On Performance Of Construction Projects In Saudi Arabia.” (Alzara, 2022b)

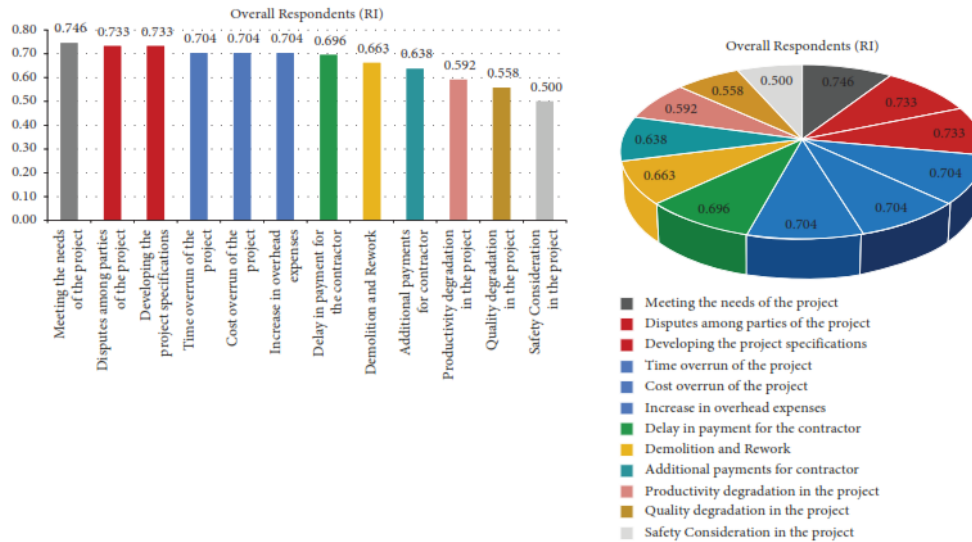


Figure 1. Frequency of impact of change orders on the project

The survey results showed that CO had the greatest impact on meeting project needs, resolving conflicts between project parties, and changing project specifications. In addition, CO also caused time delays and additional costs. Interviews with experts identified that the negative effects of CO can be mitigated by thorough initial planning, clear design criteria, and the involvement of experienced consultants.

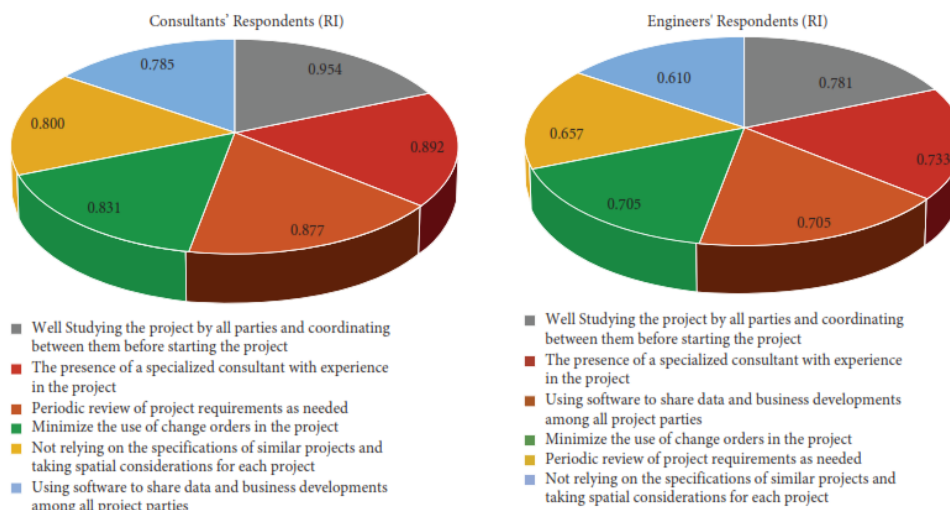


Figure 2. Consultant and Engineer responses

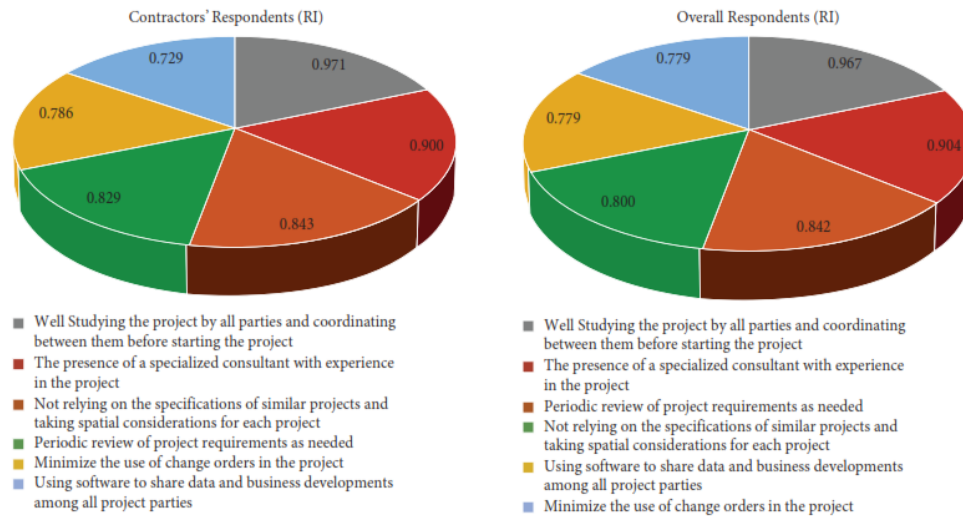


Figure 3. Contractor and Overall Respondents responses

The Research (Alzara, 2022) recommends several preventive measures to reduce the impact of CO, such as in-depth studies by all parties before the project begins, regular monitoring of project needs, and the use of specialist consultants. In addition, the use of software to share data among all project parties is considered important for facilitating better communication and decision-making.

Beyond cost and time, CCO also impacts relationships between parties. Numerous journals have revealed that contract changes can trigger tension, lack of trust, or even disputes between owners and contractors, particularly if they are not managed transparently or supported by strong technical evidence (Alzara, 2022a; Qomariah & Susetyo, 2024). This is one reason several studies have advocated the use of more comprehensive, digital change documentation systems.

In the mitigation strategy section, all journals agree that the most crucial step is improving the quality of planning documents, through more detailed design development, earlier field verification, and refinement of the BQ and specifications from the start of the project (Firdaus Alrizal et al., 2023; Khoso et al., 2019; Sukardi & Biantoro, 2025). Furthermore, improved coordination between parties, the use of analytical models such as Earned Value Analysis or Change Order Ratio, and a risk management approach are also recommended to reduce the frequency and impact of CCOs (Nusantara, 2022; Setiawan & Riantini, 2021; Waney et al., 2017).

Overall, this study demonstrates that while CCOs are inevitable, their causes and impacts can be predicted and controlled through enhanced planning, coordination, and the use of analytical techniques in construction project management. The summary table above demonstrates the commonality of findings across contexts and emphasizes the importance of document readiness and effective communication for successful contract change control.



4. Conclusion

Based on an analysis of 30 journals discussing Contract Change Orders (CCOs) across various types of construction projects, it can be concluded that CCOs are almost unavoidable in project implementation. Although contract changes can occur at all phases of the work, the literature indicates that most CCOs are triggered by problems at the planning stage and by field implementation conditions. The most dominant causes include mismatches between design drawings and actual conditions, design errors, incomplete technical specifications, and differences in work volume. In addition, external factors such as weather, material price increases, policy changes, and extraordinary events contribute significantly to contract changes.

The impact of CCO on project performance is significant and consistent throughout the literature. Contract changes can lead to cost overruns, extended implementation timelines, and reduced work quality. In many cases, contract values increase by 2% or more, while delays can reach more than 30% of the initial plan. Furthermore, CCO also has non-technical impacts such as decreased productivity, disrupted logistics flows, and tensions or disputes between owners, contractors, and consultants.

While CCO cannot be completely eliminated, various studies confirm that its impact can be minimized by improving planning quality, particularly by ensuring complete working drawings, an accurate Bill of Quantities, and clarity of the scope of work from the outset of the project. Inter-party coordination has also proven to be highly effective in reducing the frequency of contract changes. Furthermore, the use of analytical approaches such as Earned Value Management, Change Order Ratio, and risk prediction models can help identify potential changes earlier and manage their impact more effectively.

Overall, this literature review indicates that the causes and impacts of CCO can be predicted and controlled if projects implement thorough planning, strong communication, and a structured change control system. By understanding the trends in the causes and consequences of CCO from previous research, project stakeholders can formulate more appropriate mitigation strategies to maintain cost, time, and quality performance throughout the construction process.

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