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A REVIEW OF MAJOR CAUSES OF VARIATION REQUESTS IN THE CONSTRUCTION INDUSTRY

Hamza Ali Abdel Salam
E-mail: Hamza_ali@su.edu.ly

Department of Civil and Architectural Engineering , Faculty of Engineering, Sirte University, Sirte, Libya.

Abstract
Construction projects are vulnerable due to their unique qualities, and they are influenced by a variety of external and internal causes. Because of their actions, a large number of project participants produce variances in the scope and design of the projects. Natural causes can also play a role in variation requests for construction projects. Variations have a number of negative consequences in construction projects. The building sector is also influenced by a number of elements that are unique to the country. In this context, the goal of this study is to learn more about the causes and consequences of building project variances. A quantitative poll of engineers and construction management experts working in public works was used in the study, in addition to a thorough literature review public and private development projects The study concludes that differences are caused by a lack of coordination among the parties and changes in specifications by the owners, based on a review of the literature and a survey. The report also shows that the most significant impacts of building project variances are schedule overruns and cost increases. According to the findings of the survey, contracting organizations examine price terms and timing agreements when signing contracts. The study has identified a few topics for future research and knowledge expansion in the subject.
Keywords: Variation Order, Construction Industry, causes, types, Impact, effects,

1. INTRODUCTION

Un scheduled modifications in construction contracts are unavoidable, and they frequently result in more work than anticipated. Such extra effort is likely to increase the cost and length of time it takes to complete the construction project. The parties' interpretations of the contract's provisions are bound to differ, which could lead to modifications in the scope of work. However, because the parties to a construction contract have differing perspectives, there are more potential for disagreements to occur between owners, contractors, and subcontractors. Furthermore, in today's environment, because construction deadlines are compressed for speedier completion, construction activity begins even before the final design is finalized (Chen & Hsu, 2007). This could lead to erroneous design in the future. owing to the Changes in the industry's demands and preferences, as well as changes in the employers' needs from contractors, are unavoidable. All of these variables have resulted in a considerable increase in change orders in building projects, which frequently result in disagreements among the project's numerous partners. It must be understood that owners and design experts must have the ability to issue change orders so that suitable alterations in building projects can be made to meet the employers' specific

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needs. Any construction project is subject to change orders, which are defined as any modification to the construction contract's original scope. Such adjustments could have a substantial impact on construction time, cost, and quality. If the contractor is unable to complete the project, If you don't manage the modifications quickly enough, you can run into serious problems with the project's completion, which could result in claims.

Contractors must also be willing to carry out these change orders, but they must be adequately compensated for the extra time and expense involved in doing so. Although the owners are aware that change orders will have an impact on certain tasks, they are unaware of the ramifications that such modifications may have on the overall project timetable. Because of the connectivity between different operations in mechanical building, changes in one activity are likely to affect changes throughout the entire project, according to (Coffman 1996)

The higher cost of modification orders to contractors will be reflected in the need for additional materials, as well as conflicts. in the timetable of existing project operations, instances of rework of already completed work, a halt in the project's progress, and lower labor efficiency Change orders have a financial consequence The majority of the items impacted by modification orders are measurable. However, measuring the impact of change orders on labor efficiency is difficult. As a result, change orders may substantially stymie the development of construction projects. Because Change orders are risky for both the contractor and the employer, and they must be accepted and managed correctly. In this context, this study seeks to learn about the impact of variation orders from all project stakeholders, including clients, consultants, contractors, and subcontractors, as well as the problems that have arisen as a result of variation orders, as well as possible solutions to the problems and issues that have arisen as a result of variation orders. Weather conditions, a lack of cost data, a scarcity of resources, a scarcity of competent contractors, and frequent design modifications by employers all tend to effect the building business.

2. LITERATURE REVIEW

2.1 Introduction

The effect of change orders on the productivity and efficiency of building projects has been the subject of numerous studies. The causes and effects of change orders on public building projects were examined by Alnuaimi et al. in (2010). Four significant initiatives were the subjects of case studies in the study. The study discovered that the most significant reason for modifications in construction projects is altered owner requirements. It also discovered that these changes caused delays in project completion and cost overruns. A methodology to calculate the losses on variation orders was published by Moselhi et al. in their 2005 study on the impact of variation orders on labor productivity. This methodology examined the timing of modification orders to identify numerous aspects influencing productivity have a significant impact on the timely completion of the project. Keane et al. (2010) offered a number of recommendations to prevent or reduce the frequency of modification orders in construction projects. In their 2003 study, Lee et al. looked at the effects of repeated change orders on production and proposed ways to measure the productivity losses brought on by these orders. Hanna and Swanson's (2007) research concentrated on the types of alterations that might be made to various construction projects and identified compensation that might be due to contractors for each sort of alterations. The findings of all these studies are pertinent to how the construction sector operates \ because there are more change orders due to frequent modifications to the owners' specifications.

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2.2 Previous Study on Changes in Construction Projects

Variation orders are prevalent across all categories of construction operations, according to literature on construction project management (Thomas et al. 2002, Oladapo, 2007). The existence of variation provisions in all varieties of construction contracts, according to Ssegawa et al. (2002), suggests that every project will involve some kind of variation. Change orders are most likely to negatively affect a project's completion time and cost. Cost and time overruns will eventually be the outcome of design revisions. Since there are no ideal designs in building contracts, owners frequently need the freedom to revise the plans and gain from the adoption of better technologies dvancements. Alternately, in some circumstances the owner might prefer that the contractor assume the risk of unforeseen events. Hanna & Swanson (2007) identified three categories of changes: cardinal changes, which are regarded as a breach of the contract's terms; actual or directed changes, which are requested by the owner or his representative and which have the agreement of all parties; and constructive changes, which result from divergent views between the owner and the contractor about the contract's parameters. Cardinal modifications can happen when the owner authorizes the contractor to perform operations outside the scope of the contract and when the owner makes several requests that could result in comprehensive adjustments.

Agreement between the parties on deviations from the initial terms of the contract. According to Alnuaimi et al. (2010), different countries may have different reasons for issuing variation orders. The researchers discovered that modification orders are typically issued in greater numbers in developing nations than in wealthy nations In 130 of the examples examined, Al-Momani (2000) discovered that alterations brought about by the owners were one of the main causes of project completion delays. According to Goudreau (2001), among the crucial factors that raise the cost and length of a construction project's completion are the inability to pay contractors on time, the initiation of change orders, and discrepancies in the contract agreements. Change orders were the third significant factor discovered by Acharya et al. (2006) for conflict's occurrence in construction projects. Assaf and Al-Heiji (2006) found that "change order" was the most often cited cause of project delays among clients, consultants, and contractors in their investigations of 76 Saudi Arabian projects. The influence of modification orders on Saudi Arabian construction projects is supported by the findings of all these earlier research. However, the justifications for change orders might differ from nation to nation and from one project to another. Study Aiyetan et al (2013) looked at the causes of rework in Nigerian public construction projects. Based on the questionnaire survey, they identified 71 rework issues and divided them into three categories relating to the customer, contractor, and design. According to their research, the five main reasons of construction rework are incorrectly laid forming courses (blockwork), poor concrete quality, incorrect client requirements interpretation, poor communication, and insufficient construction planning.

Based on a questionnaire survey, Zaiter et al. (2017) investigated the causes of building projects in the Caza strip that were reworked. They came to the conclusion that there were 57 reasons for the building rework, which they classified into 7 groups. The major reasons for the reworks, according to their findings, included contractor efforts at fraud, competitive pressure from low contract value, inefficient management and decision-making, scheduling demands during the building process, and a lack of job security competence. Based on 86 contractor participation, Mahamid (2016) analyzed the reasons for rework in residential structures in the West Bank. He found 43 rework reasons and grouped them into five categories. According to his results, the main reasons for rework included poor client contact with the contractor and consultants, the use of low-

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quality materials, bad site management, and poor communication with the design consultant.

Ye and Skitmore (2014) conducted research on the reasons of rework in Chinese building projects. Based on 277 variables, they identified 39 significant factors Using surveys, 11 groups were created. The most important factors, according to their findings, were unclear and ambiguous project process management, poor quality of construction technologies used, use of poor construction materials, active rework made by the contractors to improve quality, and design error or omission due to an excessive number of design tasks and time boxing.

Raghuram and Nagavinothini (2016) conducted research on the reasons behind rework in Indian building projects. 40 reasons for rework were found in their investigation, which they divided into five categories based on the customer, design, construction, site, and subcontractor. The most often occurring reasons for rework were found to be mistakes resulting from improper construction techniques, a lack of qualified supervisors, poor labor skill levels, non-compliance with the specification, and a lack of expertise and understanding of the design process.

Jarkas et al. (2015) conducted research on the reasons of rework in Qatari construction projects. 36 delays were identified by the study, and they were divided into 4 main categories: client, designer, contractor, and exogenous. They discovered that the five main reasons for rework were: frequent modifications during the building phase; confusing contractual conditions and requirements; inadequate design details at the tendering stage; faults and omissions in design drawings; and a lack of trained labor.

3. TYPES AND CAUSES OF VARIATIONS REQUESTS

In practically all building projects, variations become an unavoidable component (Ibbs et al. 2001). In order to satisfy his diverse needs, the owner may choose to alter the contract's scope at any point while the project is still in process. Similar to this, adjustments in the project's parameters may be necessary due to market conditions. The engineer may opt to modify the design or building process in light of the most recent technical advancements, which will also result in changes to the construction project. As a result of the engineer's examination of the design, adjustments may be made to enhance or optimize the design and subsequently the project's operations. Additionally, mistakes or omissions during engineering or construction may necessitate a revision. All of these variables, in addition to a number of others, call for costly and often unwelcome reforms (Arain & Pheng, 2010).

Therefore, a variety of reasons may be the cause of differences. This chapter discusses several variables that could affect how building projects turn out.

3.1 Types of Variations

Changes can be categorized in a variety of ways depending on their goals. Depending on the reason for the change, changes in a construction project can be categorized. A classification of changes based on originator is ideal since it makes it easier to determine the cost impact of changes. There are several known circumstances that resulted in the issuance of change orders. More than 52% of variant orders are the result of design revisions, which are the main source of variations (Burati et al. 1992). Design modifications fall into one of two categories: I variations coming from advancements in the design process. Changes required as a result of reviewing designs, advancing technology, or reviewing activities from the perspective of constructability are a few examples of this type. (ii) Owner-initiated adjustments, such as modifications to the contract's terms and conditions; (iii) process modifications introduced by the architect or (Consultant acting in accordance with his area of expertise; these adjustments might

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involve adding instruments that could have an effect on the facility. Based on how these variations affect the contract's overall scope, revisions can be categorized. These changes entitle the contractor to a revision in the project schedule in addition to cost adjustments, subject to the terms of the contract. They are I additive changes involving additional work to the scope, (ii) deductive changes eliminating some activity and thereby reducing the scope of the contract, (iii) rework caused by a deficiency in the quality of work already completed, and (iv) changes necessitated by force majeure.

A third method of categorizing the modifications is based on the steps taken to implement each change. From a legal perspective, this classification of the modifications is significant. The two types of changes are I formal or directed change, which occurs when the owner or his representative introduces the change through the application of a change clause in the contract, and (ii) constructive change, which is caused by the owner or his representative's actions or failure to take certain actions. The owner's actions or inaction usually do not qualify as changes, making them potential grounds of contention and subsequent claims. Inaccuracies in the contract contracts or incorrect interpretations of the terms by the parties involved occur as a result of the companies. Cardinal alterations are adjustments made to a construction project that are outside the parameters of the contract (iii). Only when the entire contract has been renegotiated or the entire contract's scope has been clarified are these adjustments put into effect.

3.2 Causes of Variations Requests

In their study (Aibinu and Jagboro 2002) examined how delays affect construction projects. The implications of delay were listed by the authors as "time overrun, cost overrun, dispute, arbitration, total abandonment, and litigation." Koushki et al. (2005) noted that the selection process for materials and their accessibility on the local market will cause cost and schedule overruns. The performance of the contractors is affected by delays in construction projects, which also cause disagreements between the parties, low productivity, and higher construction expenses.

(Sambasivan and Yau (2007) noted that client-related and contractor-related issues such the contractor's lack of experience and the client's interference would cause a time overrun if the owner. According to Koushki et al. (2005), the primary reasons for cost overruns in building projects include problems with the contractor, problems with the materials, and financial limitations. Inflation-driven increases in material costs, client-requested design changes, design flaws, bad weather, a delay in paying contractors' bills, and problems with the quality of building work all contribute to disagreements and delays in construction projects, according to Wiguna and Scott (2005). Hegab and Nassar (2005) discovered that project start-up delays contributed to schedule overruns later on According to(Ebsworth & Ebsworth 2008), providing false information during the Arain and Pheng (2010) conclude that reviewing the designs will cause delays and drive up the project's cost. More than 52% of the delays are attributed to design modifications, which are the main reason for variant orders (Burati et al. 1992). Construction projects are delayed as a result of variation orders that are issued for various reasons. According to Harbans (2003), even though a project has undergone meticulous planning, it is still likely that changes will be required as construction moves forward, which will delay the project's completion. Due to the nature of the work required and the foregoing causes, building contracts allow for probable modifications (Finsen, 2005). Variations may happen due to number a variety of factors, including advancements

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in construction (Ssegawa et al., 2002). Construction delays are a common effect of variation orders.

3.2.1 Variations Throughout the Project's Progress

The course of many events, which have unpredictable alterations, can have an impact on the construction process. These factors could result from different sources. These sources comprise the actions of the parties involved in the building, the accessibility of resources, the environment, the participation of other parties, and contractual relationships Furaih,n.d (2011). It's interesting how some of these characteristics create possibilities for expanding the construction projects already underway. The modifications brought on by changes to the building works are covered in this section. In order for the construction project to match the owner's expectations, additions are typically recommended by the owner. Due to inadequate planning at the point where the project scope is determined, owners are likely to change the plans or scope of the work. The owner's absence from the project's planning and design stages may also be to blame for the addition of new works. In most cases, the owner will be responsible for covering the cost of improvements if they are added to the project to benefit the owner. In some cases, the contractor could provide suggestions for improvements to the project to improve its performance and speed its completion. Even in these circumstances Since the owner would ultimately benefit from any improvements made to the contract works, the contractor may be required to carry out modification orders given by the owner at the owner's expense.

Changes in how employers see employees' health and safety may also have an impact on additions. Given that the number of employees is expected to rise and that such arrangements are required under the relevant labor rules, it might be necessary, for instance, to add health clinics or child care facilities to an industrial building.

If certain specific project criteria are not included, variation requests may result. It will be necessary to issue variation orders if certain owner requirements aren't included in the contract agreements or design specifications (Hanna et al. 2002). It is possible that when designing the construction project, the design team overlooked taking unusual ground conditions or neighborhood issues into account. Certain of these elements might result in changes to building contracts. The omissions can potentially be related to various health and safety issues that the design team failed to take into account. Certain omissions are likely to have a major influence on the work time and expense, even though most contracts include a language that addresses variants of these omissions in the construction clause. When this occurs, the parties must consider the costs and timing of the modifications on account of omissions before issuing a variation order that modifies the terms of the existing contract

Similar to this, changes to construction projects are frequent. The recommended changes might be made to make life easier for the contractor or the owner. To carry out the building activities effectively in some cases, changes may be required. These modifications could be made to the construction process or to previously completed work. In any event, the economic impact of the differences resulting from the suggested modifications is a crucial consideration for assigning responsibility to a specific party. If the suggested changes are made to help the contractor, the variation orders must be carried out at the contractor's expense. If changes are required for the project to be completed effectively, both parties may agree to split the cost and grant more time Variation requests coming from additions, omissions, and adjustments to be made during the construction process are more frequent in the context. The owners'

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lack of technical understanding to comprehend the design team's work or what the design specifications mean is the cause of the rise in variant requests. They are not included by the owners in conversations about the technical facets of the construction projects either. Some of the design elements won't live up to their expectations until the project is actually built, however. The owners frequently request revisions in the designs in the form of additions, deletions, or alterations since they are unable to clearly articulate their expectations for the project. Based on current economic conditions, the owners may in some cases decide to revise the construction designs. The economic scenarios may alter during the course of the development process because construction projects have a long gestation time. The owners would desire to have the constructions updated depending on the economic fluctuations. More variant requests from the owners would result from this varations.

3.2.2 Client and contractor variation requests

A construction contract variation can be categorized as "one of the following: an unavoidable variation; a variation for the client's convenience; or a variation for the convenience of the Contractor (or Consultant)" (New South Wales Government, 2008). Changes that the owner requests because his expectations have changed are included in the modifications made to help the customer. Since it is still possible to proceed with and complete the project without making the suggested alterations, these changes don't indicate inescapable deviations. The majority of client-initiated changes will nearly always affect the contract's scope and incur extra expenditures. Even the recommended changes to narrow the scope of the job can incur some extra costs. "This is so that variations may be evaluated by reducing the contractual value of the work removed from the contract and adding the cost of the additional work, plus a margin. The real cost of the additional work can frequently exceed the contractual value of the job that was omitted from the original contract" (New South Wales Government, 2008).

The costs connected with the reworks proposed under the variation as well as the delays and disruptions brought on by variations requested to assist the customer would raise the project's overall budget. Before any modifications to assist the customers are ordered to be carried out, the necessary funds must be provided and the modifications must be approved. The amount offered must be sufficient to pay for the extra expenses required to implement the adjustments. The cost in the event of modifications may include the contractor's real costs, losses, and extra fees, if applicable. The effects of modification orders on public building projects carried out in the Sultanate of Oman were examined by Al-Moumani in (2000). The study, which comprised case studies and a field survey, discovered that changes in owner needs are the primary reason that building projects change. The study came to the additional conclusion that changes in specifications result in completion delays, cost overruns, and claims against contract parties. The variations that are granted are those that the contractor requests for convenience. "Unavoidable variations" are these variances. It is The owner is not need to consent to an alteration that is designed to help the contractor. The change might, however, increase the project's worth The owner may take the request into consideration whenever a contractor requests a variation to help himself in order to maintain good relations with the contractor. It is crucial that the contractor gives the owner enough information so that the owner can properly assess the contractor's request for a change. Until he assesses the variation request and concurs for the entire impact of such modification, the owner may decide not to allow the variation to assist the contractor.

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The owner may also demand that the contractor assume full responsibility for ensuring that the proposed modification won't have an impact on the project's remaining operations.

3.2.3 The variation requests as a consequence of the Subcontractor

According to research undertaken by each of these companies, subcontractor-related issues represent a significant category that influences rework (Ye and Skitmore, 2014; Miri et al., 2015; El Hussein,2014; Love et al., 2004). In residential structures, the projected subcontractor-related portion of the overall rework cost is 10.54%. (Liu and Peng, 2018). The main causes of rework connected to subcontractors include poor communication between construction managers, poor coordination of subcontractors between upstream and downstream (contractor), poor communication among construction team members, and damage to the finished works (Ye and Skitmore, 2014; Liu and Peng, 2018). Inadequate subcontractor selection was also noted as a key contributor to the need for rework (Ajayi and Oyeyipo, 2015; Zeiter et al.,2017) The main subcontractor-related issues, according to Love et al. (200b, 2010), are an inefficient application of quality management methods, harm brought on by negligence, a lack of managerial and supervisory abilities, and the use of subpar materials.

3.2.4 Variation orders as a result of poor Human resources capability and supervisory related

According to research, the two primary causes of rework in Nigerian construction projects are subpar craftsmanship and poor managerial/supervisory abilities (Ajayi & Oyeyipo,2015). According to Zeiter et al. (2017), the most significant influences on human resources capabilities are poor management and decision-making, a lack of job stability, and a lack of talent. These characteristics are what lead to rework. Additionally, research done by have identified poor craftsmanship, insufficient supervision, a lack of qualified labor, a paucity of skilled supervisors, inadequate supervision, and imprecise instructions as important rework reasons (love et al.,2004b; Love et al.,2010; El Hussein 2014; Simpeh 2012).

To decrease rework in construction, skilled supervisors play a critical role. According to Alwi & Mohamed (1999), contractors that invest more money in training to improve their supervision abilities should expect to lower their rework costs by 11% to 22%. Table 7 provides a summary of the total of 14 rework variables connected to human resources competency and supervision.

3.2.5 Variations requests as a result of other causes

A construction contract may include variations due to a variety of reasons, including design considerations. A building project that begins before the design phase is complete is typically more likely to get variant requests (Finsen, 2005). Variations in work contracts could result from flaws, mistakes, or oversights in the planning or designing phases. These faults and omissions include inaccurate quantity estimates, poor planning, wrong citation of requirements in the contract documents, improperly arranging contract interfaces, and lack of consistency between drawings and site conditions. The planning and design department will be accountable for deviations brought on by design elements. To ensure the health and safety of employees, either the owner or the contractor may seek modifications .

Unforeseen circumstances can arise during various construction processes, and the contractor must take whatever action is necessary to keep the project on schedule while abiding by safety rules. Such modifications may be slight enough to force the construction to clear an unforeseen site path or truck route, or they may be so significant that project activities must be rescheduled or even a new construction approach must be adopted

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(Hseih et al., 2004) Typhoons and other severe weather events have an impact on how safely the building activity is progressing. It might be essential to modify the project's initial timetable in these situations, as well as in others like landslides and flooding, by issuing the requisite variation orders. Another significant source of variation, particularly when a project lasts a longer time, is a change in work regulations. The governing authority may amend the work norms and regulations that were in place during the planning and design stage later on, prompting the issuance of requests for variations. Similar to this, modifications to construction contracts are permitted when decision-making authority changes while the project is still in progress. As the decision-making authority have changed, the interpretation of Regulations could change, so it is necessary to limit the risk to the project's continuation due to changes that are outside the control of the contractor and the owner by issuing variation orders. In order to minimize costly changes at a later stage of construction, community concerns are typically taken into account throughout the planning and design stage of any building project. However, in some cases, such as "lack of experience, absence of proper authorization, or simply scarcity of time," neighborhood considerations may have been overlooked, and some of them may have arisen after wards leading to variances in contract conditions. Regulations could change, so it is necessary to limit the risk to the project's continuation due to changes that are outside the control of the contractor and the owner by issuing variation orders. In order to minimize costly changes at a later stage of construction, community concerns are typically taken into account throughout the planning and design stage of any building project. However, in some cases, such as "lack of experience, absence of proper authorization, or simply scarcity of time," neighborhood considerations may have been overlooked, and some of them may have arisen afterwards leading to variances in contract conditions.

4. CONCLUSION

Rework is one of the main causes of cost and schedule overruns in building projects, which are inevitable. Therefore, this study's goals were to pinpoint the primary sources of rework in the construction sector. To ascertain the causes of rework, a thorough assessment of the literature was carried out. As a result, many of rework reasons in total were found, and they were divided into five main categories that were connected to the client, design, contractor, subcontractor, human capabilities, and supervision.

According to the findings of a thorough review of earlier studies, the most significant factors contributing to client-related rework include a lack of funding for site investigations and consultations, a lack of client involvement in the design and construction processes, a lack of knowledge and experience for those processes, an inadequate summarization of the client's requirements, and a lack of coordination and communication with design consultants. Incomplete design at the time of the tender, poor communication between the design team, design changes depending on client or end-user requests, and a lack of quality design processes were additional major contributors to rework related to design. The biggest causes of rework connected to the contractor include, in addition, a lack of protection for construction work, a subpar quality system, and setting-out mistakes throughout the building process. Damage to completed works, the use of subpar materials, a lack of coordination and communication with the contractor, and noncompliance with requirements were the main causes of rework involving subcontractors. The main issues relating to human capacity and supervision that lead to

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rework are worker skill deficiencies, employee turnover/reallocation to other projects, inadequately skilled labor to complete job tasks, and poor supervisory abilities. The stakeholders from customers, contractors, and consultants should take these findings into consideration in order to minimize/reduce rework on construction projects in light of the aforementioned research findings.

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