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INDICATORS ANALYSIS OF SCOPE CREEP CAUSATION FACTORS IN INDONESIAN OFFSHORE OIL & GAS CONSTRUCTION PROJECTS

Adhitya Nusa Perdana*[1], I Putu Artama Wiguna[1]

[1])Sekolah Interdisiplin Manajemen dan Teknologi, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
Corresponding Author's Email: adhitya.perdana51@gmail.com

ABSTRACT

The Indonesian oil and gas (O&G) industry, a strategic sector with vast offshore reserves, faces significant challenges due to the high failure rate of offshore construction projects. This profusion of offshore reserves has led to a rise in offshore O&G construction projects. However, the global failure rate of O&G offshore construction projects is alarming, with numerous projects experiencing delays, budget overruns, and quality issues that hinder the achievement of production targets. Scope creep, a common phenomenon leading to delays, cost overruns, and quality issues, is a major contributor to these failures. To address this critical problem, this study aims to develop and validate measurement indicators for the causative factors of scope creep in Indonesian offshore O&G construction projects. A quantitative research approach was employed, combining literature review, pilot survey, and a main survey involving 104 practitioners in the industry. Data analysis using SmartPLS 3.0 confirmed the validity, reliability, and outer loading value of measurement indicators. Key findings reveal that risk consequences and awareness are crucial indicators of the risk factor, communication frequency is a key indicator for the communication factor, task overlap and knowledge diversity are identified as key indicators of complexity, construction method changes are a key contributor to the change factor, and accurate identification and structuring of decomposed project tasks are critical indicators for achieving desirable quality in Work Breakdown Structure development. These findings provide valuable insights for industry professionals to mitigate scope creep and improve the success of offshore O&G construction projects in Indonesia.

Key words: Scope creep, Project Management, Project Scope Management, Offshore Construction Projects, Oil and Gas.

1. INTRODUCTION

The oil and gas (O&G) industry in Indonesia is a strategic sector that generates substantial revenue for the country. In 2022, the industry surpassed its target, achieving a revenue of US$17.42 billion. Indonesia is endowed with vast O&G reserves, with proven reserves of 23.6 BBO (billion barrels of oil) and 271.4 TCF (trillion cubic feet) of natural gas. To enhance production, the Indonesian government, through its Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas), is encouraging O&G operators to achieve targets for well drilling, workover, well maintenance, and supporting facilities. These efforts have spurred the development of numerous O&G construction projects across Indonesia.

Offshore O&G construction projects are a breed apart. Unlike their onshore counterparts, they necessitate a complex blend of expertise. These projects involve a multitude of interconnected subfields, from subsea engineering to well operations [1]. To navigate this complexity, a multidisciplinary project team is essential. Geologists, geophysicists, reservoir engineers, and specialists in drilling, completion, subsea engineering, and more, all come together to ensure project success. Furthermore, the harsh

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offshore environment demands advanced technology, such as deepwater operations and specialized marine fleets, to overcome technical challenges.

Despite advancements in technology and project management practices, offshore O&G construction projects continue to face significant challenges, resulting in a low success rate. This is documented by Merrow [2] revealed a concerning trend in offshore construction projects. Only 22% of the 318 strategic projects analyzed were deemed successful. The remaining projects faced significant challenges: a staggering 73% exceeded their initial budgets by more than a third, 30% suffered delays in completion, and a troubling 64% encountered production problems within two years of commencing oil and gas production. These findings are further supported by Alkarbi et al. [3] who highlight the occurrence of "scope creep" in O&G construction projects throughout their lifecycle.

Scope creep, the uncontrolled expansion of a project's scope beyond its initial plan [4], poses a significant threat to construction projects. It leads to unintended work being performed, which consumes more time, resources, and budget than originally allocated. This can strain relationships and lead to disputes among project stakeholders [5]. Furthermore, scope creep can indirectly compromise the final quality of the project [6], [7]. With limited time and resources due to the expanded scope, project teams may be forced to make concessions on quality to meet deadlines. In the worst-case scenario, scope creep can even result in project cancellation [4]. Rising costs, extended timelines, declining quality, and stakeholder disputes can all contribute to the ultimate decision to postpone or even abandon the project altogether.

Given the negative impacts of scope creep on O&G construction projects, research in this area is crucial for addressing the challenges faced by the Indonesian O&G industry. This study aims to make a significant contribution develop and analyze measurement indicators for causative factors of scope creep in Indonesian offshore O&G construction projects. The findings of this research are anticipated to benefit both academics and practitioners in the Indonesian O&G industry.

2. LITERATURE REVIEW

Scope creep, the uncontrolled expansion of a project's scope beyond its initial plan, has been extensively investigated by researchers employing diverse variables, subjects, and research scopes. Ajmal et al. [8] examined the impact of various factors on scope creep in public construction projects in the United Arab Emirates (UAE), revealing that complexity/uncertainty, tasks/specifications, risk, communication, and customers significantly influence scope creep occurrence. Similarly, Amoatey & Anson [4] identified change, unforeseen risks, and unclear scope as the primary causes of scope creep in real estate construction projects in Ghana. In contrast, Moneke & Echeme [6] found that complexity, poor customer requirement understanding, and a low-quality Work Breakdown Structure (WBS) were the top-ranked causes of scope creep in large-scale public sector construction projects in Nigeria.

Offshore construction projects are characterized by a wide range of risks that are high in category [1], and their isolated, far-removed, and remote locations [9] pose substantial challenges in terms of communication. These projects also necessitate the development of intricate work scopes [10], which frequently results in changes during the project cycle and contributes to a high degree of complexity [9]. Furthermore, Voivedich et al. [11] highlight the critical role of the Work Breakdown Structure (WBS) in significantly influencing the success of offshore construction projects. The factors that cause scope creep, as identified in prior studies are inherently present in offshore construction projects, thus suggesting a natural tendency for scope creep to occur in such projects.

2.1. Scope Creep

Scope creep, a significant concern in project management, refers to the uncontrolled growth of a project's scope beyond its initial plan. This can lead to increased costs, extended timelines, and compromised project quality. Project Management Institute [12] views it as an incremental expansion of project scope, while Shane et al. [13] emphasizes the accumulation of small changes that inflate project size and costs. Moneke & Echeme [6] define it as a continuous project expansion beyond its boundaries. Wulf [14] highlights the role of inadequate communication and document control in leading to a larger and more complex project. Finally, Nicholas & Steyn, [15] focus on changes that cause the project to expand and deliver a larger outcome than initially planned.

2.2. Risk

Risk management plays a crucial role in preventing and mitigating scope creeps. According to Project Management Institute [12], risk is an uncertain event or condition that, if it occurs, can have a positive (opportunity) or negative (risk) impact on one or more project objectives. Effective risk management involves a systematic process of identifying, analyzing, and responding to project risks. Poor risk management practices can increase the likelihood of scope creep [8].

Effective risk management begins with thorough risk identification, as emphasized by Potrzebna [16] Organizations should adopt appropriate strategies to address identified risks. Batson [17] stresses the importance of systematic risk identification during the planning phase of construction projects and suggests utilizing risk area taxonomies for effective identification.

Risk analysis involves evaluating identified risks to understand the potential impact of their consequences and likelihood of occurrence [18]. According to Kerzner [19], The absence of a structured risk assessment methodology and a robust planning process are frequently cited as primary contributors to scope creep. Risk response involves implementing strategies to reduce risks to an acceptable level within the constraints and objectives of the project plan [19]. According to Project Management Institute [12] , the Risk Owner is responsible for monitoring risks and selecting and implementing appropriate risk response strategies. Typically, the Risk Owner is a project team member with the expertise, resources, and authority to manage risks.

2.3. Communication

According to Project Management Institute [12], project communication is the process of exchanging information and ensuring shared understanding among project team member and stakeholders. Communication gaps can lead to increased scope creep risks [8]. A formal communication plan, as defined by Project Management Institute [12], outlines how project information will be exchanged, including methods, frequency, and the necessary level of communication detail. This process produces a communication management plan, a document that specifies who needs to receive information, what they need to know, when and how they will receive it, and who is responsible for providing it. The plan also considers the context, purpose, and meaning of messages, as well as potential barriers or disruptions to communication.

Technology plays a significant role in project communication, enabling the use of scheduling software, collaboration tools, video conferencing, and global virtual teams, as noted by [20]. Studies suggest that using multiple media, from informal face-to-face meetings to formal methods like letters, faxes, and emails, can enhance message delivery. Communication frequency refers to the number and timing of interactions between project team members and stakeholders. This frequency can be based on a calendar or specific events. Communication frequency can influence the level of trust among project stakeholders [20]. Information content, as defined by Barnard et al. [20], refers to the message or meaning conveyed verbally, written, or graphically from the sender to the recipient. It plays a critical role in effective project communication. High-quality information content ensures clear understanding among project stakeholders and minimizes miscommunication.

2.4. Complexity

In the field of project management, complexity is often an overlooked aspect, yet it is a critical factor that introduces additional challenges in achieving project objectives [21]. Project complexity has been identified as one of the causes of scope creep in construction projects [6], [8]. Interdisciplinary complexity, as described by Wood & Ashton, [22], compounds difficulties due to the need for coordination among the various disciplines involved in a project. The involvement of multiple stakeholders, such as governments, subcontractors, and vendors, adds to the complexity in construction projects, necessitating careful management [23]. The location factor is also significant; challenging access sites increase transportation costs and time, requiring specialized logistical arrangements and the rigidity of task sequences demands the completion of tasks in a specific order, limiting flexibility and

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contributing to increased complexity [9]. Furthermore, overlapping work stages require additional resources and intensive coordination, further complicating project management [22]. Economic and political stability also influence the complexity of construction projects, with global economic fluctuations affecting financing strategies and project costs [23].

2.5. Change

Changes in construction projects, defined as proposed modifications to any project component [12], are common and can adversely affect project success. Understanding and managing these changes is crucial to reducing their negative impact and enhancing the likelihood of project success [24]. Changes to project requirements such as specifications and scope can influence design, procurement, and construction processes [25], while changes to construction methods can lead to significant delays [6].

Client requests, market conditions, initial design errors, and unanticipated field conditions are among the causes of design changes [26]. Additionally, changes in government regulations can also impact construction projects [27]. However, not all changes result in scope creep; well-managed changes can directly contribute to project success [28], especially when they involve official decisions by stakeholders and are accompanied by detailed and well-documented procedures.

2.6. Work Breakdown Structure

According to the Project Management Institute [12], the Work Breakdown Structure (WBS) is defined as a result-oriented hierarchical decomposition of the work to be executed by the project team. The WBS serves as a tool to break down work into smaller components, thereby increasing the likelihood that all major and minor activities will be accounted for [6]. The WBS is an essential tool in project management to ensure that all activities are considered. The availability of documentation is crucial in developing the WBS. The work breakdown structure is organized based on the study of all project documents, including contracts, drawings, and specifications, unidentified work within the WBS can lead to various negative impacts on the project, potentially causing delays in the project schedule if there is unidentified work that requires time to complete, each project has its own unique characteristics, and the WBS should be designed with the flexibility to adjust the scope of work according to the specific needs of the project, The WBS plays a vital role in the implementation and management of the project as a structure for reporting project progress and financial control. Managing the WBS requires an effective tool to collect and report relevant information [11]. This tool aids in the visualization, tracking, and management of various project aspects, including schedule, resources, and costs.

3. METHODOLOGY

Following a comprehensive literature review, this study identified and defined research variables. Each variable is operationalized and measured using multiple indicators, assessed on a 5-point Likert scale as shown in Table 1. Causative factors of Scope Creep define as variable Risk (X1) with 6 measurement indicators, Communication (X2) with 5 indicators measurement indicators, Complexity (X3) with 6 indicators measurement indicators, Change (X4) with 6 indicators measurement indicators, and Work Breakdown Structure (WBS) (X5) with 6 indicators measurement indicators.

Table 1. Likert Scale

No.	Likert Scale	Skor
1.	Strongly Agree	5
2.	Agree	4
3.	Unsure	3
4.	Disagree	2
5.	Strongly Disagree	1

Survey methods were employed to conduct this research. The research population comprised individuals involved in offshore construction project management in Indonesia. This population was selected due to their direct knowledge and experience in managing projects with such characteristics. A pilot survey was conducted involving nine senior practitioners with over ten years of experience in offshore O&G

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construction projects and project management disciplines. The primary objective of this pilot survey was to validate the research variables and indicators and identify additional indicators contributing to scope creep, The final identified indicators of scope creep causative factors are presented in Table 2. The questionnaire was distributed through two channels: email and LinkedIn. Out of a total of 150 questionnaires distributed, 104 data points were successfully collected, exceeding the initial target of 100 data points. The data obtained from the main survey will be analyzed using Confirmatory Factor Analysis (CFA) with SmartPLS 3.0 to assess validity, reliability, and to obtain loading factors for each indicator.

Table 2. Indicators of Causative Factors of Scope Creep

Code	Indicator	Description
Risk (X1)		
RS1	Risk Event Awareness	Failure to properly identify and analyze potential risk.
RS2	Risk Consequences	Inability to accurately identify and assess the consequences of risks.
RS3	Risk Mitigation Strategy	Implementation of inappropriate or ineffective risk mitigation strategies to minimize the impact of risks.
RS4	Responsible Party Assignment	Designation of individuals or teams who lack the necessary expertise or authority to effectively manage project risks.
RS5	Critical Risk Respond Strategy	Inability to develop and implement effective plans to respond to critical risks that pose a significant threat to the project's success.
RS6	Implementation of Risk Monitoring	Ineffective Monitoring of Risk Response Plans During Project Execution
Communication (X2)		
KM1	Formal Communication Plan	A formal communication plan that fails to facilitate smooth communication and timely decision-making.
KM1	ICT Infrastructure	Insufficient ICT infrastructure to support seamless and efficient information distribution.
KM1	Interaction Frequency	Infrequent formal communication among project team and stakeholders.
KM1	Information Content Relevancy	Delivery of information content that is not relevant to the current project needs and developments.
KM5	Informal communication	Ineffective Informal Communication During Project Execution
Complexity (X3)		
KP1	Number of Discipline Knowledge Involved	Challenges in integrating diverse fields of knowledge and expertise involved in the project.
KP2	Number of Organization Involved	Involvement of multiple organizations (government, subcontractors, vendors) in project execution, increasing coordination complexity
KP3	Complexity affected by Location	Difficulties arising from non-ideal project site layout and location.
KP4	Rigidity of task sequence	Lack of flexibility in the work sequence, hindering adjustments to changing project conditions and requirements.
KP5	Overlapping Among Task	Extensive overlapping work, demanding significant resources simultaneously.
KP6	Politic and Economic Condition	Unforeseen in political and economic conditions affecting the project.
Change (X4)		
CG1	Change of Project Requirement	Frequency and impact of changes in project requirements during execution.
CG2	Change of Construction Method	Impact of changes in construction methods during execution.
CG3	Change of Design	Impact of changes in project design during execution.
CG4	New Law/Change on Government Regulation	Impact of new regulations or government policy changes related to project execution.
CG5	Implementation of Change Control	Impact of new regulations or government policy changes related to project execution.
CG6	Cahnge of key personnel	Changes in key personnel during a project execution
WBS (X5)		

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Table 2. Indicators of Causative Factors of Scope Creep

Code	Indicator	Description
WB1	Availability Project Documentation	Insufficient availability of complete and accurate project documentation to define and identify the work required to complete the project.
WB2	Identified Task	Inaccurate identification and definition of the work required to complete the project.
WB3	Structure of Decomposed Task	WBS structure that does not align with project needs and needs.
WB4	Software/Tools Utilization	Ineffective utilization of WBS management software/tools to effectively manage the WBS.
WB5	Task Integration Management	Failure to integrate WBS management with project resources (time, cost, etc.)

4. RESULT AND DISCUSSION

4.1. Respondents Characteristics

The survey garnered responses from 104 individuals, with a strong majority identifying as male (79.8%). The largest age group fell within the 41–50-year range (41.3%). In terms of education, a bachelor's degree (S1/D4) was the most common qualification (76.9%). Work experience revealed a concentration in the 11–20-year range, with 28.8% having 11-15 years and 22.1% having 16-20 years. Examining organizational roles, most respondents were employed by Main Contractors (57.7%), followed by Project Owners (32.7%). Department manager roles (23.1%) were the most prevalent within these organizations, while Project Manager (10.6%) and Project Sponsor (3.8%) titles were held by a smaller percentage. Project Management/Project Control emerged as the most common departmental affiliation (38.5%).

4.2. Data Analysis

Validity Test

The initial step involves evaluating convergent validity. For reflective construct, an indicator is considered to have good validity if its loading factor exceeds 0.70 [29]. The following Table 3 presents the calculation of outer loading for each indicator to its corresponding construct.

Table 3. Convergent Validity Loading Factor

Item	Outer Loading	Result
Risk (X1)		
RS1	0,908	Valid
RS2	0,929	Valid
RS3	0,871	Valid
RS4	0,891	Valid
RS5	0,864	Valid
RS6	0,869	Valid
Communication (X2)		
KM1	0,796	Valid
KM2	0,801	Valid
KM3	0,820	Valid
KM4	0,793	Valid
KM5	0,819	Valid
Complexity (X3)		
KP1	0,823	Valid
KP2	0,794	Valid
KP3	0,793	Valid
KP4	0,808	Valid
KP5	0,831	Valid
KP6	0,767	Valid

Item	Outer Loading	Result
Change (X4)		
CG1	0,778	Valid
CG2	0,838	Valid
CG3	0,801	Valid
CG4	0,729	Valid
CG5	0,782	Valid
WBS (X5)		
WB1	0,844	Valid
WB2	0,897	Valid
WB3	0,890	Valid
WB4	0,871	Valid
WB5	0,792	Valid

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The results of the outer loading calculation for each indicator to its corresponding construct. Based on Table 3, it is evident that all indicators have outer loading values above the threshold of 0.7, indicating that these indicators are valid in measuring their respective constructs. Additionally, factor loadings can be employed to prioritize indicators. Indicators characterized by higher factor loading values are generally considered more important and relevant for measuring the construct compared to those with lower values. Indicators with low factor loading values (below 0.5) may require reconsideration for potential removal from the model.

According to Table.2 an assessment of outer loading values revealed that none of the indicators for any variable fell below 0.7. Consequently, no indicators were eliminated from the model.
To further corroborate the findings of convergent validity, an assessment of average variance extracted (AVE) will be conducted. The AVE criterion for construct validity is AVE > 0.5, indicating that the constructs employed in the study are valid [29].

Table 3. Laten's Average Variance Extracted (AVE) value

Laten	*Average Variance Extracted* (AVE)	Result
X1	0,790	Valid
X2	0,650	Valid
X3	0,645	Valid
X4	0,615	Valid
X5	0,739	Valid

The data in Table 3 clearly demonstrates that all constructs meet the convergent validity criterion. This indicates that the measures employed in this study adequately capture their respective latent constructs.

Reliability test
Subsequent to the evaluation of validity, the next step involves assessing the internal consistency reliability of the constructs using Cronbach's Alpha and Composite Reliability. A construct is considered reliable if its Cronbach's Alpha and Composite Reliability values exceed 0.7 [29].

Table 4. Cronbach's Alpha and Composite Reliability Value

Laten	*Cronbach's Alpha*	*Composite Reliability*
X1	0,947	0,958
X2	0,866	0,903
X3	0,890	0,916
X4	0,875	0,905
X5	0,911	0,934

An examination of Table 4 reveals that all composite reliability (CR) values exceed the recommended threshold of 0.7, ranging from 0.8 to 0.9. Additionally, all Cronbach's alpha values surpass 0.7, indicating satisfactory internal consistency reliability for all constructs. These findings suggest that the research instrument demonstrates strong reliability in measuring both indicators and variables.

4.3. Discussion

The findings from data analysis provide evidence for the validity and reliability of the research instrument. All indicators loaded significantly onto their respective latent constructs, demonstrating convergent validity. Additionally, the AVE values and Cronbach's Alpha & Composite Reliability values exceeded the recommended thresholds, indicating both discriminant validity and internal consistency. These results suggest that the research instrument is an effective tool for measuring the identified constructs contributing to scope creep in offshore construction projects in Indonesia.

Risk Factors

Offshore construction projects in the O&G industry are prone to high-category risks [1], characterized by a high likelihood of occurrence and significant project impact. The results of the validity and reliability tests for Risk (X1) indicate that this construct and its associated measured indicators are well-suited to assess the concept of risk as a causal factor of scope creep in offshore construction projects in Indonesia. This finding aligns with previous research by Amoatey & Anson [4], who emphasize that unidentified risks (unforeseen risk) can result in inadequate contingency planning by project teams. Consequently, additional resource allocation becomes necessary to address the impact of these risks, potentially triggering Scope creep. Furthermore, Scope creep arises from poor risk management practices, highlighting the importance of effective risk management in mitigating Scope creep in construction projects [8]. Analysis Table.3 identified two indicators with the highest loading factor values RS2 - Risk Consequences (0,929) and RS1- Risk Event Awareness (0,908). This finding suggests a strong positive relationship between these indicators and the Risk variable, implying that weak risk consequence analysis and inadequate risk identification teams are the most prominent contributors to risk factor.

Communication Factor

Remote offshore locations and limited accessibility pose significant challenges to communication in offshore construction projects [9]. These factors hinder face-to-face communication and delay information dissemination, potentially leading to Scope creep. In this study, Communication emerged as the third most influential variable contributing to Scope creep, aligning with previous research. Ajmal et al., (2022) highlighted that poor communication among Project team member and project stakeholders can lead to communication gaps, resulting in unclear or incomplete project scope definitions. This, in turn, can trigger unexpected project scope changes and increase the risk of Scope creep. The results of the validity and reliability tests for Communication (X2) indicate that this construct and its associated measured indicators are well-suited to assess the concept of Communication as a causal factor of scope creep in offshore construction projects in Indonesia. The analysis in Table.3 identifies KM3-Interaction Frequency as the highest loading factor (0,820), suggesting a strong relationship between this indicator and the Communication variable. In the context of this study, the lack of formal communication frequency among project team members and stakeholders represents the most critical aspect in assessing communication gaps.

Complexity Factors

Offshore construction projects are inherently complex due to the involvement of multiple interrelated subfields (subsea, production systems, wells, and transportation systems) [1]. These projects also necessitate the participation of project teams from diverse functions and disciplines. Additionally, they employ advanced technologies to overcome technical challenges (deep-sea operations, high reservoir pressure and temperature, specialized heavy-lift marine fleets, diving, etc.). The results of the validity and reliability tests for Complexity (X2) indicate that this construct and its associated measured indicators are well-suited to assess the concept of Complexity as a causal factor of scope creep in offshore construction projects in Indonesia. This finding aligns with previous research by Ajmal et al. [8], who suggest that project complexity can lead to Scope creep due to the increased uncertainty and challenges in effectively managing project scope. Complex projects tend to involve numerous variables, interactions, and components that require simultaneous management. This can obscure project scope definitions and increase the likelihood of unexpected changes, thus amplifying the potential for Scope creep [6]. The results of the validity and reliability tests for Complexity (X3) indicate that this variable and its associated measured indicators are well-suited to assess the concept of Complexity as a causal factor of scope creep in offshore construction projects in Indonesia. Examination of loading factors in Table.3 reveals that KP5-Overlapping Among Task (0.83) and KP1-Number of Discipline Knowledge Involved (0.82) exhibit the highest values. This suggests a strong positive relationship between these indicators and the Complexity variable. Within the context of this research, the high degree of overlapping tasks and the requirement to combine expertise from various disciplines and knowledge domains emerge as the most critical aspects for assessing project Complexity.

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Change Factor

Offshore construction projects in the O&G industry are renowned for their complexity and dynamism, demanding intricate and comprehensive planning and scope of work formulations. Factors such as remote locations, extreme conditions, and the involvement of multiple parties increase the likelihood of changes, which can lead to increased costs, delays, and even project failure [10]. The results of the validity and reliability tests for Change (X4) indicate that this construct and its associated measured indicators are well-suited to assess the concept of Change as a causal factor of scope creep in offshore construction projects in Indonesia. This finding aligns with previous research highlighting that unplanned or unapproved additions or modifications to the project scope can lead to increased costs, schedule delays, and additional project execution complexities, all of which can contribute to Scope creep [7], Ajmal et al. [8] further emphasize that unexpected or uncontrolled scope change requests can elevate the risk of project delays and cost overruns, ultimately resulting in Scope creep. The analysis in Table.3 identifies CG2-Change of Construction Method with a loading factor of 0.838 as having the highest value, suggesting a strong relationship between this indicator and the Change variable. In the context of this study, changes in construction methods during the project represent the most critical aspect in assessing changes factor.

WBS Factor

In the dynamic of offshore construction projects, a well-structured and organized Work Breakdown Structure (WBS) serves as a foundation for successful project execution [11]. The results of the validity and reliability tests for WBS (X5) indicate that this construct and its associated measured indicators are well-suited to assess the concept of WBS as a causal factor of scope creep in offshore construction projects in Indonesia. An inadequately developed WBS can lead to the oversight of certain activities or work elements from documentation. This lack of clarity in project scope definition can cover the way for incremental changes that eventually transform into significant scope modifications, increasing the likelihood of Scope creep [6]. The analysis in Table.3 identifies WB2 - Identified Task with a loading factor of 0.897 and WB3-Structure of Decomposed Task with a loading factor of 0.890, indicating strong relationships between these indicators and the WBS variable. In the context of this study, project team's weaknesses in identifying and defining the tasks required for project completion and project team's ability to create a WBS structure hierarchy that precisely fits the project's needs emerges as the most critical factor affecting the overall quality of the WBS.

4.4. Recommendation for future research

Building on the findings of this study, several avenues for further research can be explored such as:

- Conducting in-depth qualitative studies alongside quantitative analysis can provide a richer understanding of how the identified factors influence the occurrence of Scope Creep. Examining the thought processes and decision-making of project stakeholders can offer valuable insights into the mechanisms by which these factors contribute to scope changes.
- Investigating the influence of these factors on Scope Creep in other industrial sectors beyond offshore O&G construction project would enhance the generalizability of the findings. Comparing and contrasting results across different industries can reveal potential industry-specific patterns.
- Conducting further research on the factors causing Scope Creep in the early stages of the project lifecycle (project initiation and planning phases) is crucial. Identifying and anticipating potential scope changes at the outset of a project allows for proactive mitigation strategies and can significantly improve project outcomes.

5. CONCLUSION

This research identified several key indicators contributing to scope creep in Indonesian offshore oil and gas construction projects. Risk consequences and risk event awareness emerged as primary drivers of the Risk factor. Communication frequency proved crucial for the Communication factor, while overlapping tasks and diverse knowledge requirements significantly impacted Complexity factor. Changes in construction methods were identified as a key contributor to the Change factor. Finally, the ability to accurately identify and structure decomposed project tasks hierarchy was found to be critical for desirable quality of Work Breakdown Structure development.

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