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Risk Assessment in the Implementation of Advanced Work Packaging (AWP) in the Oil and Gas Industry

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This study proposes a risk assessment in the implementation of AWP (Advanced Work Packaging) as a method of monitoring capital projects of industrial assets by oil and gas operators in a scenario where industrial construction companies execute these projects. Traditional methodologies for managing and monitoring these projects have already brought many advances. However, gaps still translate into delays in time and costs, which, when monetized, represent considerable losses. The AWP is considered a good practice by the CII (Construction Industry Institute) and offers methods for monitoring and executing capital projects focused on the construction, commissioning, and delivery of complex industrial assets, and was born from the union of studies focused on hand productivity construction work in heavy industry industrial projects associated with structured and multidisciplinary planning and management. AWP advocates starting the project with the end in mind, allowing a holistic view of the components that integrate and materialize the project. The lack of risk assessment in the AWP implementation may lead to project failure. As a methodological approach, the authors conducted a field survey with SMEs (Subject Matter Experts) working in different segments. This made it possible to focus the risk study, which used the PFMEA (Process Failure Mode and Effects Analysis), on those with the most significant impact in the context of the study, in addition to identifying additional risks to those already reported in the literature. This contribution is essential since ensuring the successful implementation of the AWP will allow oil and gas operators to monitor and technically supervise the execution of their projects through a standard interface for dialogue between interested parties, focusing efforts on managing work packages, each one focused on a key aspect for the execution of a project stage that, when executed in an integrated manner, guarantees success in the construction of the asset. Although conducted in a specific oil and gas operator, the study can be generalized to other companies affected by risk issues. Despite identifying new risks in the implementation of the AWP, the FMEA matrix of this study limited the analysis to only those described in the literature and indicated by SMEs. Future studies may address these new risks and apply other techniques, such as multicriteria analysis, AHP (Analytic Hierarchy Process) is a good example. The study can change the practice and thoughts of professionals dealing with project risk assessment in AWP implementation.

Keywords: Advanced Work Packaging, Risk Assessment, Capital Project, Oil and Gas, AWP, PFMEA.

1. Introduction

There are several project management methodologies. Depending on the characteristics and peculiarities of the projects and the segment in which they are inserted, some methodologies may fit better, be adequate and consequently bring more benefits to the stakeholders. Approaches such as PMBoK, PRINCE 2, and IPMA have already shown value in being tested in projects of all sizes and complexities. However, the success of a project is not exclusively related to the practice or method that will be used to manage these projects. It also depends on how the methodology approach was implemented, the project implementation's risks, and how it was executed in corporations' functional and organizational structures.

Just as many projects fail for inadequate risk analysis and assessment, implementing project management methods also fails for the same reason. An adequate risk assessment in adopting and internalizing a project management practice is an essential step to ensure the implementation's success in realizing the expected benefits.

In the context of the oil and gas industry, it is no different. The adoption of practices and methods for the management of industrial asset projects is an essential tool in the execution of these projects. The oil and gas industry is capital-intensive, where delays, lack of quality, or compromised scope can generate tremendous losses, in addition to compromising the security and image of the corporation.

Under the custody of the CII (Construction Industry Institute), the AWP (Advanced Work Packaging) is considered a good practice and presents itself as an alternative for managing asset projects of offshore corporations in a scenario where the executive project is carried out by a contracted EPC (Engineering, Procurement, and Construction) company.

AWP is a project management methodology primarily used in construction and engineering. Its aim is to improve the efficiency and productivity of complex construction projects by optimizing the planning and execution of work packages. AWP involves thorough front-end planning, work packaging, interface management, construction-driven planning, and the use of construction work packages (CWPs). CWPs are the core units of work that contain all the necessary information, materials, and resources for completing specific project portions. The methodology emphasizes clear communication, coordination, and collaboration between disciplines and contractors to manage interfaces and dependencies effectively. It also promotes a shift in planning from engineering design-driven to construction-driven, enabling a more practical and efficient project execution.

In this context, this study proposes to ensure the success of implementing AWP as a method through appropriate risk assessment and seeking to answer questions such as:

Research question 1: What risk factors are present in the context of this implementation?

Research question 2: What peculiarities should be considered in AWP implementations, and how do they differ from other project management methods?

Research question 3: What benefits can an oil and gas operator obtain through this proposal?

The study is structured as follows: Section 2 covers a literature review, presenting previous studies on risk assessment in project management methodologies adoption. Section 3 addresses methodology. Section 4 shows the results. Section 5 discusses the results, and Section 6 the conclusion.

2. Literature Review

2.1. *AWP Implementation barriers faced by the Industry*

The barriers in AWP implementation include the following (CII/COAA, 2013): 1 - Lack of clear implementation strategy; 2 - Lack of owner support for the process; 3 - Lack of clarity of contractual requirements for advanced work packaging; 4 - Lack of explicit descriptions of role changes among personnel, including the new role of workforce planner; 5 - Lack of champions and knowledgeable staff for organizations with limited AWP experience; 6 - Lack of support for increased resources and roles during planning; 7 - Lack of compatible information systems and handover requirements.

The Industry also experienced many of these barriers when field interviews, questionnaires, and workshops were developed to collect the expert's and community's perceptions about the AWP implementation (Hamdi, 2013).

The barriers also can vary according to the company's AWP maturity level. The maturity level model was developed by CII research team 272 and is based on five dimensions: planning and scheduling, work packaging, materials management, construction readiness, and performance management. The higher maturity companies faced barriers more closely connected with integrating AWP with engineering. In contrast, median maturity companies presented a mix of barriers related to awareness and barriers related to integration with engineering. Finally, the lower maturity companies encounter more barriers that come with being unconvinced of

AWP's benefits or not being interested in implementing AWP (CII, 2020).

The implementation process of any management system usually faces various obstacles related to organizational changes, culture, requirements, and peculiarities. For example, reported obstacles and challenges in the lean construction implementation process (Liker, 2004; Ballard et al., 2007; Hamzeh, 2009).

2.2. *Risk management in project management practices implementation*

Companies often look to implement new methodologies to supersede what traditional approaches have been unable to enhance. However, it was identified that usually, when businesses want to implement new methodologies to improve their project performances, there are always some risks associated with its rollout (Galli, B. J., & Lopez, P. A. H., 2018).

These potential risks could arise when implementing a project management approach, including resistance to change, lack of support from top management, inadequate communication, lack of understanding of project management concepts, lack of resources, and difficulty in balancing project demands with organizational goals (Peña-Mora, F., Park, K. J., & Tamayo, J. L., 2001).

Once the need for implementing a project management approach is identified, companies can conduct a more detailed analysis to determine the risks and challenges that may arise during the implementation process. This analysis can then be used to develop a plan for addressing those risks and ensuring successful implementation (Harold Kerzner, 2017)

2.3. *Risk management strategies and tools*

Literature review in general, shows that risk management is about the definition of objective functions to represent the expected outcomes of a project, measuring the probability of achieving that by generating different risk occurrence scenarios and developing of risk response strategies to ensure meeting/exceeding the desired goals (Dikmen, I., Birgonul, M. T., & Arikan, A. E. (2004).

Many different techniques for risk analysis and identification have already been described in the literature; researchers demonstrated how the risk management process might be carried out more systematically and efficiently using these techniques, some of that are: 1 - Influence diagramming method; 2 - Cross impact analysis; 3 - Fuzzy event tree analysis; 4 - Monte Carlo Simulation; 5 - Fuzzy set theory; 6 - Analytical Hierarchy Process (AHP).

Just as risk management techniques and tools are crucial for a good risk management process, the definition of a corporate risk management strategy is equally responsible for the success of the process. The literature review shows that many different approaches to risk management strategies according to the business have been developed, for instance: Evaluating risk management strategies in resource planning (C. J. Andrews, 1995); A Global Review of Farmers' Perceptions of Agricultural Risks and Risk Management Strategies (Duong TT, Brewer T, Luck J, Zander K., 2019); Global supply chain risk management strategies (Manuj, I. and Mentzer, J.T., (2008); Risk Management Strategies in New Zealand Agriculture and Horticulture (Martin, Sandra, 1996), and so many others. Thus, the risk management strategy must be adapted not only to the characteristics of the project but also to the environment and cultural issues of the company because, as each project is unique, it is necessary to adapt how the project's risk management processes are applied, this is known as tailoring (PMBoK 6th Edition, 2017).

Hatefi and Balilehvand (2023) proposed an improved version of the FMEA method (Failure Mode and Effects Analysis), named as modified FMEA, is suggested by adding risk controllability criterion.

Murtopo and Chimayati (2023) stated that the application of technology in the oil and gas industry could have a dangerous impact on human safety, the impact of environmental pollution, and damage to technology and equipment. Risk analysis and identification must be carried out primarily on offshore platforms by identifying the risk of potential accidents that result in emergency conditions.

Maulana and Pandria (2023) conducted a study to identify damage and repairs to the working tools of the Screw Press machine. The study uses the

Failure Mode Effect and Analysis (FMEA) method to identify risks and take preventive measures in advance.

Ebadzadeh et al. (2023) conducted a study to evaluate the environmental risks caused by the ammonia and urea production process. Process hazard analysis (PHA) was used to screen the risks identified in the follow-up phase. The environmental aspects were also assessed using environmental failure mode and effects analysis (EFMEA).

3. Methodology

3.1. *Defining the risk assessment approach*

The literature review showed many techniques and tools to promote a risk analysis, some of which require more or less effort and complexity depending on the specific case. It also showed that a risk strategy must consider the business's and the project's peculiarities. Considering the barriers already identified in the literature on the adoption of the AWP, this study proposes a simplification in the implementation process, focusing mainly on how an owner-operator can use the AWP in managing its executive projects with EPC companies.

Thus, to select the risk assessment approach for implementing the AWP, this study considered the following assumptions: 1 - It must be a simple method that is easy to implement and understand by all stakeholders; 2 - It should allow the peculiarities of the AWP to be considered in risk analyses; 3 - It should allow demonstrating the benefits and positive impacts.

As the PFMEA offers an open and holistic approach to the analysis of failure modes, it is possible to consider the peculiarities of the AWP in the risk analysis, being feasible to focus on specific failure modes that may be unique in implementing this methodology. Examples would be strengthening the relationship between field, engineering, and acquisitions, adopting the appropriate information management culture, using specific technologies, orchestration between project teams, commissioning, and operations, and contracts that establish the AWP as a practice. To ensure that these failure modes are addressed adequately in the PFMEA process, involving experts familiar with the AWP methodology is essential. This could include project managers, construction professionals, or other experts familiar with the AWP process and its complexities.

Finally, considering that PFMEA can also identify opportunities, it can be a way to exploit the benefits and positive impacts of AWP implementation.

3.2. *Data collection and analysis*

As the literature review brought essential data on the barriers to the implementation of the AWP (CII, FR-DCC-04, 2020), these were used as a source for research. The selected SMEs received by email the list of barriers described by the CII (Fig. 2) and were asked which barriers could have the most significant impact on the implementation of the AWP in a scenario where the owner-operator monitors its executive projects made by EPC companies, as well as which new risks they believe could have an impact. These SMEs were selected from the authors' network based on their experience with the topic addressed by the study so that the study could focus on the context of AWP implementation from an owner-operator perspective.

The survey was sent out to twenty-five people, and twenty responses were counted for the study. The respondent's industrial segments can be seen in Fig. 1.

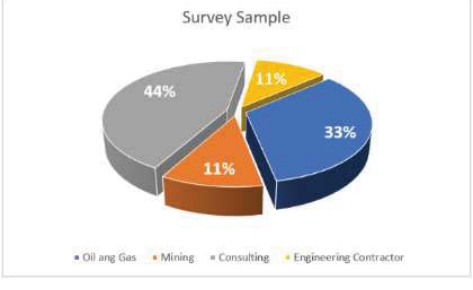

Fig. 1. Respondents by industry segment.

Fig. 2 shows a list of barriers to AWP implementation identified by companies with different levels of maturity in the implementation process. Some of these barriers could be grouped into categories.

Top Barriers for Each Maturity Level			
Cod.	Category	Description	Score
High Maturity			
39		Design engineering organization not supportive of AWP	2.50
57b		External push-back from engineering design contractor	2.09
57c		External push-back from engineering design contractor/procurement contractor	2.09
57d		External push-back from engineering design contractor/procurement/construction contractor	2.09
10		Lack of alignment between AWP implementation strategy and field execution	2.08
12		Contractor does not buy in early enough	2.00
22		Contruction company not available to provide timely path of construction input	2.00
56		AWP program is not owner-driven	2.00
57h		External push-back from suppliers	1.92
57a		External push-back from owners	1.90
Median Maturity			
49		Low level of AWP maturity among contractors	2.46
18		Not enough qualified resources for implementing AWP	2.18
50		Poor integration of AWP information system with other corporate systems	2.12
57b		External push-back from engineering design contractor	2.06
3		Lack of clear understanting of AWP methodology and processes	2.00
11		Lack of alignment between AWP and front-end planning	2.00
57c		External push-back from engineering design contractor/procurement contractor	2.00
55		Lack of financial incentives to improve execution efficiency	1.95
56c		Internal push-back from project managers	1.94
26		Engineering design sequence not able to match construction sequence	1.92
Low Maturity			
4		Expectation of limited (or no) benefits to company from AWP	2.50
56a		Internal push-back from cost estimators	2.50
6		Company not interested in implementing AWP	2.43
7		Awaiting more industry AWP project results before implementing	2.38
46		Do not need AWP because current project performance/results are good enough	2.38
12		Contractor does not buy in early enough	2.36
29		Need (or perceived need) for additional project team members for AWP	2.30
39		Design engineering organization not supportive of AWP	2.22
56b		Internal push-back from general foremen	2.21
56m		Internal push-back from field crews	2.21

Fig. 2. CII – Top barriers for each maturity level.

Label	
	AWP maturity level, resource availability, and AWP understanding
	Integration of AWP with engineering
	Company unconvinced of AWP benefits or not interested in implementing AWP
	Alignment and integration of AWP with existing company processes and systems

Fig. 3. CII – Category label.

3.3. *Using PFMEA*

The FMEA matrix was completed through a joint workshop with some of the interviewees, allowing the identification of recommended actions and mitigation strategies concerning risks.

Items highlighted by respondents were considered for PFMEA analysis. First, they recognize that those barriers are actually potential risks in implementing the AWP and also could be categorized as follows: 1 - External relationship; 2 - Internal and cultural alignment; 3 – Resources; 4 – Skillset; 5 - Stakeholder engagement; 6 - Value proposition; 7 - Work process; 8 - Wrong assumption.

4. Results

The potential new risks were identified and listed to complement the analysis; therefore, a comprehensive list of risks has been created to support the implementation of the AWP for oil and gas operators who expect to manage their executive projects with EPC companies, as follows: 1 - Inaccurate data: Accurate data is essential for effective AWP implementation. Inaccurate or incomplete data can lead to mistakes in planning and execution. 2 - Technology challenges: AWP relies heavily on technology, and any technical issues can impact the implementation process's success. 3 - Lack of continuous improvement: AWP implementation is an ongoing process, and continuous improvement is necessary to achieve the intended results. Failure to focus on continuous improvement can result in stagnation and diminished returns. 4 - Lack of standardization: AWP implementation relies on standardized processes and procedures. Lack of standardization can lead to inefficiencies, rework, and quality issues. 5 - Contract management: Establish contracts that provide for the use of AWP as a project management practice, considering the continuous flow of information between the owner-operator and the EPC contractor. 6 - Reducing bureaucracy: Make AWP a value-adding practice and not a bureaucratic burden that impacts stakeholders and, consequently the results of companies.

The FMEA matrix is shown in Fig 6. Owner-operators can mobilize efforts and focus on the risks with the highest RPN (Risk Priority Number) rates. The exact process can be developed for the new risks that are detected.

The study workflow in Fig 4 helped to respond to the research questions presented in Fig 5.

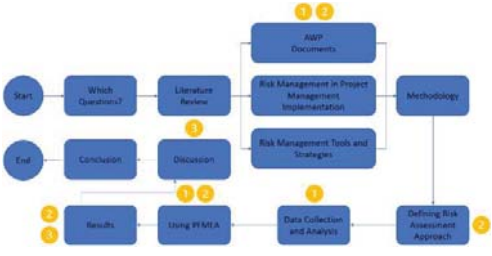

Fig. 4. Study workflow.

1. **Research question 1:** What risk factors are present in the context of this implementation?
2. **Research question 2:** What peculiarities should be considered in AWP implementations and how do they differ from other project management methods?
3. **Research question 3:** What benefits can an oil and gas operator obtain through this proposal?

Fig. 5. Research questions.

5. Discussion of results

There is concrete evidence that several risks can affect the implementation of the AWP, leading to frustrations and losses. Owner-operators often do not consider all the relevant risks surrounding a project management implementation practice.

complex and requires time and expertise that cannot be mobilized immediately.

The proposed method revealed a simple way to identify, analyze and propose actions to mitigate known risks. Thus, offering a whole set of vital information so that decision-makers are more

Function / Process	Failure Mode	Potential Effects of Failure	Severity	Potential Causes of Failure	Occurrence	Current Controls	Detection	RPN	Recommended Actions	Mitigation Strategies
External Relationship	External push-back from engineering design/procurement/construction contractor	Delay in implementation, poor AWP implementation	10	Poor communication, lack of trust	9	Clear communication of expectations, use of trusted contractors	6	540	Establish clear communication with the contractor and set expectations for their involvement in the AWP process	Use a trusted contractor with experience in AWP, and involve them in the planning process to help ensure buy-in and engagement
Skillset	Low level of maturity among contractors	Poor AWP implementation, rework, project delays	10	Lack of experience, lack of training	9	Use of experienced contractors, training programs	6	540	Provide training to contractors to help them understand the value of AWP and how it can be integrated into their work	Use experienced contractors with a history of success in AWP, and involve them in the planning process to help ensure buy-in and engagement
Internal and cultural Alignment	Internal push-back from project managers	Poor AWP implementation, lack of cooperation	9	Lack of understanding, lack of communication	8	Clear communication of expectations, use of experienced project managers	7	504	Provide AWP training for project managers. Communicate the benefits of AWP to project managers and emphasize the importance of their support.	Address concerns of project managers and ensure they understand how AWP can improve project outcomes. Involve project managers in the development of AWP implementation plans.
Value Proposition	Company not interested in implementing AWP	No AWP implementation, missed opportunities	9	Lack of understanding, lack of motivation	8	Clear communication of benefits, use of experienced advocates	7	504	Develop a clear business case for AWP implementation that includes potential benefits to the company. Communicate the benefits of AWP to all stakeholders, including owners and contractors.	Conduct case studies of successful AWP implementations to demonstrate the benefits to the company. Provide training and education to all stakeholders to ensure they understand the potential benefits of AWP.
External Relationship	External push-back from engineering design/procurement contractor	Delay in implementation, poor AWP implementation	9	Poor communication, lack of trust	9	Clear communication of expectations, use of trusted contractors	6	486	Involve the contractor in the AWP planning process to ensure they understand the goals and benefits of the program	Establish clear communication with the contractor, and provide training to help them understand the value of AWP and how it can be integrated into their design and procurement processes.
Stakeholder Engagement	Contractor does not buy in early enough	Poor AWP implementation, rework, project delays	10	Lack of understanding, lack of communication	8	Clear communication of expectations, use of experienced contractors	6	480	Clearly communicate the benefits of AWP to contractors and involve them in the planning process	Use experienced contractors with a history of success in AWP, and provide training to help them understand the value of AWP and how it can be integrated into their work
Stakeholder Engagement	Design Engineering organization not supportive of AWP	Delay in implementation of AWP, poor AWP implementation	8	Lack of management support, lack of resources	8	Clear communication of expectations, management buy-in	7	448	Communicate the benefits of AWP to the engineering team and involve them in the process	Provide training to the engineering team to help them understand the value of AWP and how it can be integrated into their design process
Value Proposition	AWP program is not owner-driven	Poor AWP implementation, lack of adoption	8	Lack of ownership, lack of understanding	8	Clear communication of expectations, management buy-in	7	448	Ensure that the owner is engaged in the AWP planning process and understands the benefits of the program	Provide training to the owner to help them understand the value of AWP and how it can be integrated into their business processes
External Relationship	External push-back from engineering design contractor	Delay in implementation, poor AWP implementation	8	Poor communication, lack of trust	9	Clear communication of expectations, use of trusted contractors	6	432	Establish clear communication with the contractor and set expectations for their involvement in the AWP process	Use a trusted contractor with experience in AWP, and involve them in the planning process to help ensure buy-in and engagement
Stakeholder Engagement	Construction company not available to provide timely path of construction input	Poor AWP implementation, rework, project delays	8	Poor communication, lack of resources	7	Use of experienced construction companies, clear communication of expectations	7	392	Establish clear communication with the construction company and set expectations for their involvement in the AWP process	Use experienced construction companies with a history of success in AWP, and involve them in the planning process to help ensure buy-in and engagement
Work Process	Lack of alignment between AWP implementation strategy and field execution	Poor AWP implementation, rework, project delays	8	Poor planning, lack of communication, poor execution	7	Clear communication of expectations, use of experienced planners	7	392	Involve field personnel in the planning process and ensure clear communication and alignment between planning and execution	Use experienced planners and field personnel to help ensure that the AWP implementation strategy is properly aligned with field execution
Work Process	Lack of alignment between AWP and front-end planning	Poor AWP implementation, rework, project delays	9	Lack of planning, lack of communication	6	Use of experienced planners, clear communication of expectations	7	378	Define clear communication channels between AWP and front-end planning teams. Ensure that front-end planning includes AWP considerations from the outset.	Conduct AWP training for front-end planning teams. Schedule regular communication between AWP and front-end planning teams to identify and resolve issues.
Work Process	Engineering design sequence not able to match construction sequence	Poor AWP implementation, rework, project delays	9	Lack of understanding, lack of communication	6	Clear communication of expectations, use of experienced designers	7	378	Involve construction teams in the design process. Develop a design-for-construction process that includes input from construction teams.	Use 3D modeling and visualization tools to identify and resolve design issues. Provide AWP training for designers to ensure they understand the construction process.
Resources	Need (or perceived need) for additional project teams members for AWP	Poor AWP implementation, rework, project delays	8	Lack of understanding, lack of resources	6	Adequate resource allocation, use of experienced team members	7	336	Evaluate the necessity of additional team members and ensure clear communication regarding their roles and responsibilities, provide training as needed	Develop clear guidelines for team member roles and responsibilities on AWP projects to ensure all team members are on the same page
Skillset	Lack of clear understanding of AWP methodology and processes	Poor AWP implementation, rework, project delays	7	Lack of training, lack of understanding	8	Adequate training programs, clear communication of expectations	6	336	Conduct regular training sessions on AWP methodology and processes, review and update work instructions as necessary	Develop a comprehensive training program on AWP methodology and processes to ensure team members have a clear understanding
Value Proposition	Expectation of limited (or no) benefits to company from AWP	Poor AWP implementation, lack of motivation	8	Lack of understanding, lack of communication	6	Clear communication of expectations, use of experienced advocates	7	336	Develop a clear business case for AWP implementation that includes potential benefits to the company. Communicate the benefits of AWP to all stakeholders, including owners and contractors.	Conduct case studies of successful AWP implementations to demonstrate the benefits to the company. Provide training and education to all stakeholders to ensure they understand the potential benefits of AWP.
External Relationship	External push-back from owners	Delay in implementation, poor AWP implementation	8	Poor communication, lack of trust	5	Clear communication of expectations, use of trusted owners	8	320	Establish clear communication with the owner and set expectations for their involvement in the AWP process	Provide training to the owner to help them understand the value of AWP and how it can be integrated into their business processes
Internal and cultural Alignment	Internal push-back from general foremen	Poor AWP implementation, lack of cooperation	7	Lack of understanding, lack of communication	6	Clear communication of expectations, use of experienced general foremen	7	294	Provide additional training and support to general foremen, establish clear expectations for their role in AWP projects	Develop a communication plan specifically targeted at general foremen to help them understand the benefits of AWP methodology and processes
Internal and cultural Alignment	Internal push-back from field crews	Poor AWP implementation, lack of cooperation	7	Lack of understanding, lack of communication	6	Clear communication of expectations, use of experienced crew leaders	7	294	Provide additional training and support to field crews, establish clear expectations for their role in AWP projects	Develop a communication plan specifically targeted at field crews to help them understand the benefits of AWP methodology and processes
Internal and cultural Alignment	Internal push-back from cost estimators	Poor AWP implementation, lack of cooperation	7	Lack of understanding, lack of communication	6	Clear communication of expectations, use of experienced cost estimators	7	294	Provide AWP training for cost estimators. Communicate the benefits of AWP to cost estimators and emphasize the importance of their support.	Address concerns of cost estimators and ensure they understand how AWP can improve project outcomes. Involve cost estimators in the development of AWP implementation plans.
Skillset	Not enough qualified resources for implementing AWP	Poor AWP implementation, rework, project delays	7	Lack of resources, lack of planning	6	Adequate resource allocation, use of experienced planners	7	294	Provide adequate resources and support to the AWP planning and implementation process	Use experienced planners and resources to help ensure the success of the AWP program
Work Process	Poor integration of AWP information system with other corporate systems	Poor AWP implementation, rework, project delays	7	Lack of integration, lack of understanding	6	Use of experienced IT professionals, clear communication of expectations	7	294	Involve experienced IT professionals in the planning process to ensure proper integration and alignment with other corporate systems	Establish clear communication and set expectations for the IT professionals and the AWP team
Wrong Assumption	Awaiting more industry AWP project results before implementing	Delay in AWP implementation, missed opportunities	8	Lack of understanding, lack of motivation	5	Clear communication of benefits, use of experienced advocates	7	280	Conduct pilot AWP projects to demonstrate the benefits of AWP to stakeholders. Identify and address concerns of stakeholders through regular communication.	Establish a clear timeline for AWP implementation and communicate it to all stakeholders. Conduct regular progress reviews to ensure implementation stays on track.
Wrong Assumption	Do not need AWP because current project performance/results are good enough	No AWP implementation, missed opportunities	9	Lack of understanding, lack of motivation	5	Clear communication of benefits, use of experienced advocates	6	270	Develop a clear business case for AWP implementation that includes potential benefits to the company. Communicate the benefits of AWP to all stakeholders, including owners and contractors.	Conduct case studies of successful AWP implementations to demonstrate the benefits to the company. Provide training and education to all stakeholders to ensure they understand the potential benefits of AWP.
External Relationship	External push-back from suppliers	Delay in implementation, poor AWP implementation	6	Poor communication, lack of trust	5	Clear communication of expectations, use of trusted suppliers	8	240	Establish clear communication with the supplier and set expectations for their involvement in the AWP process	Use trusted suppliers with experience in AWP, and involve them in the planning process to help ensure buy-in and engagement
Resources	Lack of financial incentives to improve execution efficiency	Poor AWP implementation, lack of motivation	6	Lack of incentives, lack of understanding	5	Adequate incentives, clear communication of expectations	8	240	Develop a business case for AWP implementation that includes potential cost savings and other benefits. Establish financial incentives for contractors who successfully implement AWP.	Offer bonuses or performance-based incentives to contractors who achieve AWP targets. Establish KPIs and measure contractor performance against them.

Fig.6. FMEA matrix table

Risk Level and Type of Actions	RPN Range
Risk 1: Mandatory	> 500
Risk 2: High Importance	400 to 500
Risk 3: Monitoring	300 to 400
Risk 4: Uncritical / Monitoring	200 to 300

Fig.7. Range risk level table

Most of the time, this happens because the risk assessment approach is neglected, and other times because the risk assessment approach is too

aware of the risks and their respective impacts on the implementation process of the AWP project management method.

The FMEA matrix showed that items with an RPN greater than 500 were the items highlighted by the SMEs as the most relevant risks for the owner-operators, being mandatory for the success of the implementation that the actions and strategies mitigation measures are implemented.

The SMEs understand that the item - **External push-back from engineering design/procurement / construction contractor** – is the most critical risk since, in the scenario in which an EPC develops the executive project, the commitment and alignment of this company with the AWP method is essential, under risk of imminent failure to implement and adopt the AWP. The second item concerns to - **Low level of maturity among contractors** - the general understanding is that contractors need to be familiar with the AWP, as well as its conceptual practices, vocabulary, and all theoretical knowledge that will translate into a good practical implementation in the field. There is no doubt that the relationship with the contracted company is a very critical item, as described above. However, the internal alignment described in the item - **Internal push-back from project managers** - is also a key factor. Without engaged managers who see the AWP as an ally that will bring the expected benefits, the chance of success in the implementation project will be greatly reduced. And finally, if the perception of value is not clear and the - **Company not interested in implementing AWP** - there will not be the necessary sponsorship to internalize the culture and permeate the AWP as a practice.

Items with RPN between 400 and 500 are essential items and must also receive attention and mobilization to be adequately treated. The main difference in the view of SMEs is that the first group is a critical success factor in implementation. At the same time, the second has a high potential for impact and should also have mobilized attention. For other less critical groups, risk monitoring is the most recommended action.

It is also important to mention that, as an open tool for risk assessment, the PFMEA can support risk analysis for each specific AWP implementation issue, often transforming qualitative information into quantitative information that can be analyzed objectively.

The literature review results were a significant contribution, as they provided the basis to support the interaction with SMEs. The study also contributes by providing the point of view of SMEs on the proposal to simplify risk assessment through the adoption of a specific project management approach.

The benefits for owner-operators are as follows but they are not limited to: 1 - Risk awareness for AWP implementation; 2 - A simple way for risk assessment. 3 - Manage the known risks appropriately; 4 - Raise the successful implementation rate; 5 - Improve the stakeholder's engagement; 6 - Anticipate gains with AWP implementation

6. Conclusion

Much information from the literature can be used to detail this study. Hamdi, O. (2013) et al. and the CII have done and maintained an in-depth study on the implementation and evolution of the AWP and should be considered as a guide for all those who intend to derive value from the implementation and evolution of the AWP.

Although the method suggested in this study can simplify and provide a shortcut to face the risks when adopting the AWP, the content is a complex and deep structure requiring continuous study and industry knowledge. The consultancy support can be considered as an aid to the AWP implementation success.

In response to research question 1, the study showed that the literature review associated with an acceptable and simplified practice of risk assessment, which, combined with the analysis and interaction of SMEs, could describe the main risks for owner-operators who hope to use AWP as a method of monitoring their executive projects that EPC companies develop, as well as demonstrating that an open and holistic approach was able to consider risks and peculiar characteristics of the AWP in its implementation process as asked in the research question 2.

In response to research question 2, the study also brought relevant differences that can influence the implementation of the AWP when compared to other project management practices. There are some examples as follows: 1 - Collaborative approach: AWP involves a collaborative approach between the various stakeholders, including the construction team, engineering team, and procurement team. This collaboration is critical for the successful implementation of AWP and differs from other project management approaches that may not place as much emphasis on collaboration. 2 - Focus on construction-driven planning: AWP places a strong emphasis on construction-driven planning, which involves

aligning the project plan with the physical constraints of the construction site. This differs from other project management approaches that may focus more on time and budget constraints. 3 - Emphasis on work packaging: AWP places a significant emphasis on work packaging, which involves breaking the project into discrete, manageable work units. This allows for efficient planning and execution of the project and differs from other project management approaches that may not place as much emphasis on work packaging. 4 – Continuous improvement: AWP involves a continuous improvement process, where lessons learned are captured and incorporated into future projects. This differs from other project management approaches that may not emphasize continuous improvement to the same extent. 5 - Use of technology: AWP utilizes technology to support the planning and execution of the project, such as 3D modeling and digital work packages. This differs from other project management approaches that may not incorporate technology similarly.

Finally, in response to research question 3, the study showed benefits to the owner-operator since many risks were raised and analyzed and could be avoided or mitigated in future implementations. Simplifying the risk assessment process accelerates and anticipates points that could compromise adopting a project management practice and engaging stakeholders. It also opens space to evaluate the combined use of other techniques and more complex approaches to risk assessment if necessary.

This study can be applied as a practical and methodological guide for the AWP implementation process where owner-operators have their assets built by third parties. In this way, known risks will be avoided, and recommendations from SMEs can immediately form part of response plans. Adaptations to the concrete case and the peculiarities, level of maturity and risk tolerance of the companies must be considered in the actual implementation process.

This study limited the analysis of the FMEA only to the risks already described by the CII, not covering new risks identified by SMEs. In future studies, these risks may be studied in detail, as well as the application of other risk analysis techniques. A multicriteria analysis is suggested, which has been gaining more space in the Industry in recent years, such as AHP (Analytic Hierarchy Process) and BBN (Bayesian Belief Networks). However, it is necessary to focus on the objectives and not lose the balance between the adequate technique and the alternatives for more complex situations.

In conclusion, this article demonstrates that a simple and known technique for risk assessment can be implemented in a specific context.

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