



Gerenciamento do processo de extensão de vida

Uma abordagem integrada para
a segurança operacional

Nayara Nunes Ferreira

Superintendente Adjunta de Governança e Estratégia

Outubro 2026



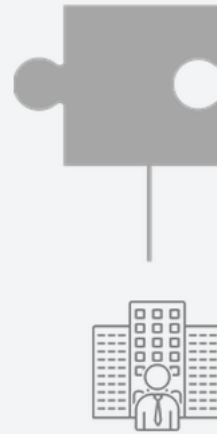
Introduction – Concepts



**End of
Life Cycle**



**Critical assessment
required**

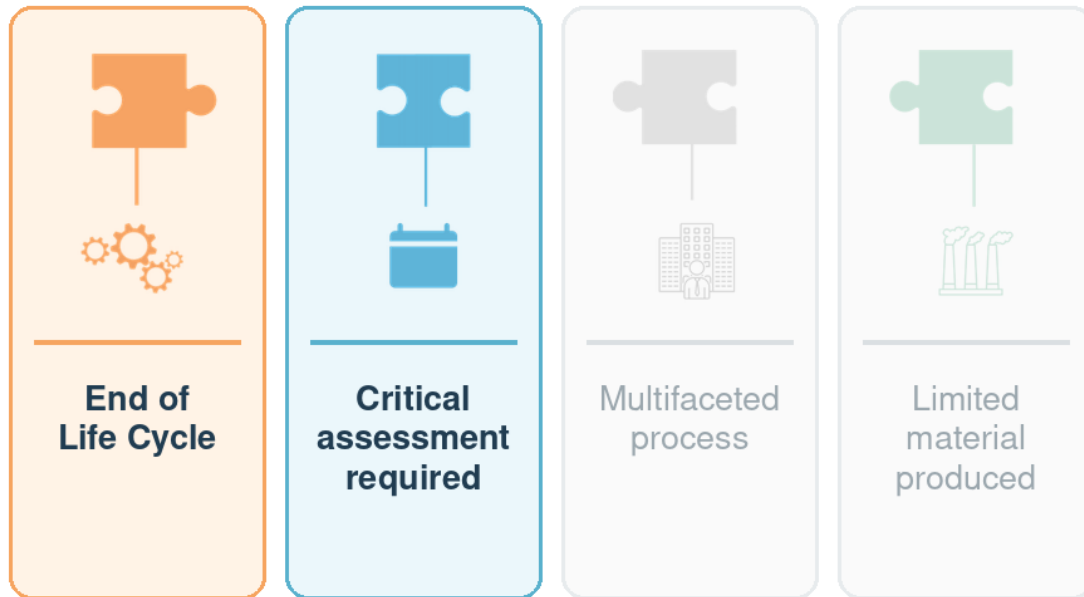


**Multifaceted
process**



**Limited material
produced**

Introduction – Concepts



 Notas



DECISION FROM OPERATOR

- ☐ Replacement
- ☐ Decommissioning
- ☐ Life extension

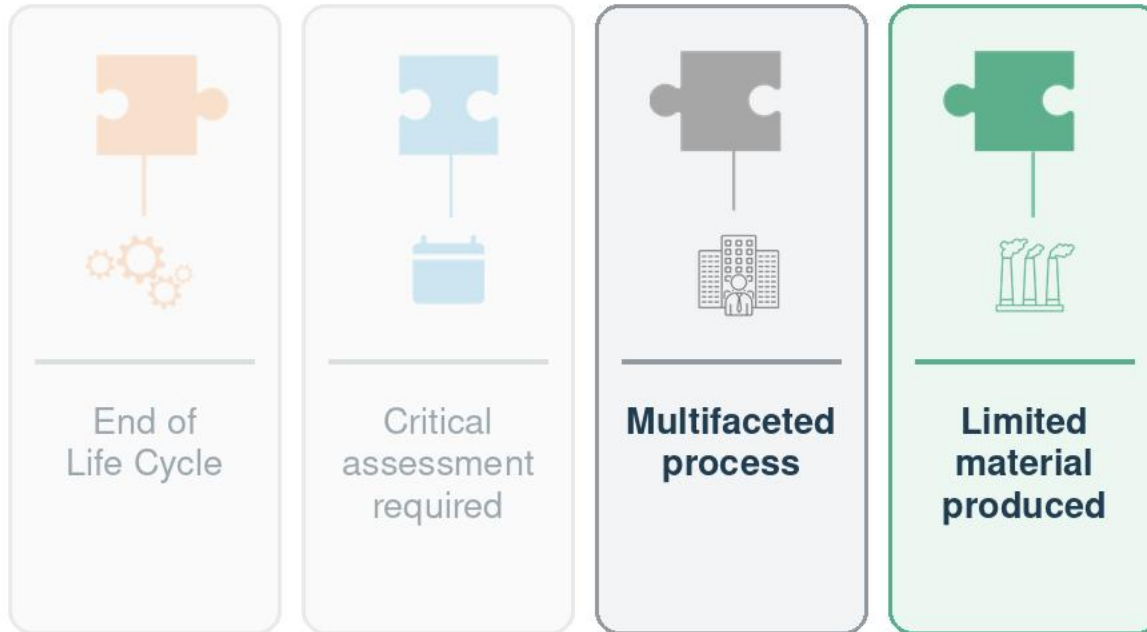
Life extension (Ageing)

- keeping the asset in operation (longer)?
- same conditions / same operational procedures?
- without any changes (strategy or added effort)?

Critical assessment of the asset!

- Recognizing and managing new hazards (ageing)
- Add measures to control the associated risks.
- Vary in implementation complexity and in the amount of investment needed

Introduction – Concepts



“

The ageing of an oil and gas facility is a multifaceted process; it is not merely defined by the chronological ageing of its SSC

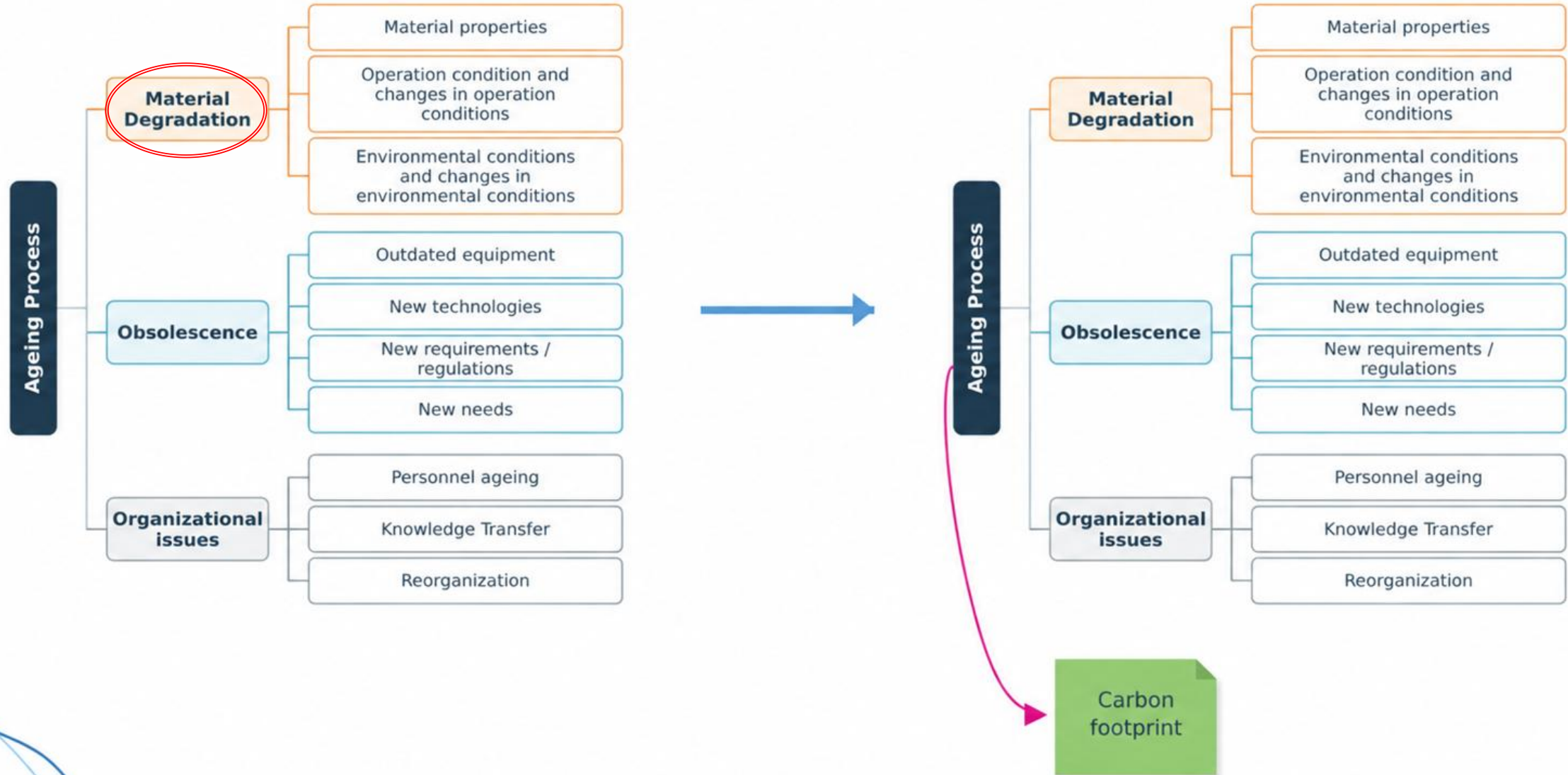
(WINTLE et al., 2006).

Regulatory bodies and Academia

Limited material that comprehensively covers critical aspects for managing the life extension process

Introduction – Concepts

Academic literature +
Regulatory bodies documentation



Life Extension Process Management

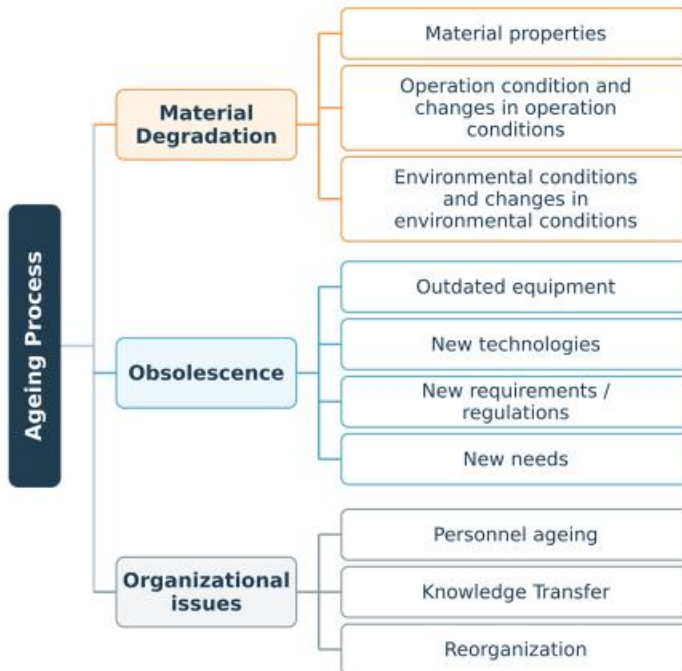


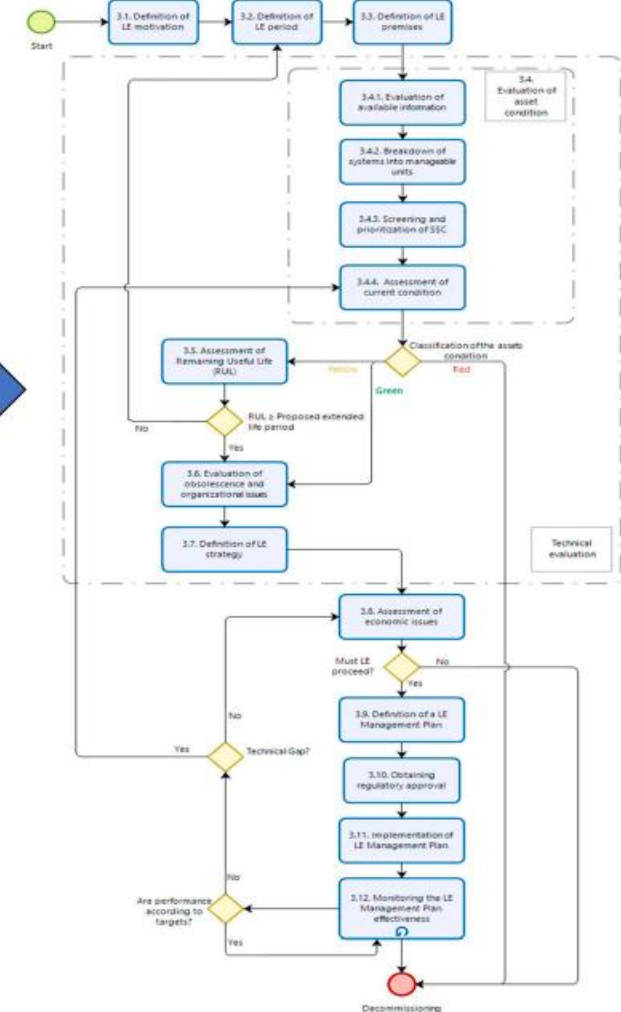
Table 1

Life Extension Process Management stages.

Item	Stages	Summary/Description	References
3.1	Definition of LE motivation	Definition of the reason to consider LE of SSC	Franklin et al. (2008)
3.2	Definition of LE period	Definition of the desired LE period. Based on this definition, the level of detail required for the LE process is assessed.	Franklin et al. (2008)
3.3	Definition of LE premises	Definition of the assumptions (objective and scope) of the LE plan, considering the proposed LE period.	Shafiee et al. (2016)
3.4	Evaluation of asset condition	Survey of SSC current condition data, regarding integrity, to assess the material degradation condition. This assessment is made through four main stages, according to items 3.4.1 to 3.4.4.	Shafiee et al. (2016); Franklin et al. (2008); Petroleum Safety Authority (2005)
3.4.1	Evaluation of available information	Data compilation to identify the level of detail of available information.	Hokstad et al. (2010); Franklin et al. (2008); Carvalho et al. (2015); Liu et al. (2015); Petroleum Safety Authority (2005)
3.4.2	Breakdown of systems into manageable units	Splitting a complex system into subsystems and components to facilitate the assessment of the condition and to provide the concentration of efforts.	Shafiee et al. (2016); Animah and Shafiee (2018); Liu et al. (2015); Petroleum Safety Authority (2005)
3.4.3	Screening and prioritization of SSC	Selection of safety critical elements (SCE) to allocate resources to SSC whose functions are more critical in terms of safety. This guarantees improvement in reliability, reduced associated risks and increased productivity of equipment and processes.	Shafiee et al. (2016); Animah and Shafiee (2018); Hokstad et al. (2010); Nitol et al. (2011); Carvalho et al. (2015); Sharp et al. (2011);

Methodology

- 1) Current state of the art about LE (literature + regulatory bodies)
- 2) Several stages (LE) > addressed individually by several authors (interesting level of depth)
- 3) Literature (LE) > **unstructured way**



Conclusion – Life Extension Process Management

Journal of Loss Prevention in the Process Industries 68 (2020) 104290



Contents lists available at ScienceDirect

Journal of Loss Prevention in the Process Industries

journal homepage: <http://www.elsevier.com/locate/jlp>



Guidelines for life extension process management in oil and gas facilities

Nayara Nunes Ferreira^a, Marcelo Ramos Martins^{b,*}, Marco Antonio Gaya de Figueiredo^c, Victor Hugo Gagno^d

^a National Agency for Petroleum, Natural Gas and Biofuels (ANP), Operations and Industrial Projects Department, State University of Rio de Janeiro (UERJ), Brazil

^b Analysis, Evaluation and Risk Management Laboratory – LabRisco, Naval Architecture and Ocean Engineering Department, University of São Paulo (USP), Brazil

^c Petroleum and Petrochemical Engineering and Technology Laboratory (LETPP), Operations and Industrial Projects Department, State University of Rio de Janeiro (UERJ), Brazil

^d Health, Safety and Environment Department, Trident Energy do Brasil Ltda; Technology, Business Management & Environment Laboratory (LATEC), Federal Fluminense University (UFF), Brazil

ARTICLE INFO

Keywords:

Life extension
Oil and gas facilities
Process management
Ageing process
Safety critical element
Techno-economic analysis

ABSTRACT

Facilities life extension has caught the attention among the capital-intensive industries, like oil and gas. By extending the life cycle of the industrial assets, a wide range of benefits is obtained, comparing with other life ending management strategies. This article first contextualizes the implementation of the life extension concept in the oil and gas industry, showing global data about life extension. Despite the importance of the ageing process, due to its great economic impact and the risk it poses to the production sector, regulatory entities, even in countries more advanced in that sector or that have already experienced the extension process, developed only superficial material about the topic without defining a structured methodology for the assessment of the possibility of useful life extension. The available references do not allow a comprehensive analysis of that possibility, which highlights the importance the methodology proposed. Thus, this article proposes a guideline for the life extension process management, strengthening a framework containing the main evaluation stages, aiming to facilitate the analysis of issues related to ageing and to support the decision-making process. Lastly, real case studies regarding current life extension processes submitted to the Brazilian regulatory body were evaluated against the proposed framework stages, evidencing their lack of necessary details to support the decision-making. Upon the realization that the real cases identified do not allow for the assessment of the contribution and adequacy of the proposed framework in its entirety, the same was also applied to a hypothetical case. The latter was developed based on facts reported by a major operator in Brazil. The result was the determination that the use of the proposed methodology transformed the assessment of the possibility of life extension into a systematic and transparent process, leading to easier and better-founded decision-making procedures, and improving the management of the asset during its extended life.



Categorizes the ageing process and the challenges related to each of the categories

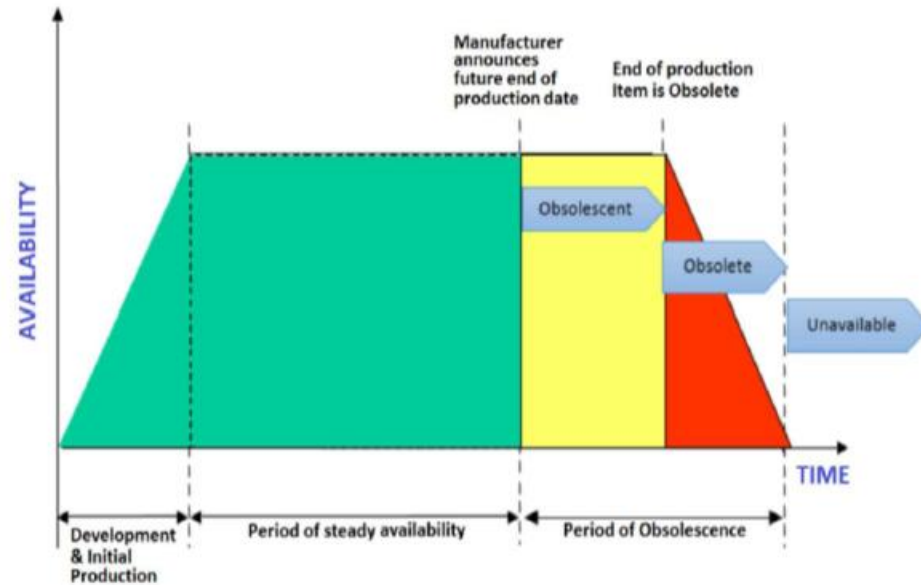


Consolidates in **12 stages topics** that is presented in the literature in an unstructured way



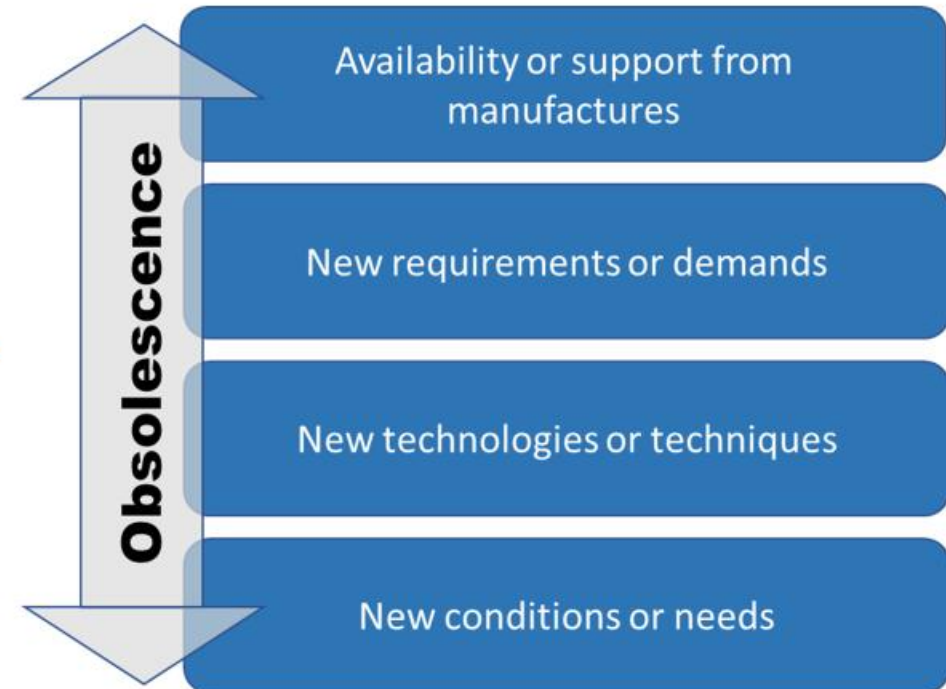
Proposes a **methodology (framework)** for the development of a process for the management of the useful LE

Obsolescence Management



Availability of manufactures

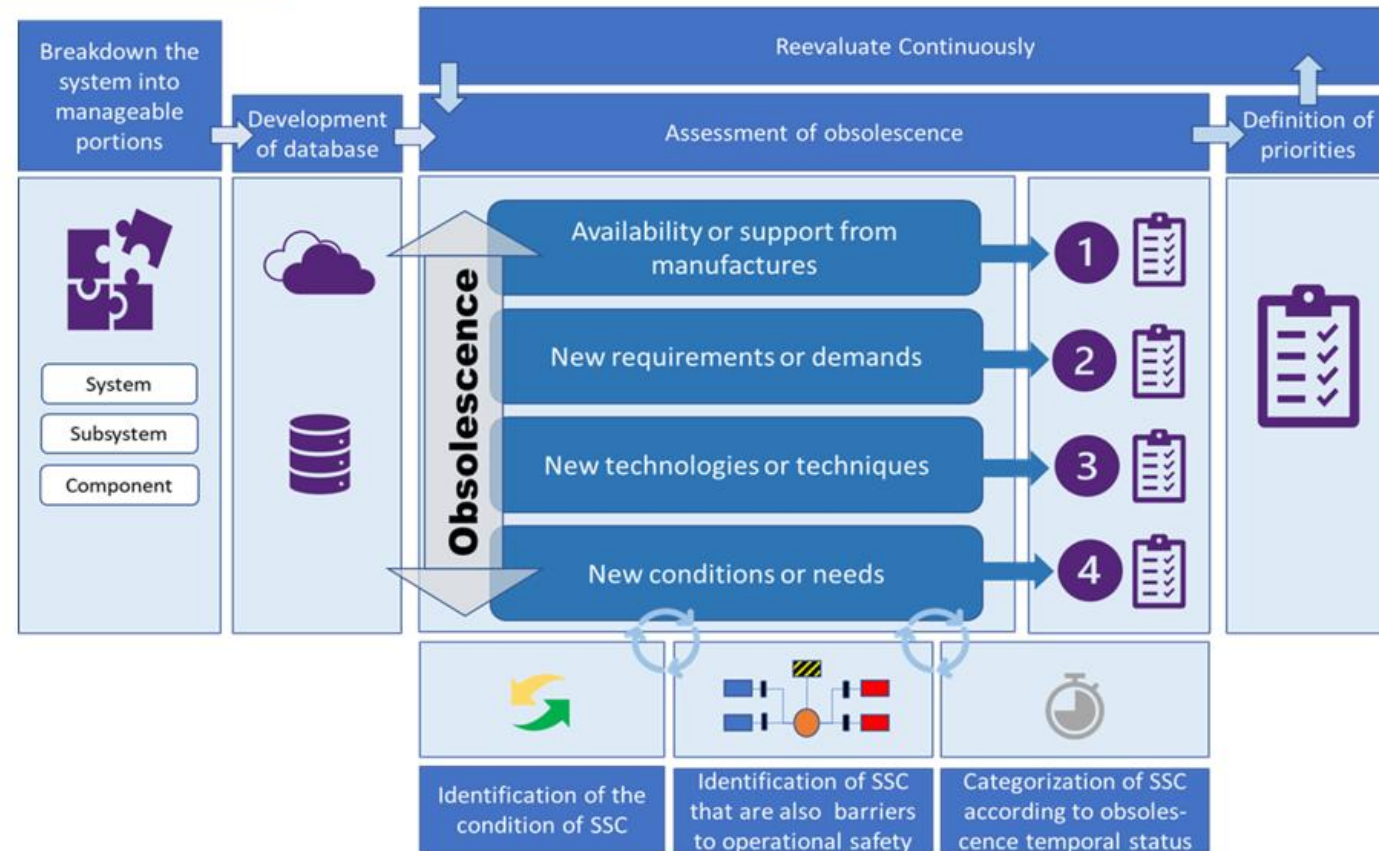
Technological obsolescence



Obsolescence Management

Methodology

- 1) Current state of the art about obsolescence (literature + regulatory bodies)
- 2) Several stages (obsolescence) > addressed individually by several authors (interesting level of depth)
- 3) Literature (LE) > **unstructured way/ not comprehensive**



Conclusion – Obsolescence Management

Ocean Engineering 265 (2023) 115308



ELSEVIER

Contents lists available at ScienceDirect

Ocean Engineering

journal homepage: www.elsevier.com/locate/oceaneng



Obsolescence management for offshore oil and gas production facility life extension

Nayara Nunes Ferreira^{a,b,c}, Marcelo Ramos Martins^{d,e}, Rebecca Dziedzic^e,
Marco Antonio Gaya de Figueiredo^f

^a Operational Safety and Environment Superintendence of Brazilian National Oil and Gas Agency (ANP), Av. Rio Branco, 65, 20090-003, Rio de Janeiro, Brazil

^b Operations and Industrial Projects Department, State University of Rio de Janeiro (UERJ), R. São Francisco Xavier, 524, 20550-900, Rio de Janeiro, Brazil

^c John Molson School of Business, Management Department, Concordia University, 1450 Guy St., Montreal, Quebec, H3H 0H, Canada

^d Analysis, Evaluation and Risk Management Laboratory (LabRisco), Naval Architecture and Ocean Engineering Department, University of São Paulo (USP), Av. Prof. Mello Moraes, 2231, 05508-030, São Paulo, Brazil

^e Building, Civil and Environmental Engineering Department, Concordia University, 1515 Ste. Catherine St. W., Montreal, QC, H3G 2W1, Canada

^f Petroleum and Petrochemical Engineering and Technology Laboratory (LETPP), Operations and Industrial Projects Department, State University of Rio de Janeiro (UERJ), R. São Francisco Xavier, 524, 20550-900, Rio de Janeiro, Brazil

ARTICLE INFO

Handling Editor: Prof. A.I. Incecik

Keywords:

Obsolescence
Life extension
Oil and gas facilities
Ageing management
Ageing process
Decision-making tool

ABSTRACT

The extension of the service life of offshore oil and gas production facilities has been an object of increased interest because of its benefits. In previous work, the authors proposed a guideline for managing the life extension process of oil and gas facilities, however without integrating obsolescence management. The main objective of the present study consists of develop a framework to guide the evaluation and management of asset obsolescence in the context of life extension, considering the concept of obsolescence as having four types of drivers - unavailability from manufacturers, new requirements or demands, technological or technical changes, and new conditions or needs. A framework with six stages of obsolescence management process was proposed and validated with a case study. Because no single request submitted to the Brazilian oil and gas regulator of a facility considering life extension had complete information to perform the obsolescence evaluation, a hypothetical case study was developed with a combination of information from real offshore production facilities. Results demonstrate that the framework: (i) transforms the assessment and management of obsolescence into a systematic process that identifies priority impacted elements and, (ii) based on the risks associated with their obsolescence, supports the definition of the most appropriate decision.



Conceptualizes obsolescence as driven by four factors

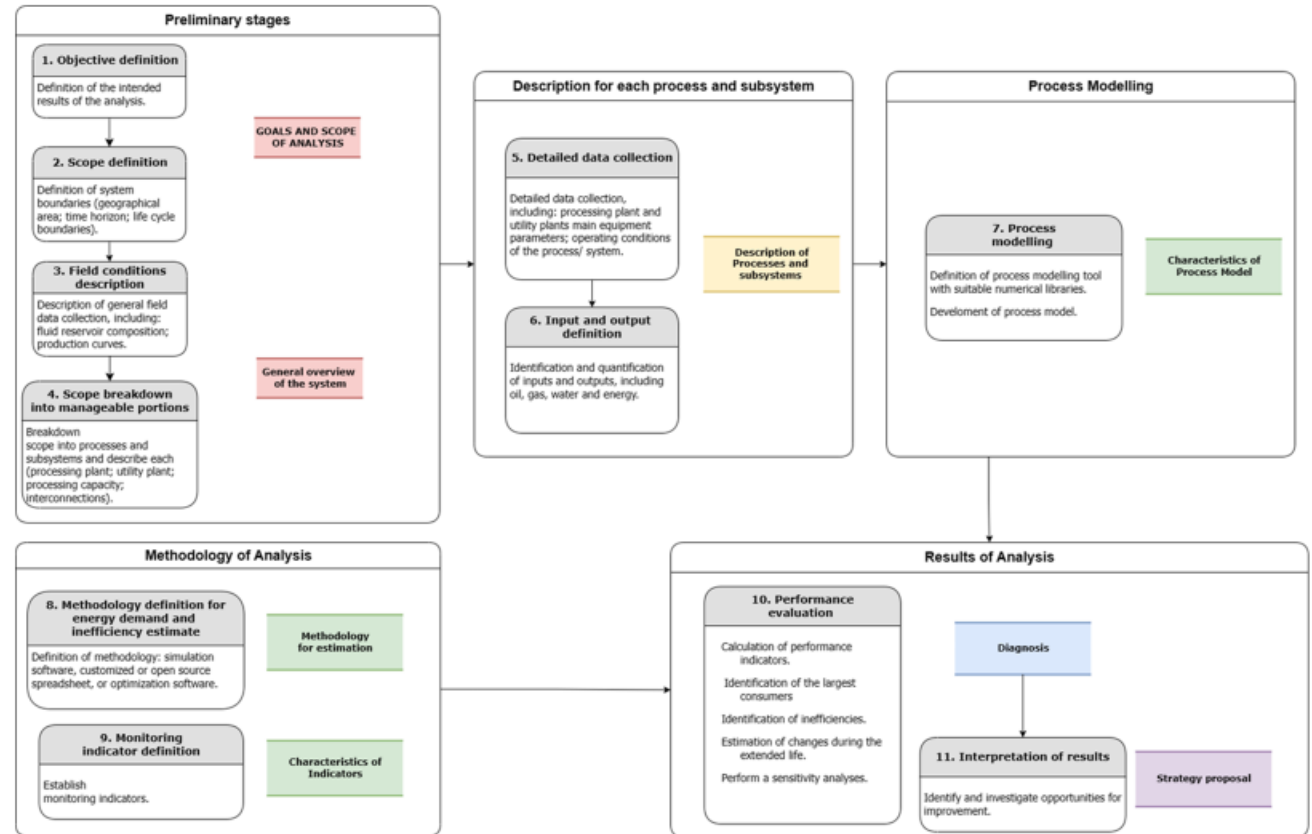
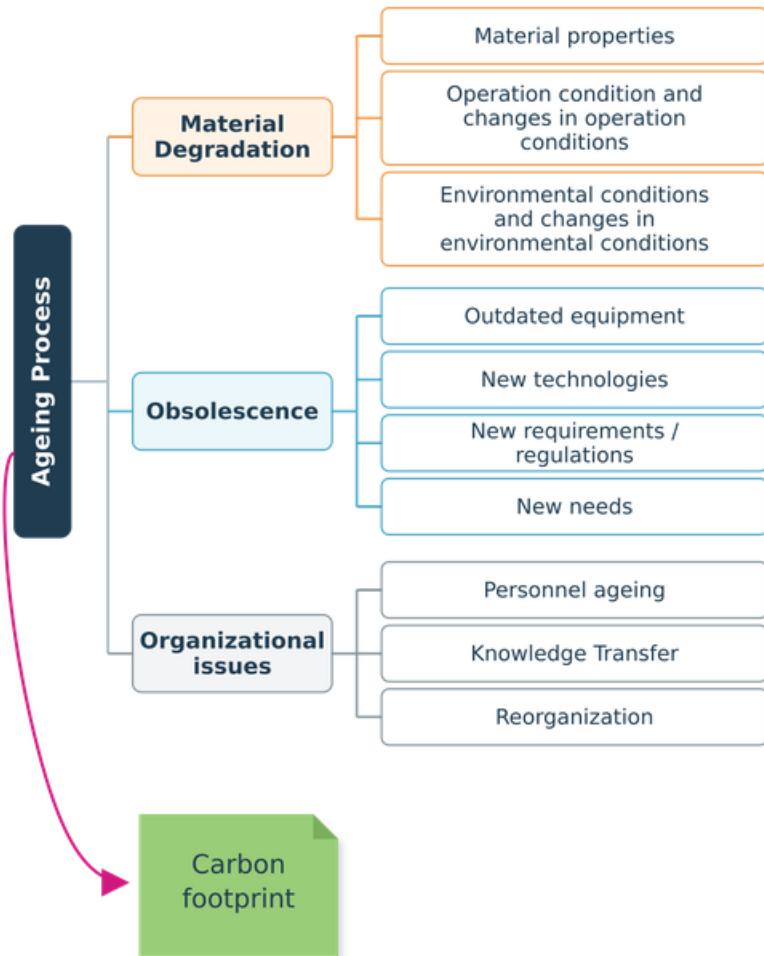


Proposes a methodology for assessing and managing the obsolescence of offshore oil and gas production facilities



Framework is able to systematically evaluate obsolescence in the context of life extension (oil and gas facility) > can be broadly applied

Carbon Footprint Assessment in the LE



Conclusion – Carbon Footprint Assessment in the LE

240 (2024) 213032



Introduction of a carbon footprint assessment in the oil and gas facility life extension decision-making process

Nayara Ferreira^{a,b,c}, Rebecca Dziedzic^d, Cyro Albuquerque^e, Silvio de Oliveira Junior^f, Shannon Lloyd^c, Marcelo Ramos Martins^{g,h}

^a Operational Safety and Environment Superintendence of Brazilian National Oil and Gas Agency (ANP), Av. Rio Branco, 65, 20090-003, Rio de Janeiro, Brazil

^b Operations and Industrial Projects Department, State University of Rio de Janeiro (UERJ) R. São Francisco Xavier, 524, 20550-900, Rio de Janeiro, Brazil

^c John Molson School of Business, Management Department, Concordia University 1450 Guy St, Montreal, Quebec, H3H 0H1, USA

^d Building, Civil and Environmental Engineering Department, Concordia University 1515 Ste. Catherine St. W., Montreal, Quebec, H3G 2W1, USA

^e Mechanical Engineering Department, Centro Universitário FEI, Av. Humberto de Alencar Castelo Branco, 3972 - São Bernardo Do Campo - SP - 09850-901, USA

^f Mechanical Engineering Department, Polytechnic School, University of São Paulo (USP), Av. Prof. Mello Moraes, 2231, 05508-030, São Paulo, Brazil

^g Analysis, Evaluation and Risk Management Laboratory (LabRisco), Naval Architecture and Ocean Engineering Department, University of São Paulo (USP), Av. Prof. Mello Moraes, 2231, 05508-030, São Paulo, Brazil

ARTICLE INFO

Keywords:
Carbon footprint
Life extension
Oil and gas facilities
Ageing management
Ageing process
Decision-making tool

ABSTRACT

In large oil and gas producing countries, extraction and processing activities, including upstream activities, can represent a large share of domestic emissions. As oil fields approach their expected service life and reach depletion, energy use and GHG emissions increase per unit of produced oil, shifting operations away from their optimal point. Thus, it is paramount that oil field life extension decisions account for energy use and GHG emissions. However, many facilities are having their service life extended without considering this energy inefficiency and previous life extension decision making studies have neglected GHG emissions. Addressing this issue, this paper proposes the inclusion of a carbon footprint assessment within the evaluation of oil and gas offshore production facility life extension. The carbon footprint assessment adds an environmental lens to the evaluation of ageing, formerly evaluated according to material degradation, obsolescence and organisational issues. An eleven-stage framework is proposed to systematise the ageing related carbon footprint assessment and support life extension decision-making: (1) Objective definition, (2) Scope definition, (3) Field conditions description, (4) Scope breakdown into manageable portions, (5) Detailed data collection for each process and subsystem, (6) Input and output definition for each process and subsystem, (7) Process modelling, (8) Methodology definition for energy demand and inefficiency estimate, (9) Monitoring indicator definition, (10) Performance evaluation, and (11) Interpretation of results. The proposed framework is applied to a hypothetical case study, developed with data from a typical oil and gas offshore production platform operated in Brazil. Two LE improvement strategies were simulated, i.e. reducing the number of gas turbines, and increasing the export of natural gas. Both alter the modus operandi of the compression system and do not require additional equipment installation. These strategies resulted in a combined reduction of 922,000 tCO₂ during the extended 10-year operation. This outcome demonstrates that by applying the framework opportunities for reducing energy use and GHG emissions during life extension can be identified and quantified, facilitating life extension decision-making.



Ability to **systemically assess GHG emissions** in LE contexts, offering a simplified and effective decision-making basis

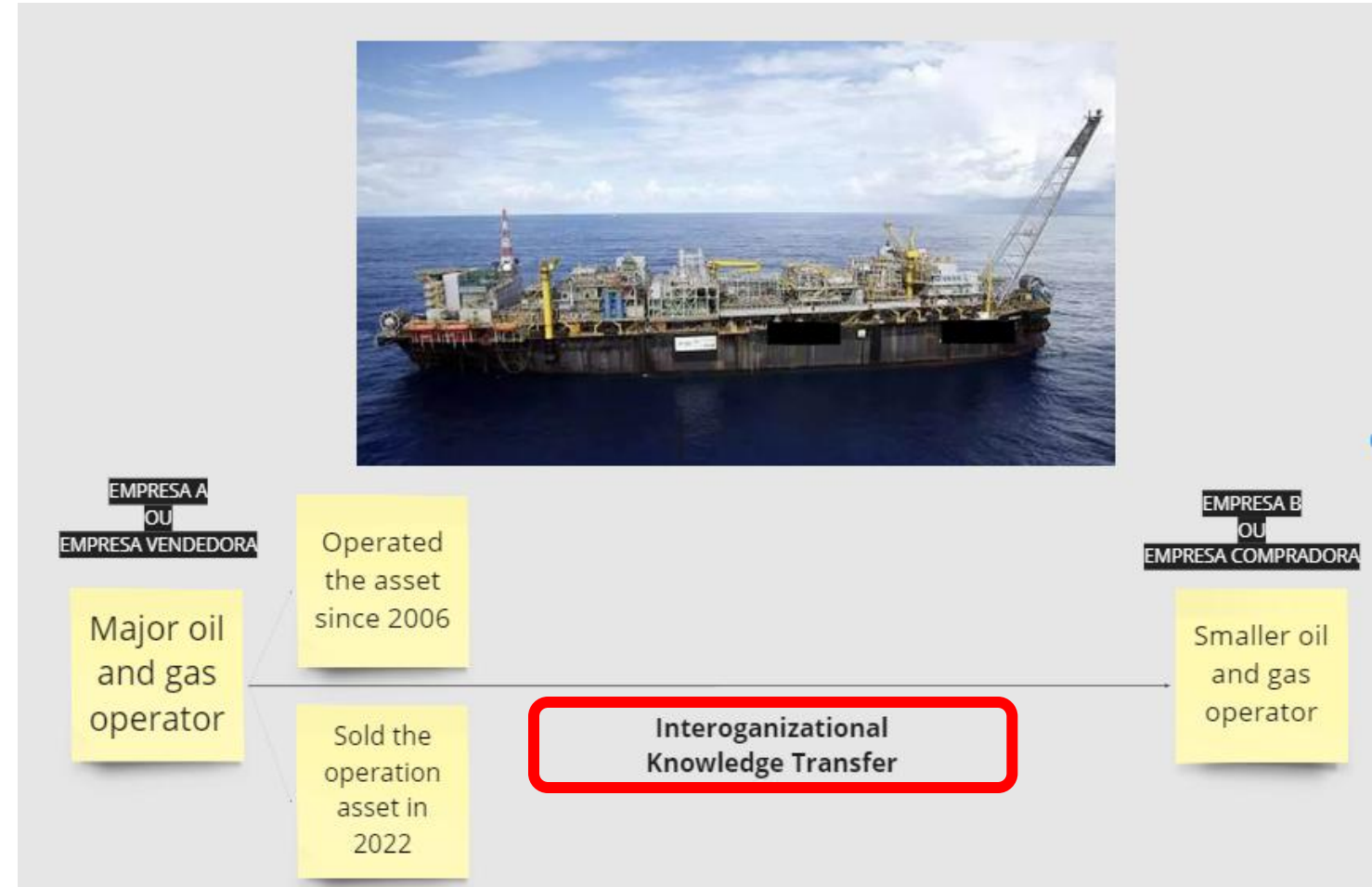
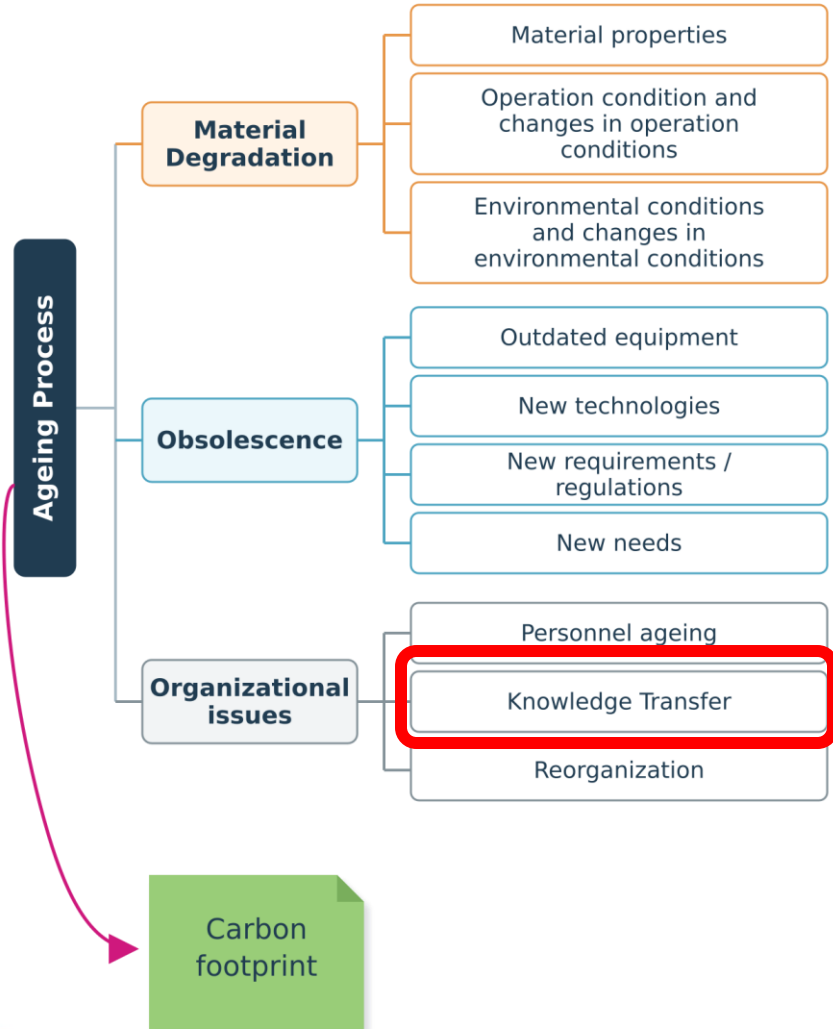


Enable the **identification of solutions** that lead to significant improvements in energy efficiency

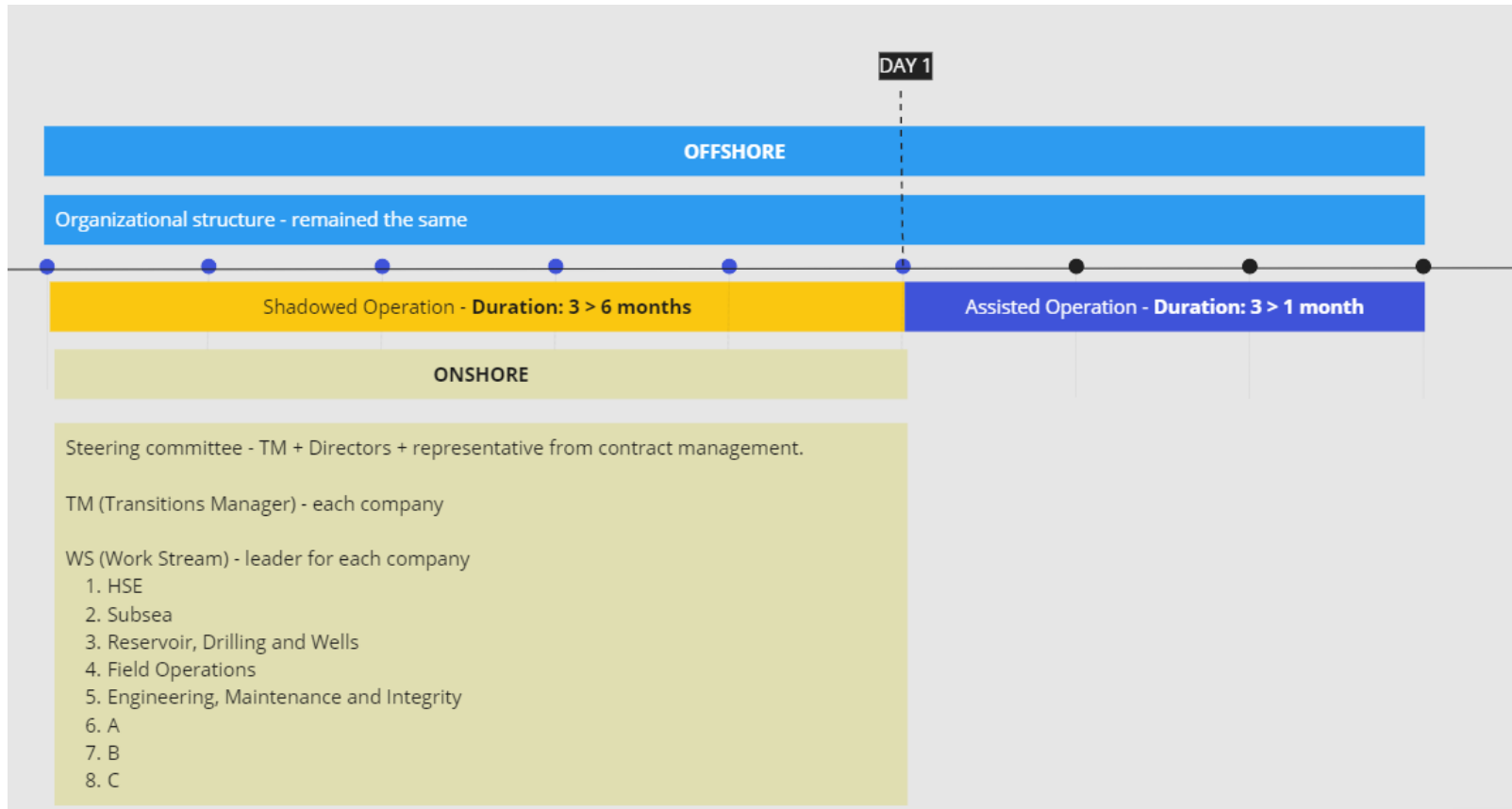


Assist operators and regulatory agencies in preparing and evaluating **LE management plan** (despite the lack of regulatory requirements for carbon footprint assessments)

Introduction and Scope of the Analysis



Context of the Case Study



Objetivo do feedback:

Aprimoramento do processo de transf. de conhecimento:

- *da Empresa Compradora (lições aprendidas)*
- *de outras empresas que passam por esse processo*

Emp Vendedora

> não faz parte do escopo de estudo!

Data Collection

Environment	Hierarchical position of the interviewees
Facility (Offshore)	Offshore Installation Manager
	Offshore Installation Manager
	Production Superintendent
	Marine Superintendent
	Maintenance Superintendent
	Marine Supervisor
	Safety Supervisor
	Mechanical Supervisor
	Electrical technician

Environment	Hierarchical position of the interviewees
Office (Onshore)	Transition Manager
	Coordinator of WS Field Operations
	Coordinator of WS Engineering, Maintenance and Integrity
	Coordinator of WS Naval
	Coordinator of WS HSE (Health, Safety and Environment)
	Coordinator of WS Drilling and Wells
	Coordinator M&A (Merge and Acquisition)
	Automation engineer

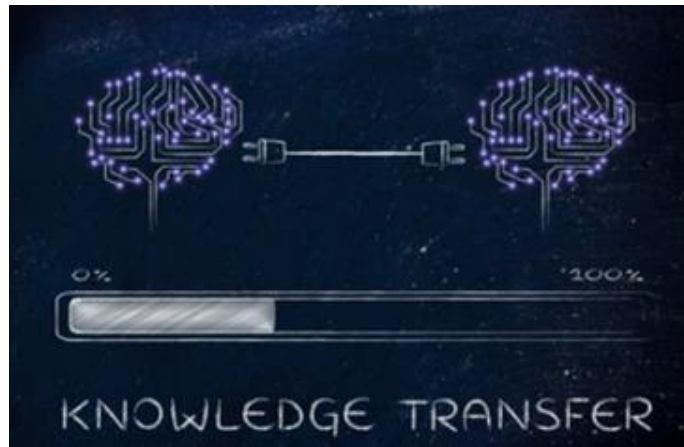


Temas abordados de forma recorrente pelos entrevistados



Base da literatura acadêmica sobre o tópico

Results – Organizational issues



STRUCTURAL GOVERNANCE

1. Contractual characteristics
2. Decision-making characteristics
3. Conflict resolution
4. Transfer period
5. Alignment of the two companies in all working environments

RELATED ABSORPTIVE CAPACITY

6. Degree of similarity

MOTIVATION

7. Availability
8. Proactivity
9. Provision of resources

PRIOR EXPERIENCE

10. Previous experiences
11. Lessons learned

TRAINING

12. Identification of training needs
13. Training effectiveness

MANAGEMENT CAPACITY

14. Transfer objectives
15. Transfer scope
16. Responsibility for transfer
17. Evaluation mechanism & method

INTER-ORGANIZATIONAL ROUTINES

18. Definition of routines

OTHER COORDINATION TOOLS

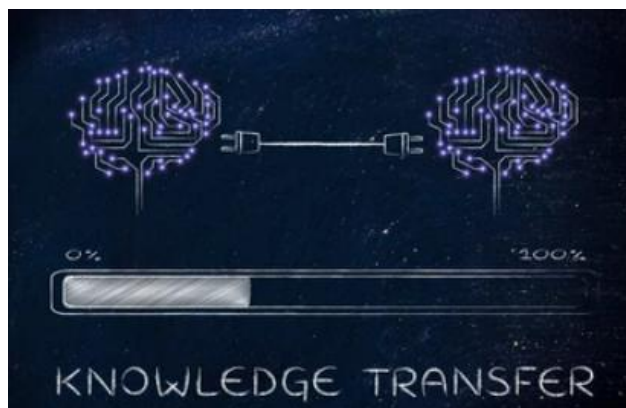
19. Access to databases
20. Mechanisms used

TIME

21. Collaboration duration

DUE DILIGENCE

22. Due diligence for knowledge transfer



22 elementos

- Resolução de conflitos
- Proatividade
- Experiência prévia
- Objetivo da transf.
- Escopo da transf.
- Etc

**39 Desafios
enfretados pelo
operador**



Offshore



Onshore

Results – Structural Governance

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Structural governance	1. Contractual characteristics		
	2. Decision-making characteristics		
	3. Conflict resolution		
	4. Transfer period		
	5. Alignment of the two companies in all working environments		

Results – Structural Governance

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Structural governance	1. Contractual characteristics	--	DESALINHAMENTO ENTRE O CONTRATO E OS REQUISITOS OPERACIONAIS. DECLARAÇÕES GENÉRICAS COM REQUISITOS E PRAZOS MAL DEFINIDOS



Pouco detalhamento/ subjetivo quanto ao conteúdo

- Emp vendora não obrigada a fornecer todos os procedimentos da unidade
- Falta de previsão de teste dos sistemas de segurança antes Day 1



Pouco detalhamento quanto aos recursos

- Definição de recursos (pessoal disponível para a transição)
- Nº insuficiente de pessoas a bordo - 4 da Emp Comp
- Falta de critérios para a Emp Comp selecionar assistentes



Indefinição da sistemática de transferência

- Informações não fornecidas gradualmente/ docs compartilhados perto do Day 1

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Structural governance	2. Decision-making characteristics	TOMADA DE DECISÃO UNILATERAL CONTRÁRIA À EFETIVIDADE DA TRANSF. DE CONHECIMENTO.	IDEM



Offshore – decisão da Emp Vend

- autorização de entrada em espaços confinados
- autorização para participação em reuniões diárias e de planejamento

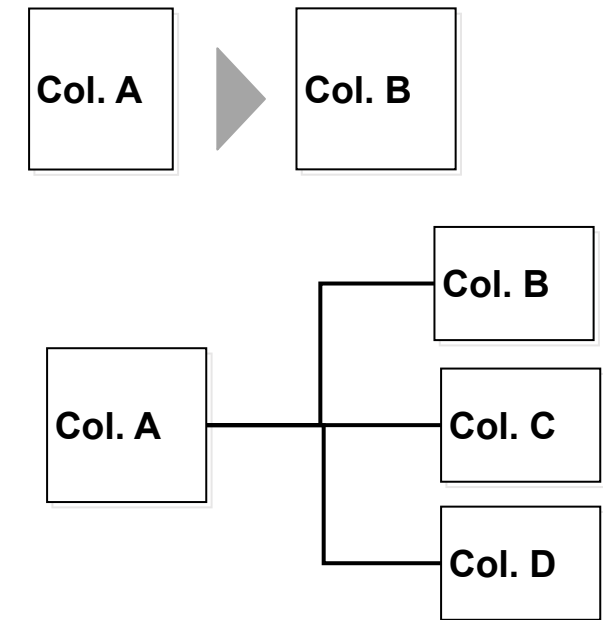
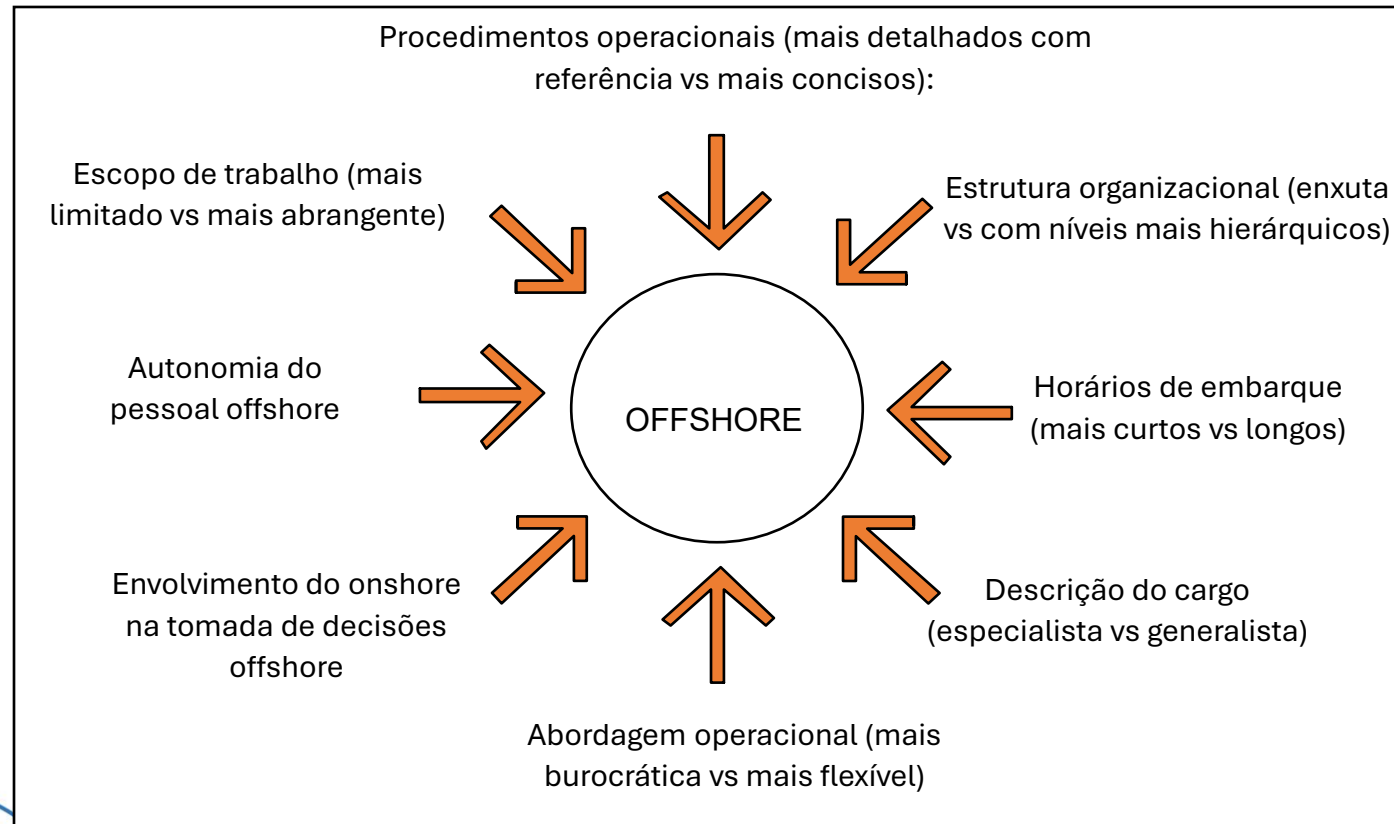


Onshore – decisão da Emp Vend

- dificuldade de aumentar frequência de reuniões
- dificuldade em participar em análises técnicas importantes com impactos futuros
- autorização de teste de sistemas de segurança antes do Day 1
- falta de compartilhamento de procedimentos importantes

Results – Related Absorptive Capacity

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Related absorptive capacity	6. Degree of similarity between the companies	INABILIDADE PARA ENTENDER E ENDEREÇAR AS DIFERENÇAS	IDEM



Results – Motivation

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Motivation	7.Availability		
	8.Proactivity		
	9.Provision of resources		

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Motivation	7.Availability	COMPETIÇÃO DAS FUNÇÕES OPER. E DAS RELAT. À TRANSF. DE CONHECIMENTO	---
		BAIXA PRIORIDADE DADA À TRANSF. DE CONHECIMENTO	IDEM
	8.Proactivity	TRANSF. DE CONHECIMENTO NÃO ESTRUTURADA	IDEM
		FALTA DE ENTENDIMENTO DA RESPONSABIL. COMPARTILHADA PELA TRANSF. DE CONHECIMENTO	IDEM
		FALTA DE VONTADE DE COMPARTILHAR (RESISTÊNCIA)	---



Offshore

- Emp Comp - 100% disponível vs
- Emp vend “...contraparte sempre dizia que não tinha tempo, estava sobrecarregado de trabalho... Parecia realmente ter muitas tarefas para lidar.”



Onshore

- Emp Comp - não tinha 100% de disp.
- Emp Vend - Grande variação entre os líderes das WS (para aumentar frequência e duração das reuniões semanais)

Trabalho “investigativo” > baseado em perguntas

Results – Experience

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Prior experience	10.Previous experiences		
	11.Lessons learned		

Results – Experience

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Prior experience	10.Previous experiences	EXPERIÊNCIA LIMITADA EM TRANSIÇÃO DE ATIVOS	IDEM



Offshore/ Onshore

- Emp Comp – Maioria experientes

Mas a transição era completamente DIFERENTE das demais

> NECESSIDADE DE ANTECIPAÇÃO, não dava para replicar o modelo usado anteriormente!

- Emp Vend – Pouca/ Nenhum experiência prévia

Dificuldade de entender o objetivo, escopo, nível de colaboração necessários!

Results – Training

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Training	12. Identification of training needs	FALTA DE COMPREENSÃO DE QUE O TREINAMENTO DA EMP VEND. É UM MEIO DE AQUISIÇÃO DE CONHECIMENTO	IDEM
	13. Training effectiveness	---	---



Offshore/ Onshore

- Não reconheceu ou não percebeu que poderia solicitar treinamento da Emp Vend > aquisição de conhecimento

Lacuna de conhecimento ou com dificuldades para entender as especificidades da unidade

>>> Treinamento externo

>>> Contratação de fornecedores para assistência

Results – Management Capacity

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Management capacity	14.Transfer objectives		
	15.Transfer scope		
	16.Responsibility for the transfer		
	17.Evaluation mechanism and method		

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Management capacity	14.Transfer objectives	DEFINIÇÃO POUCO CLARA DE OBJETIVOS	IDEM
	15.Transfer scope	DEFINIÇÃO DE ESCOPO INCONSISTENTE	IDEM
		PRIORIZAÇÃO POUCO CLARA ENTRE AQUISIÇÃO DE CONHECIMENTO TÁCITO E AVALIAÇÃO DE ATIVOS FÍSICOS	AVALIAÇÃO DE ÚLTIMA HORA DE DOCUMENTOS PARA RESTRIÇÕES DE PROPRIEDADE INTELECTUAL ANTES DO COMPARTILHAMENTO



Offshore

- Objetivo > Principal dificuldade: pessoal offshore da Emp Vend (muitas vezes sabiam dos objetivos pelo pessoal da Emp Vend)
- Escopo > Diferentes entendimentos (não padronizados): (1) assimilar o conhecimento tácito (como), (2) se familiarizar com a planta (não precisavam focar nos procedimentos), (3) ler os procedimentos para entender o *modus operandis* da unidade, (4) fazer um diagnóstico da planta e estado dos equipamentos etc.



Onshore - Líderes das WS se “sentiam perdidos”

- Objetivo > (1) ler tudo, (2) critério de priorização; (3) “*garimpar e entender*” após a transição
- Escopo > (1) adquirir infos, (2) confirmar a integridade dos dados, (3) compreender e assimilar a medida que fossem obtendo

Foram traçados pelos próprios líderes da WS de acordo com a sua carga de trabalho e as prioridades.

Results – Inter-organizational Routines

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Inter-organizational routines	18.Definition of routines	ROTINAS INDEPENDENTES DEFINIDAS PARA AS EQUIPES OPERACIONAIS DE CADA EMPRESA. ROTINAS INDIVIDUAIS DEFINIDAS DE ACORDO COM A DISPONIBILIDADE E NÃO PARA A TRANSF. IDEAL DE CONHECIMENTO.	FALTA DE ROTINAS QUE INCLUISSEM TODOS OS ASPECTOS DA TRANSF. DE CONHECIMENTO.



Offshore - Nenhuma rotina foi criada entre as duas empresas

- Dificuldade para estabelecer uma dinâmica para transferir conhecimento
- Retrabalho para a Emp Comp > refazer sua programação
- Dependência do interlocutor > legal?



Onshore - Rotinas estabelecidas entre as duas empresas

- Poucas WS foram além de somente receber a documentação (Transition Plan)
- Não foram estabelecidas rotinas entre as WS
 - > Não buscou padronização e possíveis sinergias entre as WS

Results – Coordination Tools

IKT Construct	IKT Element	Challenges	
		OFFSHORE	ONSHORE
Other coordination tools	20. Mechanisms used for knowledge transfer	FALTA DE ALINHAMENTO ENTRE OS MECANISMOS APLICADOS, O TIPO DE CONHECIMENTO E O ESTILO DE APRENDIZAGEM PREFERIDO.	MECANISMOS RESTRITOS E NÃO ESTRUTURADOS DE TRANSF. ENTRE EMPRESAS.



Offshore

- Sistemática utilizada nem sempre compatível com a função

“eu não sei aprender olhando, ninguém aprende dirigir olhando alguém dirigir”

“6 meses de observação foi uma perda de tempo...só aprendo com as mãos sujas”

>>> Pessoas operacionais - dificuldade em aprender através da leitura e observação (sem colocar em prática a cada ponto observado).



Onshore

- As reuniões não eram estruturadas.

Emp vend. (detentora do conhecimento) não trazia os principais pontos de forma organizada e com explicações

>>> Processo centrado em perguntas e respostas > quem conduz não tinha conhecimento > gerando perda de informação

Conclusion – Organizational issues

IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, VOL. 71, 2024

5559

Challenges in Inter-organizational Knowledge Transfer for the Life Extension of Oil and Gas Facilities

Nayara Nunes Ferreira , Rebecca Dziedzic , Ana Burcharth , and Marcelo Ramos Martins 

Abstract—The aging process of oil and gas facilities poses unique challenges in risk management, especially when operators have the intention to extend their service life. Facility extension has been an object of increased interest in the oil and gas industry because of its benefits. Researchers have identified several organizational issues that can impact this process. Among these, knowledge transfer is a critical aspect in contexts involving facility transfer between companies. The goal of this research is to investigate the inter-organizational knowledge transfer (IKT) elements and mechanisms of oil and gas facilities acquired for life extension and understand their main challenges. A qualitative case study was carried out on the transfer of an oil and gas offshore production facility between companies. The study identified 22 key elements and 27 challenges that the acquiring operating company faced during the IKT process. This case study provides valuable insights that can guide other organizations in similar situations, helping them better manage the IKT process, mitigate potential risks, and ensure smoother operations during and after facility transfer. It can also support the development of future frameworks by managers and oil and gas regulators to evaluate IKT issues as part of oil and gas facility life extension.

Index Terms—Aging process, knowledge transfer, life extension, oil and gas facilities organizational.

I. INTRODUCTION

THE acquisition of oil and gas facilities for life extension has grown in prevalence. Operating these facilities be-

comes a multifaceted challenge. Aging of an oil and gas facility is multifaceted, it is not simply characterized by the temporal aging of its equipment [1]. According to Ersdal et al. [2], Hornlund et al. [3], and PSA [4], aging comprises four categories: functional (physical), technological, knowledge-based, and organizational. While most of the literature on the aging of oil and gas facilities focuses on physical degradation [3], organizational issues, such as knowledge transfer and personnel aging, are also crucial [5].

The evaluation of organizational issues is nevertheless not mandated by global oil and gas regulators for operators to demonstrate that a facility can continue to be safely operated beyond its intended lifespan. For example, life extension cases submitted to the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), never considered organizational issues [5]. Neither the ANP, the HSE (U.K. regulator) nor the PSA (Norwegian regulator) has guidelines for evaluating organizational issues [6], [7], [8]. The constraints observed in prior regulatory analyses highlight the complexities faced by both operators and regulators in comprehending and evaluating organizational matters.

Based on previous aging process classifications, potential organizational issues during life extension include the aging of the workforce, the need for knowledge transfer, and the adaptations arising from changes to company structure, such as company



IKT elements >> 22 key elements



Challenges >> 27



IKT > Knowledge transfer failure



Differences between environments GAP (offshore and onshore)



Offshore > less structuring.



How to improve?

- Pre-transition planning
- Transition
- Post-transition

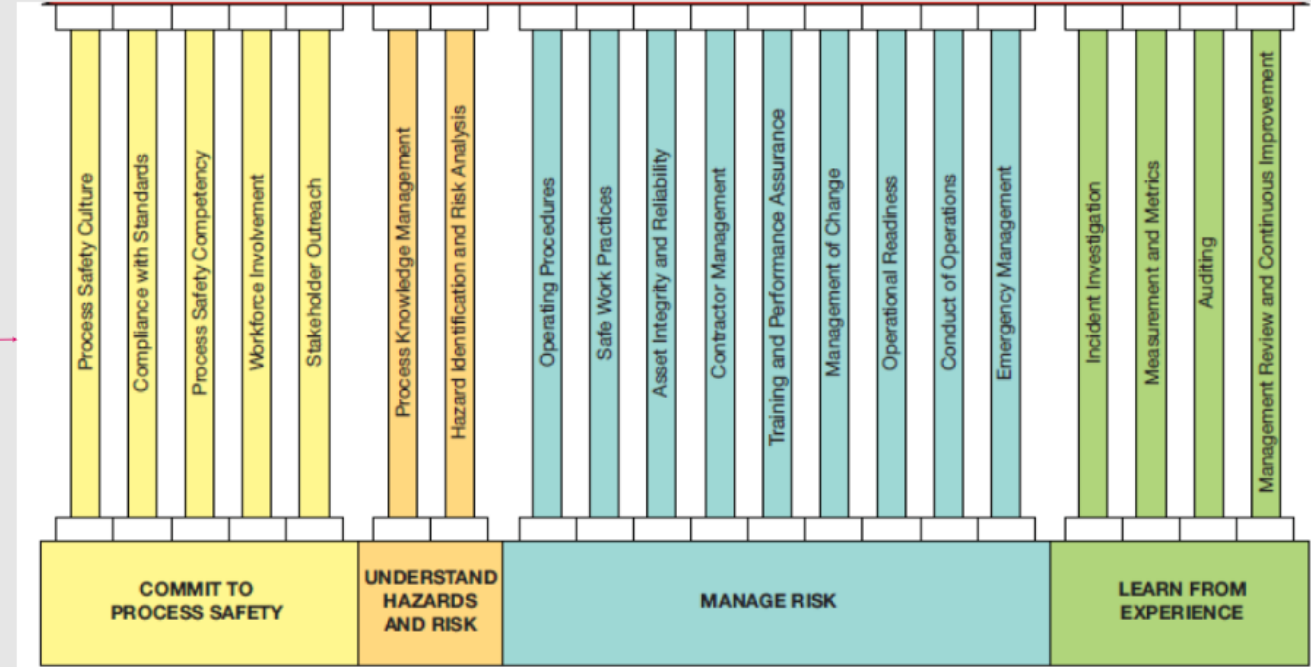
Pré-transição



Data Analysis

ICT elements		OFFSHORE	ONSHORE
STRUCTURAL GOVERNANCE	Contractual characteristics	—	MISALIGNMENT BETWEEN THE CONTRACT AND OPERATIONAL REQUIREMENTS. SEVERE STATEMENTS WITH IL-DEFINED REQUIREMENTS AND EXCLUSIONS.
	Decision-making characteristics	UNLATERAL DECISION-MAKING CONTRARY TO THE EFFECTIVENESS OF KNOWLEDGE TRANSFER.	MEMO DO OFFICER.
	Conflict resolution	AD-HOC APPROACH TO CONFLICT RESOLUTION DURING KNOWLEDGE TRANSFER.	MEMO DO OFFICER.
	Transfer period	UNPREDICTABILITY OF THE KNOWLEDGE TRANSFER PERIOD.	MEMO DO OFFICER.
	Alignment of the two companies in all working environments	LACK OF TRANSPARENCY ON CONSENSUAL DECISIONS MADE IN DIFFERENT ENVIRONMENTS.	MEMO DO OFFICER.
HUMAN ASPECTS	Degree of similarity between the companies	UNABLE TO RESOLVE DIFFERENCES.	DIFFERENCES IDENTIFIED WERE NOT INPUTS TO DEFINE HOW TO PERFORM KNOWLEDGE TRANSFER. ABRUPT MODIFICATION (SYSTEM).
	Availability	COMPETITION BETWEEN OPERATIONAL FUNCTIONS AND THOSE RELATED TO KNOWLEDGE TRANSFER. LOW PRIORITY GIVEN TO SCHEDULING OF KNOWLEDGE TRANSFER.	LACK OF FLEXIBILITY IN SCHEDULING KNOWLEDGE TRANSFER ACTIONS.
MOTIVATION	Proactivity	UNSTRUCTURED KNOWLEDGE TRANSFER. RELIANT ON QUESTIONS. MISINTERPRETATION OF SOURCE KNOWLEDGE TRANSFER RESPONSIBILITY AMONG COMPANIES. UNWILLINGNESS TO SHARE KNOWLEDGE DUE TO RESISTANCE TO ACQUISITION.	MEMO DO OFFICER. MEMO DO OFFICER.
	Provision of resources	LACK OF RESOURCES (SOFTWARE, HARDWARE, EQUIPMENT & PERSONNEL) PRIOR TO BEGINNING KNOWLEDGE TRANSFER.	LACK OF DEDICATED PERSONNEL FOR KNOWLEDGE TRANSFER.
KNOWLEDGE EXPERTISE	Previous experiences	LIMITED EXPERIENCE IN ASSET TRANSITION. LACK OF PRIOR UNDERSTANDING OF THE DIFFERENCES BETWEEN PREVIOUS AND	MEMO DO OFFICER.
	Lessons learned	LACK OF DOCUMENTED LESSONS LEARNED.	INCOMPATIBILITY BETWEEN WHAT IS DOCUMENTED AND THE LESSONS LEARNED.
TRAINING	Identification of training needs	LACK OF UNDERSTANDING THAT TRAINING FROM THE SOURCE COMPANY IS A MEANS OF ACQUIRING KNOWLEDGE.	MEMO DO OFFICER. LACK OF AGREEMENT REGARDING TRAINING OPPORTUNITIES.
	Training effectiveness	—	—
MANAGEMENT CAPACITY	Transfer objectives	UNCLEAR DEFINITION OF OBJECTIVES.	MEMO DO OFFICER.
	Transfer scope	INCONSISTENT SCOPE DEFINITION. UNCLEAR PRIORITIZATION BETWEEN FACT KNOWLEDGE ACQUISITION AND PHYSICAL ASSET ASSIGNMENT.	MEMO DO OFFICER. LACK OF DISCUSSION BETWEEN THE LEADERS WHO PARTICIPATED IN THE TRANSFER ON DIFFERENT POINTS.
	Responsibility for the transfer	LACK OF DEDICATED PERSONNEL TO FOCUS ON AND COORDINATE KNOWLEDGE TRANSFER (COVERING OFFSHORE AND ONSHORE ENVIRONMENTS).	MEMO DO OFFICER. LACK OF IDENTIFICATION OF POTENTIAL SYNERGIES AMONG THE ILS.
	Evaluation mechanism and method	LACK OF SYSTEMATIC DEFINITION OF EVALUATION TOOLS.	EVALUATION FOCUSED ON DOCUMENTATION, IGNORING OTHER KNOWLEDGE TRANSFER ASPECTS.
INTERORGANIZATIONAL ROUTINES	Definition of routines	INDEPENDENT ROUTINES SET FOR EACH COMPANY'S OPERATIONAL TRAIL. INDIVIDUAL ROUTINES SET ACCORDING TO AVAILABILITY AND NOT FOR OPTIMAL KNOWLEDGE TRANSFER PERSONNEL.	LACK OF ROUTINES THAT COVER ALL ASPECTS OF KNOWLEDGE TRANSFER, OTHER THAN JUST DOCUMENTATION TRANSFER. LACK OF ROUTINES TO MONITOR THE VARIOUS POINTS WHERE THE TRANSFER OCCURS. LACK OF ALIGNMENT BETWEEN THE SCOPE OF THE TRANSFER AND THE ROUTINES OF THE SOURCE COMPANY PERSONNEL.
	Access to databases	POOR LABELING OF DOCUMENTS. NOT BASED ON TYPE OF FUNCTION AND SYSTEM. DOCUMENTS NOT ORGANIZED PRIOR FOR KNOWLEDGE TRANSFER.	LAST-MINUTE EVALUATION OF DOCUMENTS FOR INTELLECTUAL PROPERTY RESTRICTIONS BEFORE SHARING. INADEQUATE WAY OF SHARING INFORMATION.
OTHER CONSIDERATIONS	Mechanisms used for knowledge transfer	LACK OF ALIGNMENT BETWEEN MECHANISMS APPLIED, KNOWLEDGE TYPE AND PREFERRED LEARNING STYLE.	DYSFUNCTIONAL TRANSFER BETWEEN COMPANIES.
	Duration	LACK OF DETAILED PLAN TO ACCURATELY ESTIMATE TIME REQUIRED.	MEMO DO OFFICER.
IMP BARRIERS	Due diligence	—	DUE DILIGENCE FOCUSED ONLY ON ECONOMIC ASPECTS, NOT INCLUDING KNOWLEDGE TRANSFER.

?



Falha na transf. de conhecimento (ambos ambientes)

Processo de aquisição do conhecimento foi mais custoso, mais demorado, menos efetivo, mais complexo e gerou retrabalho

?

Segurança de Processo

Organization	Expertise
Regulatory agency	Risk, Safety and Human Factors
Petrochemical company	Risk analysis and Reliability Engineering
Consulting company	Asset management
Consulting company	Risk, Safety Culture and Human and Organizational Factors
Oil and gas exploration and production company	Risk and Safety
Chemical Center for Process Safety (CCPS)	Industrial Risk Management

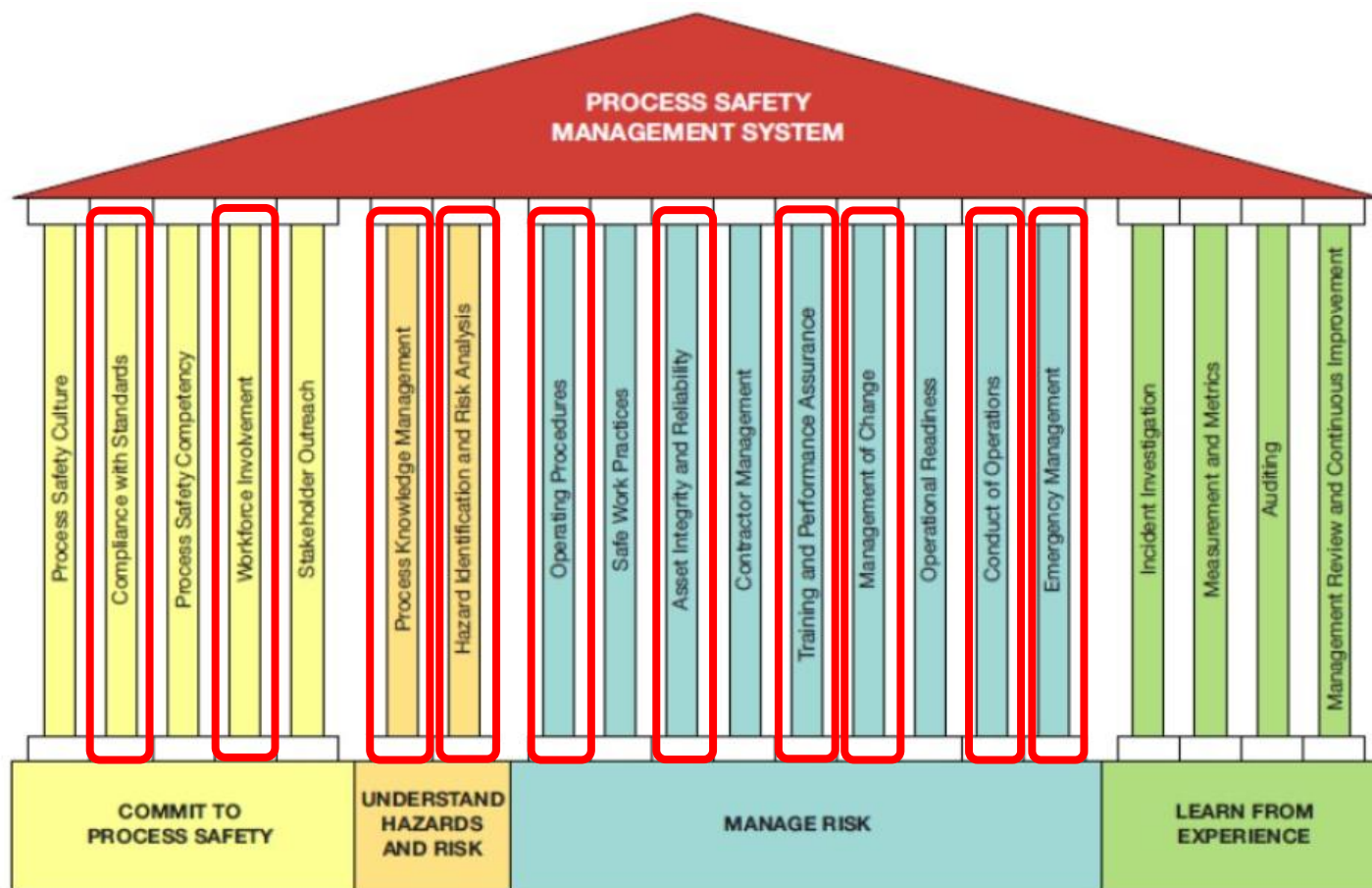
Com base em sua experiência dos entrevistados:

1) Causalidades concretas

2) Efeitos sistêmicos

em segurança do processo

Conclusion – Organizational issues



Elemento mais impactado

>>> **Process Knowledge Management**

IKT elements		OFFSHORE	ONSHORE
STRUCTURAL GOVERNANCE	Contractual characteristics	---	MISALIGNMENT BETWEEN THE CONTRACT AND OPERATIONAL REQUIREMENTS. GENERIC STATEMENTS WITH ALL DEFINED REQUIREMENTS AND DISCLOSURE.
	Decision-making characteristics	UNILATERAL DECISION-MAKING CONTRARY TO THE EFFECTIVENESS OF KNOWLEDGE TRANSFER.	MISSING DO OFFSHORE.
	Conflict resolution	Q-WOC APPROACH TO CONFLICT RESOLUTION DURING KNOWLEDGE TRANSFER.	INABILITY TO RESOLVE CONFLICTS WITHIN ESTABLISHED FRAMEWORK, REQUIRING THIRD PARTY INVOLVEMENT (A.S. REGULATING AGENCY).
	Transfer period	LACK OF PREDICTABILITY OF THE KNOWLEDGE TRANSFER PERIOD.	MISSING DO OFFSHORE.
	Alignment of the two companies in all working environments	LACK OF TRANSPARENCY ON CONSENSUAL DECISIONS MADE IN DIFFERENT ENVIRONMENTS.	---
RELATED ANALYSIS	Degree of similarity between the companies	UNABLE TO RESOLVE DIFFERENCE.	DIFFERENCES EXISTING WERE NOT SUFICIENT TO DEFINE HOW TO PERFORM KNOWLEDGE TRANSFER. ABRUPT DISCONTINUATION (SYSTEM).
INTERMEDIATION	Availability	COMPETITION BETWEEN OPERATIONAL FUNCTIONS AND THOSE RELATED TO KNOWLEDGE TRANSFER. LOW PRIORITY GIVEN TO SCHEDULING OF KNOWLEDGE TRANSFER.	LACK OF FLEXIBILITY IN SCHEDULING KNOWLEDGE TRANSFER ACTIONS.
	Proactivity	UNSTRUCTURED KNOWLEDGE TRANSFER, RELIANT ON QUESTIONS. INDEPENDENTLY, LACK OF SHARED KNOWLEDGE TRANSFER RESPONSIBILITY AMONG COMPANIES. KNOWLEDGE TO SHARE KNOWLEDGE DUE TO RESISTANCE TO ACQUISITION.	MISSING DO OFFSHORE. MISSING DO OFFSHORE.
	Provision of resources	LACK OF RESOURCES (SOFTWARE, HARDWARE, EQUIPMENT & PERSONNEL) PRIOR TO BEGINNING KNOWLEDGE TRANSFER.	LACK OF DEDICATED PERSONNEL FOR KNOWLEDGE TRANSFER.
PRIOR EXPERIENCES	Previous experiences	LIMITED EXPERIENCES IN ASSET TRANSITION. LACK OF PRIOR CONSIDERATION OF THE DIFFERENCE BETWEEN PROVIDER AND	MISSING DO OFFSHORE.
	Lessons learned	LACK OF DOCUMENTED LESSONS LEARNED.	INCOMPATIBILITY BETWEEN WHAT IS DOCUMENTED AND THE LESSONS LEARNED.
TRAINING	Identification of training needs	LACK OF UNDERSTANDING THAT TRAINING FROM THE SOURCE COMPANY IS A MEANS OF ACQUIRING KNOWLEDGE.	MISSING DO OFFSHORE. LACK OF AWARENESS REGARDING TRAINING OPPORTUNITIES.
	Training effectiveness	---	---
MANAGEMENT CAPACITY	Transfer objectives	UNCLEAR DEFINITION OF OBJECTIVES.	MISSING DO OFFSHORE.
	Transfer scope	INCONGRUENT SCOPE DEFINITION. UNCLEAR PRIOR DEFINITION BETWEEN TACT KNOWLEDGE ACQUISITION AND PHYSICAL ASSET ASSIGNMENT.	MISSING DO OFFSHORE. LACK OF EXCHANGE BETWEEN THE LEADERS WHO PARTICIPATED IN THE TRANSFER ON DIFFERENT PROBLEMS.
	Responsibility for the transfer	LACK OF DEDICATED PERSONNEL TO FOCUS ON AND COORDINATE KNOWLEDGE TRANSFER (COVERING OFFSHORE AND PROVIDER INVOLVEMENT).	MISSING DO OFFSHORE. LACK OF IDENTIFICATION OF POTENTIAL SYNERGIES AMONG THE US.
	Evaluation mechanism and method	LACK OF SYSTEMATIC DEFINITION OF EVALUATION TOOLS.	EVALUATION FOCUSED ON DOCUMENTATION, IGNORING OTHER KNOWLEDGE TRANSFER ASPECTS.
INTERORGANIZATIONAL ROUTINES	Definition of routines	INDEPENDENT ROUTINES SET FOR EACH COMPANY'S OPERATIONAL TEAM. INDIVIDUAL ROUTINES SET ACCORDING TO AVAILABILITY AND NOT FOR OPTIMAL KNOWLEDGE TRANSFER.	LACK OF ROUTINES THAT INVOLVE ALL ASPECTS OF KNOWLEDGE TRANSFER, OTHER THAN JUST DOCUMENTATION TRANSFER. LACK OF ROUTINES TO INTEGRATE THE VARIOUS PROBLEMS WHERE THE TRANSFERENCE OCCURS. LACK OF ALIGNMENT BETWEEN THE SCOPE OF THE TRANSFER AND THE ROUTINES OF THE SOURCE COMPANY PERSONNEL.
OTHER COORDINATION TOOLS	Access to databases	PROHIBITED SHARING OF DOCUMENTS, NOT BASED ON TYPE OF FUNCTION AND SYSTEM. DOCUMENTS NOT ORGANIZED PRIOR FOR KNOWLEDGE TRANSFER.	LAST QUALITY EVALUATION OF DOCUMENTS FOR INTELLECTUAL PROPERTY RESTRICTIONS BEFORE SHARING. SUFFICIENT WAY OF SHARING INFORMATION.
	Mechanisms used for knowledge transfer	LACK OF ALIGNMENT BETWEEN MECHANISMS APPLIED, KNOWLEDGE TYPE, AND PREFERRED LEARNING STYLE.	DYSFUNCTIONAL TRANSFER BETWEEN COMPANIES.
TIME	Duration	LACK OF DETAILED PLAN TO ACCURATELY ESTIMATE TIME REQUIRED.	MISSING DO OFFSHORE.
FINANCIAL ASPECTS	Due-diligence	---	OUR DUE DILIGENCE FOCUSED ONLY ON ECONOMIC ASPECTS, NOT INCLUDING KNOWLEDGE TRANSFER.

Afetavam 3 formas diferentes:

- 1) compartilhamento de dados
- 2) interação de pessoal
- 3) acesso a instalações

Impactos em termos de impactos em segurança de processo:

>>> Níveis distintos

Conclusion – Organizational issues



características contratuais/ características de tomada de decisão/ período de transferência/ disponibilidade/ proatividade/ acesso a bases de dados

mais críticos - por serem difíceis de resolver durante a transição (mecan. governança corporativa).



grau de similaridade/ identificação de necessidades de treinamento/ objetivos de transferência/ escopo de transferência/ definição de rotinas/ mecanismos utilizados para transferência de conhecimento

menos críticos - poderiam ser gerenciados durante a transição (governança forte + estabelecimento dos elementos mais críticos)



resolução de conflitos/ eficácia do treinamento/ duração da colaboração

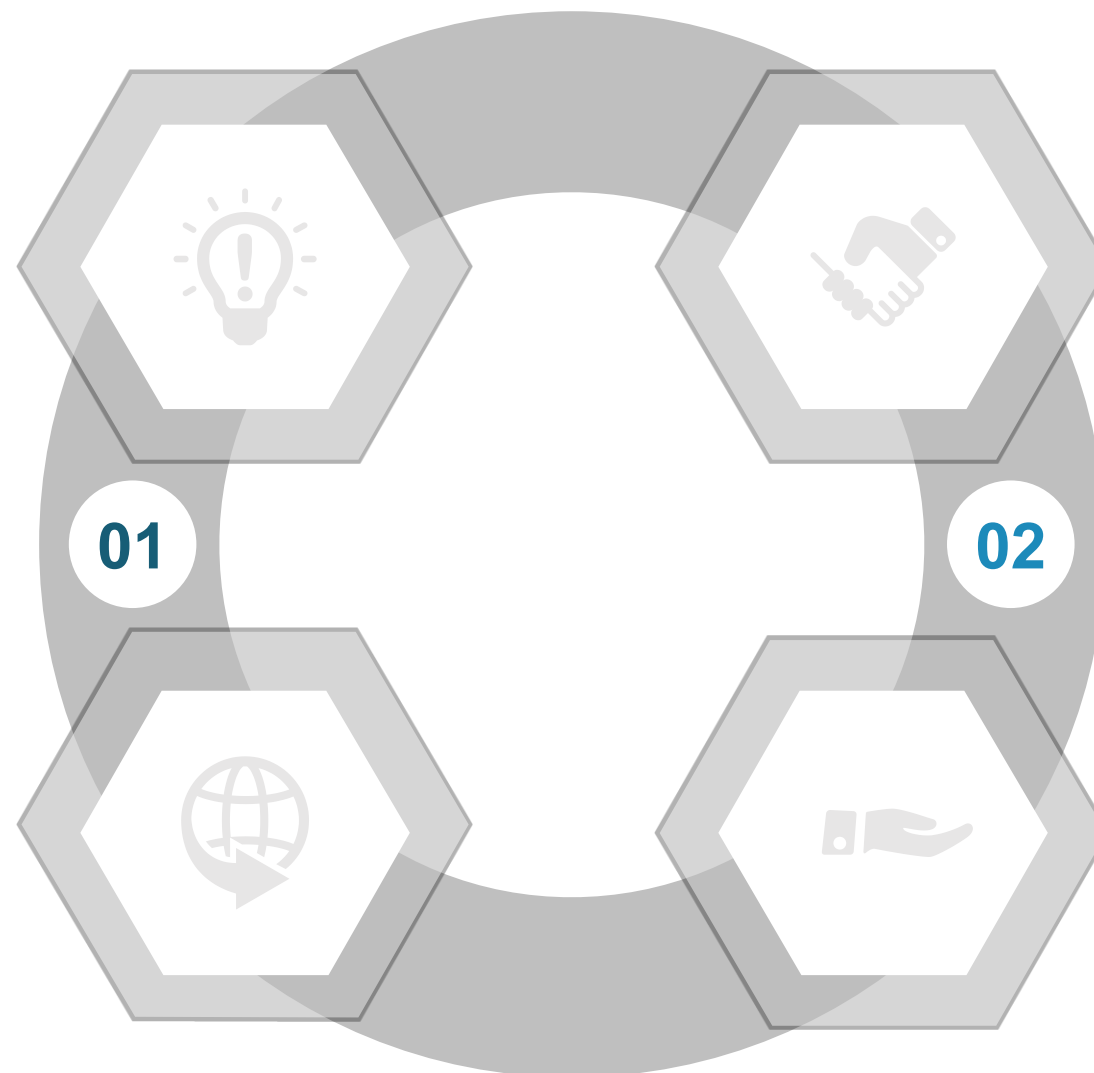
Derivados de outros desafios



alinhamento das duas empresas em todos os ambientes de trabalho/ experiências anteriores/ lições aprendidas/ due diligence

Não relacionados diretamente à segurança de processo
São **facilitadores** ou **obstáculos** à transf. de conhecimento

Conclusion – Organizational issues

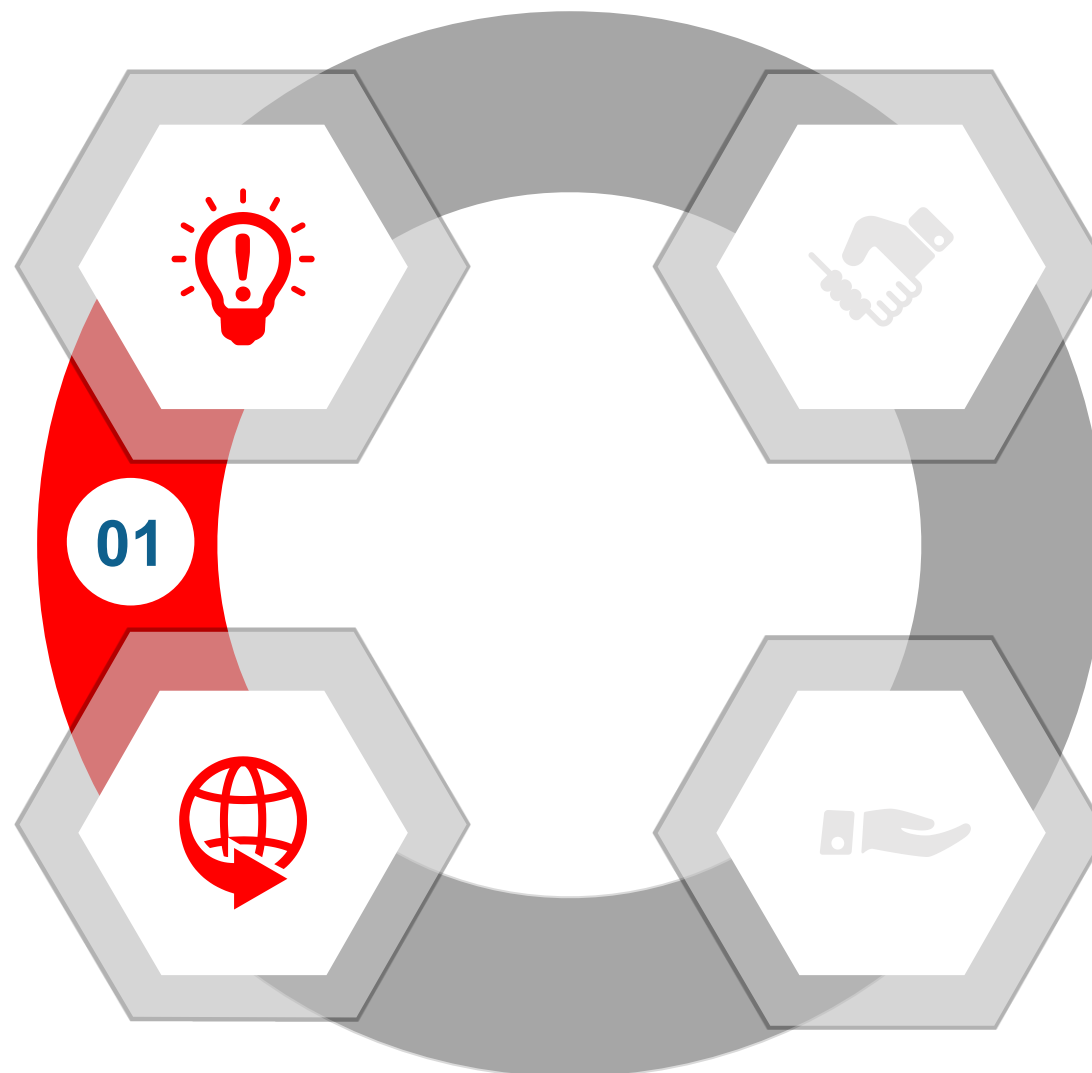


Compromisso e responsabilidade compartilhados

Emp Vend

- > Não pode simplesmente “se livrar do ativo” (FONTE do conhecimento)
- > Pessoal - envolvido desde o início na preparação para a transferência (organizar os dados, preparar treinamento e se apropriar do processo de transf.)

CONTRATO (transferência do ativo físico + dados + conhecimento tácito e explícito)



Emp Comp

- > Estabelecimento de uma boa governança capaz de formalizar elementos essenciais para transf. de conhecimento eficaz:
 - objetivos e escopo claros
 - rotinas entre as partes
 - mecanismos adequados
 - alocação de tempo para a transferência
 - dedicação dos profissionais
 - mecanismos de tomada de decisão e resolução de conflitos

Adoção de medidas corretivas ao longo do percurso

Gerenciando a mudança

- Mudança de operador da instalação -

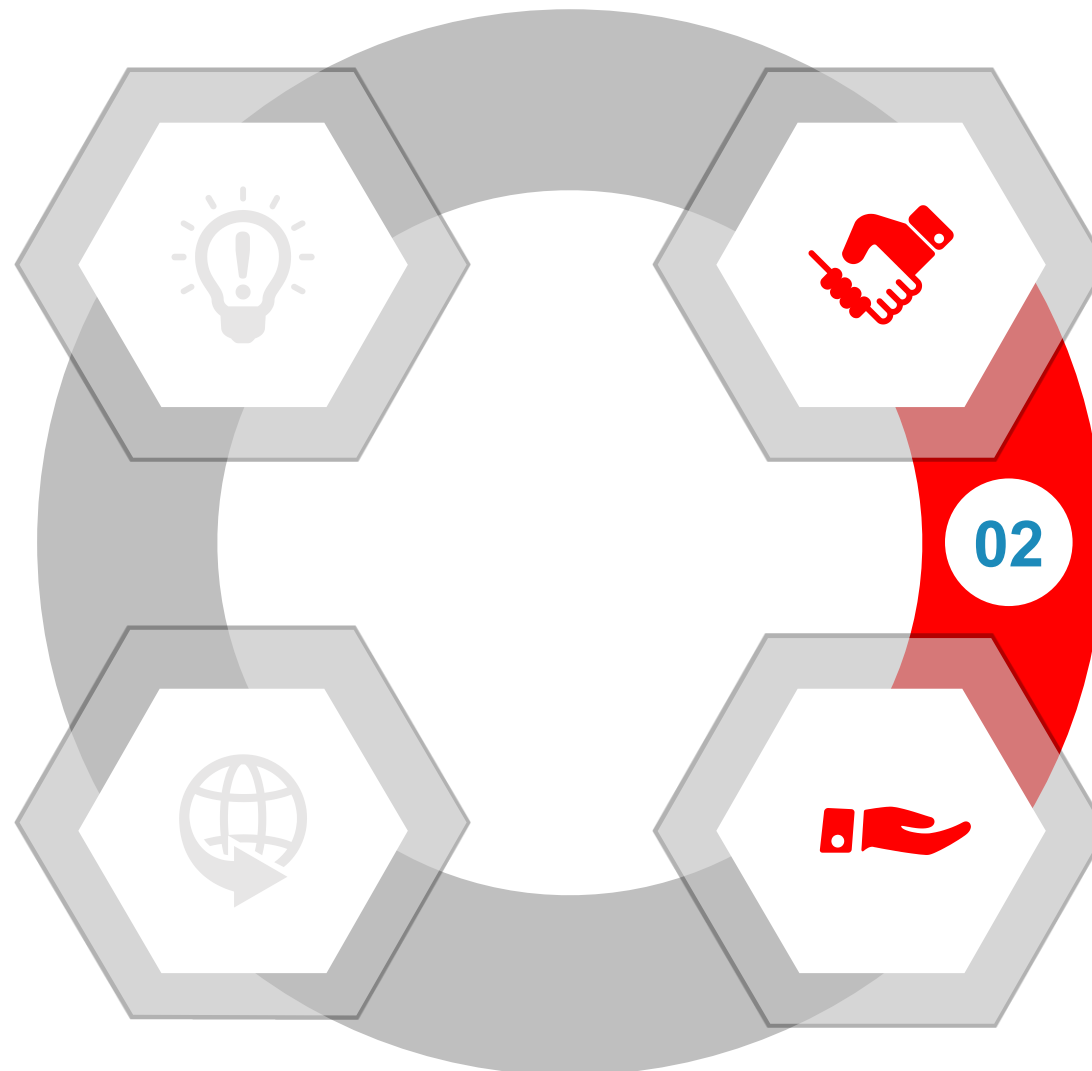
Planejamento e implementação da transf. de conhecimento

> FUNDAMENTAL

> Insumos da **due diligence**

> Priorizar a transferência de conhecimento **tácito e explícito**, reduzindo perda de informações e dados

> Formalizar esse planejamento em um **procedimento escrito de transf. de conhecimento** (todos devem conhecer e ser treinados nesse procedimento)



> Definir **mecanismos de aprendizagens** (não precisam ser os mesmos do dia a dia da organização).

> Pensar em **métodos complementares de aprendizagem** (tipo de função, tipo de conhecimento e estilos de aprendizagem dos profissionais).

> Definir **mecanismos de garantia de desempenho** (projetados de forma colaborativa entre as duas empresas).

Conclusion – Organizational issues (2)

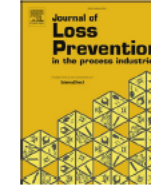
Journal of Loss Prevention in the Process Industries 99 (2026) 105779



Contents lists available at ScienceDirect

Journal of Loss Prevention in the Process Industries

journal homepage: www.elsevier.com/locate/jlp



How failures in interorganizational knowledge transfer impact process safety: Insights from the case study of an ageing offshore oil & gas facility acquisition

N.N. Ferreira^{a,1,*}, R. Dziedzic^b, G.P. Monteiro^c, C.P. Migueles^d, A. Burcharth^e

^a John Molson School of Business, Concordia University, 1450 Guy Street, H3H 0A1, Quebec, Canada

^b Building, Civil and Environmental Engineering Department, Concordia University, 1515 Ste. Catherine St. W., H3G 2W1, Quebec, Canada

^c Gilsa Monteiro Consulting and Advisory, Rua Gonzaga Bastos 39, Vila Isabel, 20541-000, Rio de Janeiro, Brazil

^d Centro de Estudos em Sustentabilidade e Gestão de Riscos (CESCRI), Getúlio Vargas Foundation (FGV), Escola Brasileira de Administração Pública e de Empresas (EBAPE), Rua Jornalista Orlando Dantas, 30, 22231-010, Rio de Janeiro, Brazil

^e Fundação Dom Cabral (FDC) & Aarhus University, Av. Princesa Diana, 760 Alphaville, Lagoa dos Ingleses, 34018-006, Minas Gerais, Brazil

ARTICLE INFO

Keywords:

Process safety

Interorganizational knowledge transfer

Ageing

Facility acquisition

ABSTRACT

An increasingly common form of organizational change in high-hazard industries is the acquisition of ageing facilities. While the safety implications of other types of organizational change have been widely studied, the risks associated with ageing facility acquisitions remain under-investigated. This acquisition process is often accompanied by significant challenges in interorganizational knowledge transfer (IKT). Although knowledge is widely recognized as essential to process safety, the impacts of IKT failures require further exploration, especially when critical operational teams are involved. This study aims to identify the process safety impacts of an

Extensão de vida com segurança

Condições para sustentar a operação

Decisão fundamentada	Condições do ativo e riscos do período adicional
Avaliação integrada	Degradação, obsolescência, organização e emissões
Conhecimento crítico	Transferência efetiva nas mudanças de operador
Estratégias adequadas	Limitações do ativo e viabilidade econômica
Gestão do LE	Responsabilidades, recursos e reavaliação dos riscos

A segurança operacional deve orientar a decisão e toda a extensão de vida.

Obrigada!

Nayara Nunes Ferreira

nferreira@anp.gov.br