Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/NA10.20250150
Published: June 17, 2025

Risk Assessment and Management - Production Best Practice Case Study for Improving Production Operations in the Energy Sector

Tariq Masood, Jamil Abdo and Kaimiao Liu
Department of Engineering
Frostburg State University
101 Braddock Road, Frostburg
Maryland, 23512, USA
tmasood@frostburg.edu; jabdo@frostburg.edu
kliu@frostburg.edu

Abstract

This study introduces the RAM protocol, known as production, best practices a powerful tool for mitigating and managing residual risks in the power utility, petrochemical, and petroleum industries. It provides a comprehensive procedural framework for effective risk screening and structured risk assessment, enabling the identification of critical risks. Furthermore, the paper proposes a robust implementation framework designed to control these risks at an acceptable level, ensuring safety and operational excellence across these vital sectors. Risk encompasses the inherent potential for adverse consequences stemming from a variety of hazards and conditions that can impact our operations. It is imperative that we conduct a comprehensive evaluation of both the severity of potential outcomes and the probability of these occurrences, allowing us to prioritize our response strategies effectively. Our business is faced with a multitude of operational risks that are critical to our success. These include challenges related to construction logistics—such as supply chain disruptions, equipment delays, and resource allocation—alongside vital concerns regarding personnel safety, which encompasses training, adherence to safety protocols, and emergency response procedures. Additionally, we must remain vigilant about well integrity and facility integrity to prevent environmental incidents and operational failures. Aviation safety is another pivotal area where protocols must be meticulously followed, given the critical nature of air transport in our operations. Lastly, we recognize the importance of robust security measures to safeguard our assets, personnel, and sensitive information against potential threats. Effective Risk Management is an essential cornerstone of our operational strategy. It encompasses the systematic application of established principles and best practices to identify, assess, and control risks in a structured manner. Our goal is to protect not only human life and the environment but also our physical assets and the integrity of our company's reputation—doing so in a manner that optimizes cost-effectiveness. We emphasize responsible stewardship of resources and prioritize transparent communication regarding our risk management processes and outcomes, ensuring that all stakeholders are informed and engaged in our risk mitigation efforts.

Keywords
Well integrity, security, facility integrity and construction

Abbreviations

Words	Definition
RCFA	Root Cause Failure Analysis
PDRR	Prevent, Detect, Respond & Recover
PBP	Production Best Practice
UVL	Unscheduled volume loss

UVDT	Unscheduled volume down time
ALT	Asset Leadership Team
PU	Production Unit

1. Introduction

This section presents crucial processes and procedures that are vital for the effective identification, assessment, and management of risks. By implementing these measures, we can significantly elevate our capability to manage Safety, Health, and Environmental (SHE) risks, ensuring that we minimize residual risks to levels that are not just acceptable, but exemplary. It delivers an in-depth overview of processes for Category 1 and 2 equipment, with a targeted focus on SHE risks management, particularly concerning high-pressure and rotating equipment. Furthermore, it articulates clear definitions and insights into Risk Assessment Outlooks and Risk Assessment Management (RAM) Plans, providing strategic guidance on optimizing risk management efforts. We will introduce a robust, structured risk assessment methodology while outlining the essential competencies necessary for building a formidable and effective Risk Management System. By embracing these guidelines, we will foster a culture of safety and risk awareness that not only protects our organization and its stakeholders but also positions us as leaders in safeguarding health and safety standards.

1.1 Objective

Risk can be compellingly defined as the potential for negative outcomes that could significantly impact our lives or operations. It encompasses three essential elements: **RISK: The fact that something bad could happen**

- **"Something"**: This represents an event that may arise due to a specific hazard or condition, highlighting the ever-present threats in our environment.
- **"Bad":** This refers to the consequences and severity of the event should it occur, underscoring the importance of understanding the stakes involved.
- **"Happen**": This denotes the probability or likelihood of the event taking place, emphasizing the need for proactive measures to mitigate potential threats.

In essence, risk is about recognizing potential events (the "something"), understanding their possible detrimental effects (the "bad"), and assessing their likelihood of occurrence (the "happen"). By grasping these components, we empower ourselves to make informed decisions and take strategic actions to safeguard our interests.

Risks exists: Knowing about risk does not create it

Why do we manage risk?

Therefore, our Business Involves Many Operational Risks which we need to address, mitigate and control in possible means.

- Production operations
- Construction risk
- Logistics risk
- Facility Integrity
- Aviation
- Drilling
- Well Integrity
- Personal Safety
- Security

2. Literature Review

Wu Jing et al. 2017 discussed the Quantitative risk assessment method for regional port major hazard installations and its application. Zhi bin Yan et al. 2020 discussed the Risk Characteristic-Oriented Renewable Energy Scenario Reduction Method for Power System Risk Assessment. Wang Lijian et al. 2010 discussed the Research the information security risk assessment technique based on Bayesian network. Yang Li et al. 2013 discussed the Quantitative area risk assessment and safety planning on chemical industry parks. Xiaobo Wu discussed the Study about environmental risk assessment and management of chemical industry park. ZOU Qi et al. 2018 Risk Assessment for Transmission Network Planning Scheme based on Conditional Value-at-Risk. Incorporate a

broader range of failure modes. Committed to addressing issues before they lead to mission aborts. Enhance our ability to assess and track reliability growth effectively. Increase the statistical power and confidence in our reliability evaluations during testing. Establish realistic and attainable reliability growth goals. Eliminate subjectivity from the reliability scoring process. Correct a greater number of failures that adversely impact system availability, maintainability, and operating or sustainment costs.

2.1 What Is Risk Assessment and Management (RAM)

The RAM is composed of two critical components: risk assessment and risk management. In the first component, risk assessment, we meticulously evaluate the significance of potential risks to determine the necessity for further reduction or mitigation strategies. This proactive approach ensures that we are not only aware of the risks but also prepared to address them effectively. In the second component, risk management, we implement a strategic system of principles and practices designed to identify, assess, and control risks rigorously. By doing so, we safeguard our objectives and foster a resilient environment, ultimately ensuring robust protection for our endeavors.

In a cost-effective manner. Risk Management includes appropriate stewardship and communication of results. Human harm, environmental degradation, and economic loss are unequivocally defined by their consequences and probabilities; these elements are what constitute a true risk.

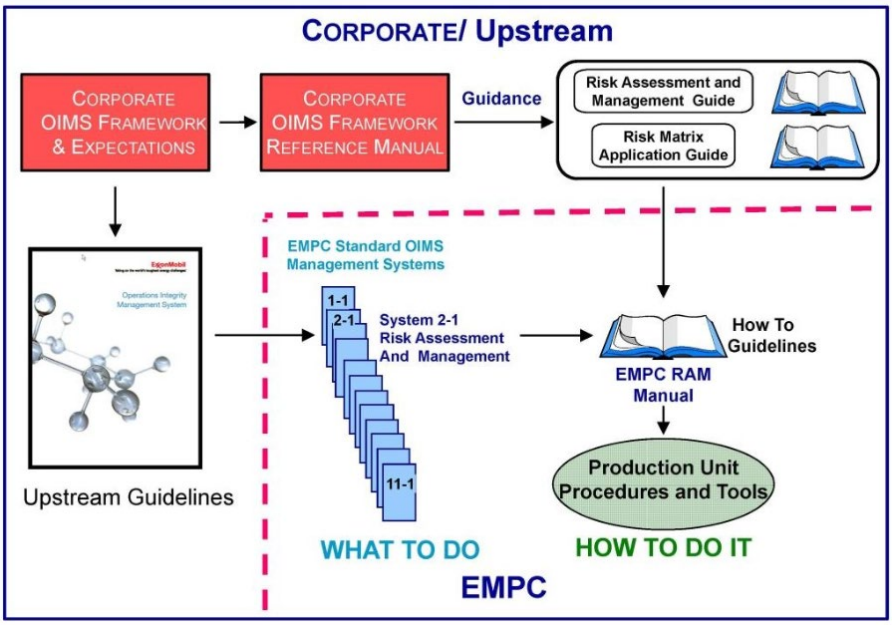

Figure 1. OIMS Provides a Structured Approach for Managing Risks

2.2 What Is RAM Manual

Our objective is to establish and underline common processes that drive consistency and efficiency in the identification and evaluation of SHE (Safety, Health, and Environmental) risks. By leveraging the Corporate RAM Guide and the Corporate Risk Matrix Application Guide, we can effectively implement the Screening and Assessment processes that are critical to our success. The RAM Manual plays a pivotal role in ensuring uniformity through standardized tools, which encompass:

1. A clear definition of what should be assessed
2. A precise distinction between SHE risks and business losses (financial exposures)
3. The development of standardized forms for risk assessments and reporting
4. Empowering the use of IMPACT to enhance the tracking of risks, action items, and stewardship
5. Clear definitions of qualifications and responsibilities

By adopting this structured approach, we are not merely improving risk management; we are laying the foundation for a culture of safety and accountability that will significantly benefit our organization. Let us commit to this initiative and transform the way we manage SHE risks.

2.3 Production Unit Addendum

Each Production Unit (PU) is mandated to create a comprehensive addendum to the Risk Assessment and Management (RAM) manual. This addendum will serve as an essential framework that outlines the specific procedures and tools employed by the production unit to adhere to the expected and recommended practices. Furthermore, it must detail any additional guidelines necessary for the production unit and highlight any approved deviations from the selected Energy Company's RAM Manual. To ensure our commitment to safety and excellence, the PU Addendum must encompass, at a minimum, the following key components:

1. Documented deviations from the selected Energy Company RAM Manual.
2. Clearly defined approval authorities specific to the production unit.
3. A tailored Risk Assessment (RA) outlook that reflects the unique circumstances of the production unit.
4. A robust Risk Communication Program designed specifically for the production unit's needs.
5. An effective Risk Stewardship Process relevant to the production unit.
6. Compliance with regulations that are specific to the production unit.
7. Detailed documentation protocols and references unique to the production unit.
8. A list of approved RA Team Leaders, Risk Screeners, and a thorough understanding of the role of legal considerations in the RAM process, including the review and approval of Risk Assessments.

By adhering to these guidelines, we demonstrate our unwavering commitment to safety, effective risk management, and operational excellence within our production units.

2.3 Risk Assessment Outlook and Annual RAM Plan

Production Unit (PUs) embark on a comprehensive 10-year Risk Assessment Outlook, meticulously outlining proactive hazard evaluations and risk assessments. The frequency of these strategic studies is determined by the varying risks associated with different operations and is also shaped by the requirements set forth by the PU's regulatory framework, such as the critical Safety Case regulations. Integral to their business planning process, PUs formulates a robust annual Risk Assessment and Management Plan for each asset as shown in Figure 2. This plan encompasses:

1. Clear and targeted assessments, detailing types and scope along with assigned responsibilities,
2. Essential risk management activities, including training initiatives, updates on prior assessments, and innovative process safety or risk management initiatives/studies,
3. Dynamic risk communication programs and initiatives designed to engage stakeholders effectively,
4. Specific targets for closing out action items and risk assessment scenarios, ensuring accountability and progress
5. Relevant updates on regulatory-related activities, including vital Safety Case updates when applicable.

By committing to this structured approach, PUs not only enhance their operational safety but also foster a culture of continuous improvement and transparency in risk management.

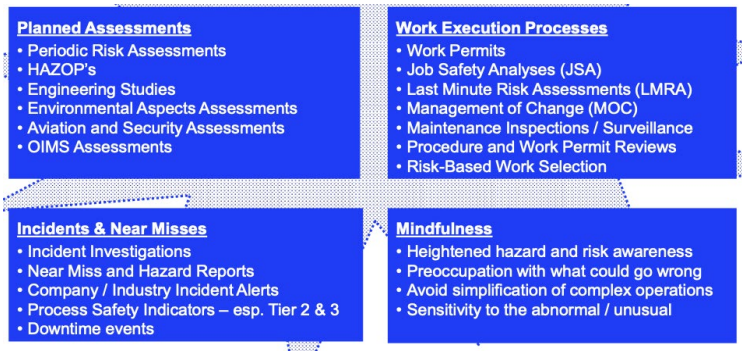

Figure 2. Hazard Identification and Evaluation

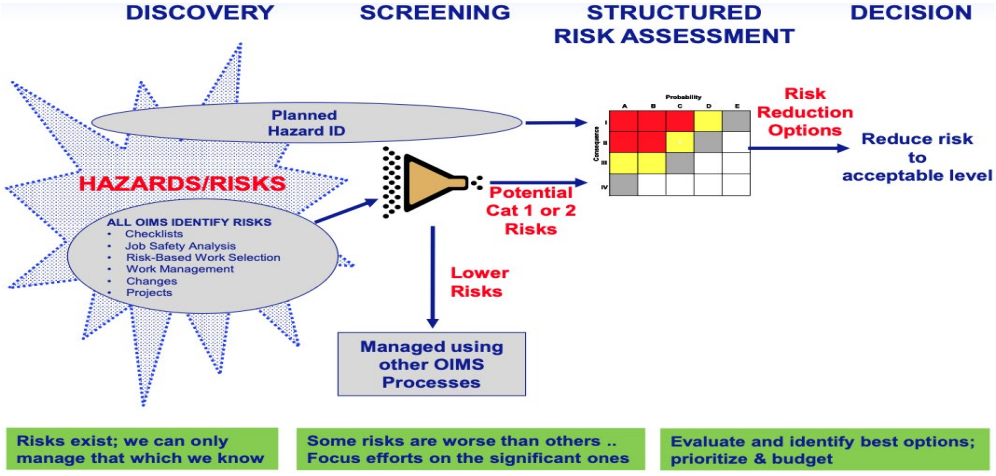

Figure 3. Risk Assessment & Management Process Overview

2.4 Risk Screening Process

Hazards that cannot be promptly mitigated or resolved warrant thorough screening to establish their potential significance. This screening process is essential for effectively identifying and prioritizing critical risks—specifically those that fall into Potential Category 1 and 2 risks as shown in Figure 4.

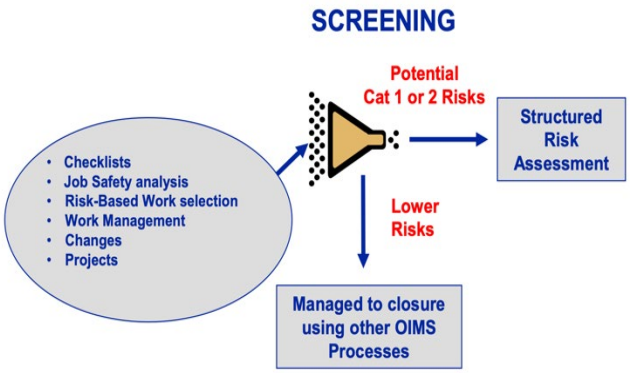

Figure 4. Risk Assessment & Management Process Overview

Once a risk is identified as potentially significant, it will be channeled into a structured risk assessment to confirm its classification. A qualified individual, known as the Risk Screener, will be tasked with rigorously evaluating these reported risks. Should the Risk Screener validate the risk as potentially a Category 1 or 2, it will be escalated to the Operations Superintendent without delay. This pivotal endorsement activates a structured risk assessment process, and the Risk Screening Form will serve as the official mandate for this assessment. By taking these proactive measures, we ensure that we address significant risks with the urgency and attention they demand.

3. Structured Risk Assessments

Hazards that may be classified as Category 1 or 2 SHE risks must undergo a structured risk assessment, approved by management. All assessments require charters signed by the Operations Superintendent (ALT Leader). The structured process involves converting identified hazards into credible risk scenarios using the Risk Matrix. The Risk Assessment team must be trained, and Financial Exposures related to business loss should be evaluated separately from Safety, Health, and Environmental (SHE) risks. For significant risks (Category 1 and 2), documentation must include a Scenario Worksheet and Event Tree. Communication is essential to ensure everyone is aware of the top risks, and

these must be escalated to unit senior leadership promptly. The goal is to provide Decision Makers with information for informed decisions. Follow-up actions must be taken according to the assessed risk category, and any changes to approved Action Plans or deadlines need the original Risk Owner's endorsement.

When chartering a risk assessment, consider whether existing controls are adequate, if other OIMS processes could address the hazard, and if necessary, actions are already known. If faced with higher-risk tasks, question the need for a risk assessment, ensure adequate safeguards are in place, confirm the availability of qualified personnel, and evaluate whether the Risk Matrix will provide sufficient insights or if a more quantitative approach is needed.

Risk Acceptance Criteria
Risks must be effectively managed to an acceptable level, necessitating thorough reviews and approvals from management. The determination of this acceptable risk level hinges on a comprehensive evaluation of the safeguards in place, aligned with recognized and widely accepted standards and practices. Clear risk acceptance criteria are essential for decisively identifying which risks can be deemed acceptable. Ultimately, this critical assessment rests with the risk approval authority, typically the Risk Manager, whose judgment shapes our organization's risk posture and strategic direction.

RISK MATRIX

	A	B	C	D	E
I	1	1	1	2	3
II	1	1	2	3	4
III	2	2	3	4	4
IV	3	4	4	4	4

Risk Category	Guidance for Mitigation
1	A higher risk that should have specific controls established in the short term, and should be reduced as soon as possible
2	A medium risk that should be reduced unless it is not reasonably practicable to do so
3	A medium risk that should be reduced if lower cost options exist to do so
4	A lower risk that is expected to be effectively managed in base OIMS practices

Figure 5. Risk Acceptance Criteria

3.1 The Risk Manager Approves the Risk

The “Risk Manager” plays a crucial role in safeguarding the organization by approving written or electronic reports (IMPACT) that address risks based on their magnitude. These reports detail identified risk scenarios, categorize risks, and recommend effective risk reduction measures. The Risk Manager has several decisive options:

1. Approve the risk scenarios along with the recommended risk reduction measures to take proactive steps in managing potential threats.
2. Request further analysis from the team, ensuring all angles are explored and that comprehensive information supports the risk decision.
3. Revise and enhance the risk reduction alternatives, ensuring we adopt the most effective strategies to mitigate risks.
4. Accept the risk as it currently stands, with existing controls, along with a documented justification that outlines the rationale for this decision.
   The Risk Manager is ultimately accountable for overseeing the risk until it is effectively resolved. Their approval is essential for either the continuation of operations—acknowledging the acceptance of the risk—or for endorsing the proposed action plan. This responsibility not only protects the organization but also fosters a culture of informed decision-making and strategic risk management.

Risk Category	Risk Manager
1	Production Mgr
2 and 3	Ops Mgr
4	Ops Supt

Figure 6. Risk Manager Approves the risk

3.2 Discussion - Risk Assessment – Key Points

Screening Discovered Hazards: All identified hazards must undergo a rigorous screening process to pinpoint those that necessitate further evaluation. This critical task is carried out by skilled professionals known as Risk Screeners. Hazards assessed as potential Category 1 or 2 risks are escalated to a Risk Screener for comprehensive analysis, ensuring that no significant risks are overlooked.

Conducting Risk Assessments: Triggered Risk Assessments (RAs) are imperative for the hazards that have already been identified. In addition, Planned RAs play a vital role in proactively identifying risks throughout the operational lifecycle, utilizing structured techniques to effectively uncover potential hazards before they can escalate.

Consistent Risk Assessment: For those screened hazards identified as having a higher risk potential, it is crucial to conduct a triggered risk assessment promptly and effectively. Both triggered and planned structured risk assessments are systematically implemented by qualified personnel using an endorsed methodology, ensuring a thorough and reliable evaluation that drives informed decision-making.

Understanding Risk Decisions: Some vital risk-related decisions can indeed be made without the formalities of structured risk assessments. However, it is essential to recognize that simply knowing about a risk doesn't create it; rather, awareness of risks empowers us to manage them effectively. In the realm of risk management, knowledge is not just power—it's a fundamental necessity.

We actively manage risks to: Protect the well-being of people and the environment. Secure and maintain our license to operate. Deliver exceptional reliability. Strengthen external relationships to become the partner of choice. The Operational Integrity Management System (OIMS) offers a robust framework for our risk management process, enabling us to systematically identify hazards and effectively manage risks.

Through the Risk Assessment and Management (RAM) system, we present vital information in a clear and organized manner, empowering informed decision-making to control Safety, Health, and Environment (SHE) risks at acceptable levels. Our objectives include:

- Providing a comprehensive view of all significant SHE risks
- Prioritizing risks to ensure that those with the highest potential impact are addressed first
- Involving the appropriate leadership in crucial decision-making processes

In our approach to decision-making, there is no predetermined point at which we should cease our efforts to minimize risks. Risk assessments merely identify potential hazards; it is our proactive actions that truly reduce risks. Delaying a decision or opting not to decide effectively means accepting the current level of risk. We are committed to taking decisive action to safeguard our people, environment, and operations.

4. Conclusion - Risk Management Expectations for You

Take a proactive approach to identify hazards and uncover risks. Embracing the discovery of risks isn't just beneficial; it is absolutely critical for our success. While integrating this mindset into our culture may present challenges, we must not allow it to be sidelined. We must establish strong practices that empower us to understand and address risks as conditions evolve. It is imperative that our most qualified experts rigorously evaluate these risks through a structured and reliable process. A deep, comprehensive understanding of our risks is vital. Remain vigilant regarding higher-risk areas and distinctly outline your "Top Ten" risks—whether they are open, mitigated, or accepted. Every leader within the organization must be fully aware of their key risks. Moreover, ensure a thorough understanding of the controls we have in place to effectively mitigate these top risks and prevent any escalation of potential issues. By doing so, we fortify our organization and cultivate a robust culture of proactive risk management and resilience. Together, we can safeguard our future and drive sustained success.

Figure 7. Risk Manager Approves the risk

References

Liang Yan "Value Engineering Application Construction Project Management "published in 2012 IEEE International Conference on Industrial Control and Electronics Engineering

Magali Simard; Danielle Laberge "Project-Based Organizing: The Unexpected Trajectory of the Project to the Crisis" published in 2015 IEEE 48th Hawaii International Conference on System Sciences

Olga Mikhieieva "Implementing a project management approach for public-funded projects in HEIs" Published in 2017 9th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems

Rajkumar Palaniyappan; "Smart Contract Project Management Framework (SCPMF) – A Conceptual Model" published in 2023 IEEE International Conference on Inventive Computation Technologies (ICICT)

Joachim Hillebrand;Michael Karner; "Gaining and keeping overview of complex RTDI projects with the DEWI assessment and monitoring framework (DEWI-Frame)" published in 2016 IEEE 11th System of Systems Engineering Conference (SoSE)

Tariq Masood and Jamil Abdo *"Review: Uninterrupted Liquid Hydrogen (E-Methanol) Production framework to deliver Clean & Green Energy"* Published 22nd International Conference on Renewable Energies and Power Quality (ICREPQ'24) Bilbao (Spain), 26th to 28th June 2024

Jamil Abdo & Tariq Masood "*Techno Economics Analysis to Reshape Global Clean and Green Energy"* 22nd International Conference on Renewable Energies and Power Quality (ICREPQ'24) Bilbao (Spain), 26th to 28th June 2024

Tariq Masood & Jamil Abdo "*New Technique to Enhance Hybrid Renewable Energy Resources'* Operational Flexibility and Reliability" **22nd International Conference on Renewable Energies and Power Quality (ICREPQ'24)** Bilbao (Spain), June 2024

Jamil Abdo & Tariq Masood *"New Technique to develop Intelligent, highly reliable & Efficient Unmanned Power Generation Modular"* **22nd International Conference on Renewable Energies and Power Quality (ICREPQ'24)** Bilbao (Spain), 26th to 28th June 2024

Biographies

Tariq MASOOD an Asst. Professor (Tenured-Track) at Frostburg State University, Frostburg, Maryland. A versatile, collaborative, accomplished, and knowledgeable professional with a successful track record as a Professional Engineer/Academician in *(Advance Process Integration and* Renewable Energy Resources Integrated with Artificial Intelligence) He has also contributed as a Visiting & Adjunct Professor, and Invited speaker, at OIT, UTT, Texas A&M Qatar, UTA, TTU, UND, and UDC, in the United States of America. He joined the Qatar Petroleum since 1997 where he served as a Technical Coordinator Operations/Advisor Qatar Petroleum He is/has been on several Asset Integrity department technical and management committees' member. He is also member of BPTC (Best Practices Technical Committee) under the patronage of H.E: Dr. Mohd Saleh Al-Sada Minister of Energy and Industry Qatar. He has published more than 68 technical research papers in IEEE Conference, Journal, Honeywell Users group and other International Conferences and three comprehensive books on Micro control at Macro level on SMART GRID based FACTS Technology ISBN-978-3-659-40995-0 ISBN: 978-3-659-40995-0 ISBN:978-3-659-40995-0. He received several awards in recognition of his outstanding performance and dedication to improve Qatar Petroleum production operations and control, two Mubarak awards received from H.E Minster of Energy and Industry and three Al-Hasba Awards received from Director Operations Qatar Petroleum. He was the secretary for the GCC oil producing companies (QP-Qatar, PDO-Oman ARAMCO-Saudi Arabia, KOC-Kuwait, TATWEER-Bahrain, and ADNOC-United Arab Emirates) Production and Maintenance Technical Committee in 2008 and 2011. Research interest:

SMART GRID control and optimization of process operations of FACTS controllers, financial markets, renewable resources and control system restructuring, computational intelligence, centralized & decentralized control, large scale optimization and modelling, decision analysis: He is also serving as an Associate Editor IEEE Access (Impact Factor 3.44)

Dr. Jamil Abdo is an esteemed faculty member known for his significant contributions to the fields of mechanical design, systems design and reliability. With a profound commitment to sustainable technologies, Dr. Abdo has dedicated his career to advancing research and fostering innovation in these critical areas. Dr. Abdo holds a Ph.D. in Mechanical Engineering from Southern Illinois University. Currently, Dr. Abdo is a professor and currently the chair of the Department of Engineering at Frostburg State University. Dr. Abdo brings over 20 years of rich academic and industry experience that include more than 15 major funded research projects to his role. Dr. Abdo also serves as director for the Center of Product Design and Advanced Manufacturing at Frostburg State University, where he plays a pivotal role in the development of cutting-edge advanced design and manufacturing techniques and technologies. Dr. is a leading expert in the seamless integration of renewable energy sources. Dr. Abdo excels in engineering systems design. His expertise spans the design and optimization of complex systems, with a focus on minimizing environmental impact and maximizing efficiency.

Dr. Kaimiao Liu is an Assistant Professor at Frostburg State University, specializing in materials science, one of her focus area is natural gas pipeline materials, the environmental effects on pipelines, and welding techniques. Prior to joining FSU, she worked as a postdoctoral researcher and materials scientist at the National Energy Technology Laboratory, where she contributed to multiple projects, including retrofitting natural gas pipelines for hydrogen transport. Dr. Liu has extensive expertise in understanding pipeline material degradation under various environmental conditions and developing strategies to protect materials from deterioration. Her research also encompasses alloy design for a wide range of applications, emphasizing sustainability and minimizing environmental impact. Through her work, she aims to advance materials technology to enhance the durability and efficiency of critical infrastructure.