YOUR Moment IS HERE

COLLEGE OF BUSINESS
LAMAR UNIVERSITY

# Analysis of risk management practices of the oil and gas industry in Southeast Texas during Hurricane Harvey

Gevorg Sargsyan, James Slaydon, Enrique Venta, Ricardo Colon, Paul Latiolais

Sponsored by a grant from U.S. Department of Commerce, Economic Development Administration

# Introduction and Background

- The rapid recovery of the oil and gas sector from natural disasters such as Hurricane Harvey is important for the local economic development of Southeast Texas.
- The recovery of this industry depends on efficient risk management from natural disasters.
- In this study Participatory Analysis of Risk Management (PARM) methodology is developed and used to determine the best risk management practices of recovery and resiliency from natural disasters.

# Introduction and Background

- The oil and gas sector of the economy, directly and indirectly, employed more than 50,000 people in Beaumont - Port Arthur MSA. It is more than 30% of the employed population of this region and the sector showed GDP annual compound growth of between 9.3% (2018/2017) and 21% (2017/2016)
- Examples of major employers in this sector are: refineries - Exxon Mobil, Motiva, Valero, Total, and petrochemical plants - Dupont, BASF, Chevron, Goodyear. These companies have billions of dollars of assets and revenues invested in the Southeast Texas region. The oil and gas sector is important for the stability and growth of the local economy.

# Introduction and Background

**Table 1. Major storms in Texas and financial losses**

| # | Storm | Year | Economic loss | Insured loss |
|---|---|---|---|---|
| 1 | Allison | 2001 | $ 12.0 billion | $ 5 billion |
| 2 | Rita | 2005 | $ 23.9 billion | $ 11 billion |
| 3 | Ike | 2008 | $ 43.0 billion | $ 21 billion |
| 4 | Harvey | 2017 | $ 125.0 billion | $ 30 billion |

# Introduction and Background

The most serious storm for the oil and gas sector was Harvey

- 60% of U.S. upstream chemical manufacturing capacity impacted
- shut down of:
  - 25% of U.S. refining capacity (24 refineries - 3,871,449 barrels per day)
  - 24.5% of oil production in the Gulf of Mexico (428,568 barrels per day)
  - 25.9% of natural gas production (835 mln cubic feet per day)
  - more than 50% of the US production of ethylene
  - 50% of the US of polyethylene production
  - 60% of the US production of polypropylene
- 105 of  737 production platforms in the Gulf of Mexico were closed
- disruption of more than one-third of US chemical production
- pipelines were affected, transportation backlog
- on September 15, 2017, a month after Harvey made landfall most refineries and chemical plants had restarted

# Participatory Analysis of Risk Management (PARM)

- Based on the Participatory Appraisal of Competitive Advantage (PACA).
- PACA method emerged from the cooperation between the Chamber of Industry and Commerce, Brazil and the Chamber of Arts and Crafts, Germany. (Meyer-Stamer, 2006)
- The PACA model uses the theory of location competition and economic development by well-known researcher and Harvard Business School professor Michael Porter.
- The methodology uses Porter's diamond and Porter's five forces and value chain analysis to capture the structure of each sector of the local economy
- PACA methodology has been successfully used in more than twenty countries by researchers, universities, international organizations, local governments, and others.

# Participatory Analysis of Risk Management (PARM)

**Three core elements:**

# PARM's workflow chart

**Research Team Workshop (preparatory phase)**

- Formulate research questions,
- Analyze the value chain of a specific industry,
- Identify the main stakeholders of industry (create a representative group of the entire sector, include influential stakeholders in research).

**Focus Group Workshops**

- Conduct focus group workshops (target groups includes five to ten persons from the local economy knowledgeable of the industry to be analyzed),
- Gather risk management information.

**Data Analysis**

- Consolidate focus group results,
- Analyze obtained data using various tools (Porter's five forces analysis, Porter's diamond, SWOT analysis, and other tools)

Extensive research after focus groups.

**Fieldwork**

- Organize interviews with key stakeholders to get in-depth information,
- If necessary, conduct additional research

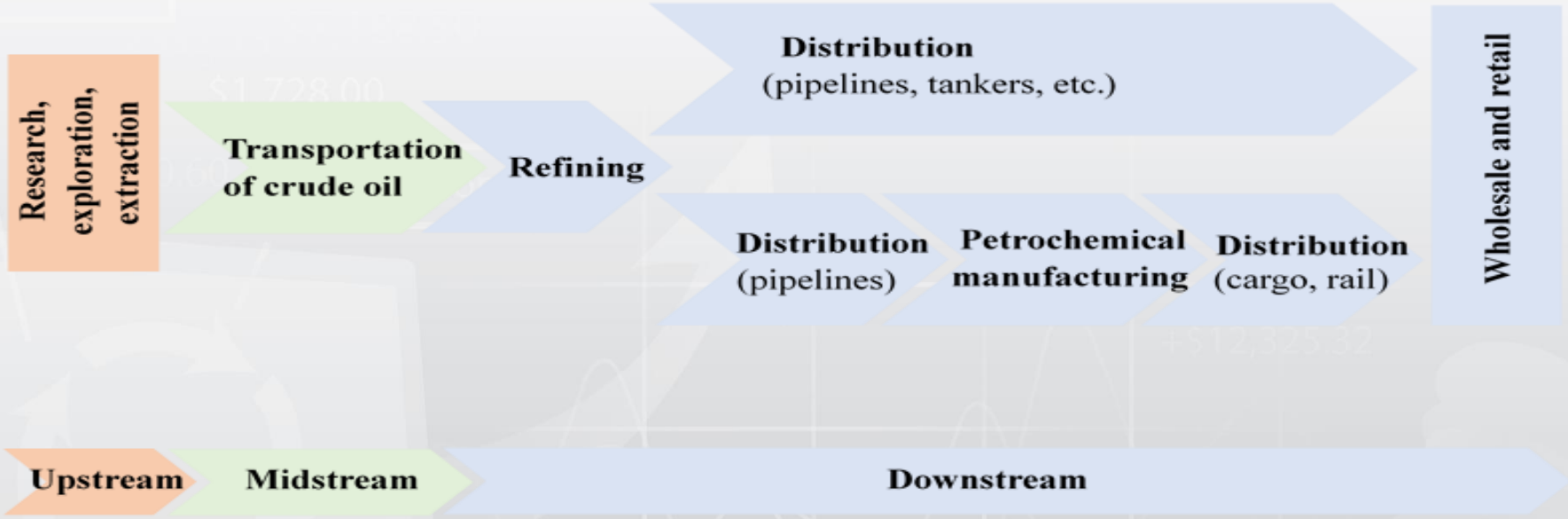
**Communication with the local community**

- Prepare a written report with practical recommendations,
- Present analysis results to the local constituency.

# Application of PARM to the oil and gas sector in Southeast Texas

- What risks/problems did you experience during Hurricane Harvey?
- What were the most successful risk management strategies that you/your group used during Hurricane Harvey? Why?
- Were there risk management strategies that were not as successful that were used during Hurricane Harvey? Why?
- How did you manage the recovery process? What risks or challenges did you encounter during recovery?
- What role did technology (including communications) play in the Hurricane Harvey response? Which were the most critical technologies? What do you see as the role of technology in the future?
- What would you like to see happen if there is ever another hurricane in Southeast Texas and what steps will help us to move in that direction?

# Value Chain Analysis of the oil and gas sector in Southeast Texas



# Findings of PARM methodology for Plant Shutdown

**Preparedness to Hurricanes and Storms**

- The safe stop of plant activity takes 24 to 48 hours.
- Usually, it takes a few weeks to close the facility. shutdown takes from 1 to 2 weeks. Even in case of complete shutdown, it is preferable to keep some activities hot, cool or running; for example, hot asphalt moving through pipelines (when it gets cold it can dry and destroy pipeline), and some chemical reservoirs are required to stay cold (temperature increase can cause an explosion).
- There are specific activities for the complete shutdown of the plant. These activities are specified in the plant's hurricane policies. These documents are updated after each event (28th edition of hurricane policy is the most recent manual for one of the plants studied).
- In order to start shut down procedures on time, they use meteorological services to receive timely weather updates.
- The plant has special communication devices always active in case of emergencies (such as satellite phones and shortwave radios).

# Findings of PARM methodology for Plant Shutdown

**Risks Related to Harvey**

- Most of the plants were prepared to receive Harvey.
- The facilities are designed to handle natural disasters of this kind.
- The rainfall during Harvey exceeded the internal drainage capacity of the plants, generally only 14 - 17-inches of floodwater during a 24 hour period.
- Harvey caused a shutdown of the facilities.
- More detailed local weather, flood and river-level forecasts and more accurate prediction models are needed.
- Conflicting information about rainfall from meteorological services created uncertainty as to what measures to put in place to safeguard facilities.
- Loss of the city's water service caused a significant problem for running air conditioners.
- Nitrogen and oxygen supplies were disrupted.

# Findings of PARM methodology for Plant Shutdown

**Best Practices of Risk Management and Lessons from Harvey**

- Preparation for hurricane season starts in May. In response to Harvey new policies and procedures have been put in place. In some plants, new chapters related to flooding have been added to the hurricane preparedness guide.
- To manage water flush in a more efficient manner plants improved their drainage system.
- Production facilities and equipment were raised to minimize potential flood damage.
- As a response to Harvey, new weather stations were built, and more stations are planned to allow more accurate predictions of rainfall/wind events. There is a need for real-time rainfall measuring stations for more accurate flood forecasting
- Establishing a more detailed local weather network could assist industry to prepare and respond to emergencies.
- For better measurement of floodwater and rain, plants placed water gauges in key locations to manage flooding more efficiently.
- A simple solution to overcome the loss of the city's water was to use fire water to run air conditioners.
- Most of the plants didn't lose power. Utilities (power and steam) were kept running at all times during Harvey and Imelda.
- Pumps are needed during hurricanes and storms. Contracts with pump rental companies will help to manage the flood better.
- Shared satellite service for all refineries in the hurricane period can be a better solution than having those phones active all year.

# Results of PARM methodology during Plant Restart

**Post-Hurricane Recovery**

- Restarting plant activity takes 1 to 4 weeks, however complete economic recovery takes much longer.
- Logistics problems to transport spare parts, raw materials and products hampered recovery.
- The Sabine-Neches waterway is a critical and strategic logistical resource. When the waterway shuts down it creates significant problems for shipments of raw materials and finished products.
- There is high reliance on pipelines which are more resilient to hurricanes and storms. Maintaining pipelines operational is an important task during storms (especially those pipelines that transport hot materials such as asphalt).
- Railroads are also an important transportation mode for raw materials and finished products.

# Results of PARM methodology during Plant Restart

**Risks Related to Harvey**

- Harvey's magnitude caused a deficit of spare parts. Plant inventory and local suppliers couldn't meet post-Harvey demand. (hundreds of motors had to be replaced or repaired after Harvey).
- A year after there was still corrosion of equipment throughout the plant.
- Most of the spare parts had been delivered to Houston, but transportation channels from Houston to Beaumont were not open.
- It took about 7 days to get back to normal operations after Imelda vs 4 weeks in the case of Harvey.

# Results of PARM methodology during Plant Restart

**Best Practices of Risk Management and Lessons from Harvey**

- Suppliers and plants keep higher levels of inventory, despite the additional holding and potential damage cost.
- As a preparedness measure post-hurricane plant restart training for all employees should be implemented.
- In some cases, large supplies and machinery were transported by helicopter from other plants to Lamar University's Montagne Center.
- A centralized transportation hub at the Beaumont airport can be a solution to the deficit of spare parts in post-hurricane recovery.
- Prioritized maintenance (zoned maintanace) of areas of the plant can help to address recovery issues more quickly.
- Flexible production practices help to identify which production processes can be restarted first and at what level (in the case of Harvey, in one plant jet fuel production started earlier than the production of other products because they had enough inventory in tanks).
- Funds are set-aside to purchase necessary supplies during the recovery period.

# Results of PARM methodology for Human Resource Mgmt during Plant Shutdown and Restart

**Hurricane's Impact on Human Resource Management**

- Refinery shut down and especially recovery need extra manpower.
- Hiring new employees is a time-consuming procedure in the oil and gas industry due to safety training and background checks.
- Another human resource challenge is getting the labor force to work because of road closures.

# Results of PARM methodology for Human Resource Mgmt during Plant Shutdown and Restart

**Risk Related to Harvey**

- Nearly half of the employees of the oil and gas industry were impacted personally.
- The safety of families and damage to the properties of the workers create difficulty in having them return to work.
- Personnel on-site was not able to leave to go home, while personnel off-site was not able to get to the refinery and chemical plants. As a result there is a need for temporary housing for emloyees.
- Strict guidelines and safety protocols add additional time in hiring new temporary personnel thus slowing down recovery.
- High demand for workers to recover from previous hurricanes around the nation in the same year made the job market very tight.
- Availability of vendors to supply food to employees on site was limited.
- Lack of medications for employees on-site became an issue.

## Best Practices of Risk Management and Lessons from Harvey

- Remote work for those employees who could complete their tasks from distance helped to manage human resources more effectively.
- During recovery, part of the workforce was not needed. Some companies used the remaining workforce efficiently by offering them opportunities to help to fix houses of other employees and of the community.
- Some employees were hosted in temporary housing near plants to avoid transportation issues. There is a need to strategically manage temporary housing, beyond just staying in hotels that have available rooms or office buildings of the plants.
- One multinational company has formed a response team that goes to the site of the disaster and takes over the emergency response actions (this strategy allows return to normal operations more quickly).
- Since Hurricane Rita, plants have implemented better communication with employees. These include text alerts and social media postings by oil and gas companies and by the city. A future step can be creating real-time logistics maps to facilitate employees' and suppliers' access to production sites.
- There is a need to reduce bureaucracy and red tape regarding the use of drone technology in case of emergencies.
- There is a need to set up medical and financial teams to handle employees' immediate needs during a crisis.
- Pre-certification and pre-security screening can shorten the time for new temporary workers to rapidly start working on plants recovery.
- Some oil and gas companies are contemplating acquiring a "High Water Vehicles" with 40'' tall tires to get essential personnel to the site from their residences if necessary.

# Conclusions

Recovery and resiliency depend on motivation, engagement, and collaboration of local stakeholders. Risk management knowledge, skills, and resources are crucial for resiliency and recovery. Robust private and public collaboration during risk management is needed before, during and after natural disasters. Risk management education programs can help to implement efficient risk management. Best risk management practices/tools, emergency simulations, and risk management training can help to be better prepared for hurricanes and storms.