R13 - U.S.-Mexico Risk Taskforce to Support the Health Supply Chain Systems for Infrastructure and Workforce Threatened by the COVID19 Pandemic

Please list PI and other key technical and project personnel (and key collaborators) in the table below

Name	Role	Position Title	Affiliations
Zenon Medina-Cetina, PhD	PI	Associate Professor	TAMU Engineering Civil & Environmental Engineering
Gregory Pompelli	Co-PI	Director	Center of Excellence for Cross-Border Threat Screening and Supply Chain Defense (CBTS)
Matt Cochran, DVM, MIA	Co-PI	Director for Research	CBTS Institute for Infectious Animal Diseases (IIAD)
Maria J. Perez-Patron, PhD	Co-PI	Adjunct Assistant Professor	Department of Epidemiology & Biostatistics Texas A&M School of Public Health
Miriam Olivares, GISP	Co-PI	GIS Librarian Consultant	Marx Science and Social Science Library Yale University & Thei Consulting

I. Objective/Purpose:

1. Integrate a triple-helix binational taskforce comprised of representatives from academia, industry, and government from the U.S. and Mexico. Address the public health impacts of the COVID-19 pandemic on the U.S. – Mexico health supply chain systems for health infrastructure and for the health of the workforce, considering current and emerging regional social, economic, and environmental Risks.
2. Develop a Data-Lake System concentrating near real-time analytics following a risk systems approach that can provide strategic information about the evolution of COVID19 and related current and emerging threats, the state of vulnerability of the health supply chain systems and the likely impacts a combination of these may cause to society, the economy and the environment.
3. Publish a monthly U.S.-Mexico COVID-19 Risk Bulletin to provide scientific, technological, and strategic cultural support to secure the operation of the U.S.-Mexico health supply chain systems.

II. Research Results:

Approved Changes:
Due to university security protocols, it was decided to modify our original system's architecture, resulting in a clear division; servers located on-premise will be hosted and managed by TAMU IT with restricted access to public resources outside the internal firewall while a separate cloud-based hosted by Amazon's Web Services will act as the public-facing element of our project.

The Data-Lake System will reside in the on-premise servers and will only be accessible through the internal university network following the security protocols. The cloud-based system will host the public dashboards of synthesized data and analytics with limited communication with the on-premise system. Futhermore, closer collaboration with R7 was encouraged and approved to

expedite the development of the Risk Model Development, and analytics generation.

Milestone 1 – Project Kickoff

- Kickoff meeting held on August 26th, 2020
    - Participants: Tom McGinn, Burke Michael, Alexander Eastman, Heather Manley, Theophilos Gemelas, Wittrock Mark, Chris D. Scarmardo, Caneva Duane, Christine Kim, Beason Valerie, Gregory Pompelli, Matt H. Cochran, Zenon Medina-Cetina, Miriam Olivares, Maria Perez-Patron, Victor Guitierrez, Oscar Sanchez, Guillermo Duran, Enrique Z. Losoya, Juan Pablo Alvarado, Araceli Lopez, Yuliana Razo, Audrey Guzman.

Milestone 2 – Data Acquisition and Management Plan in Place

- Data Acquisition and Management Plan submitted for revision in September 2020.

Milestone 3 – Taskforce

- Completed the definition of the Taskforce members (Table 1).

Organization	Member
Texas A&M University – College of Engineering	**Dr. Zenon Medina-Cetina** Project PI Associate Professor, Civil Engineering, Petroleum Engineering, Ocean Engineering, Geography
CBTS Director	**Gregory Pompelli, PhD** Project Co-PI Director, CBTS-TAMU
CBTS – Texas A&M University	**Dr. Matt Cochran** Project Co-PI Research Director, CBTS-TAMU
Texas A&M University	**Dr. Maria Jose Perez-Patron** Project Co-PI Adjunct Assistant Professor Department of Epidemiology & Biostatistics Texas A&M School of Public Health
GIS Consulting	**Miriam Olivares** Project Co-PI and Consultant Marx Science and Social Science Library, Yale University THEI Consulting
Mexican National Business Advisory Council (Consejo Coordinador Empresarial, CCE)	**Victor Gutierrez Martinez** CEO, Grupo Plenum Chair of CCE's Innovation Commission
Mexican National COVID-19 Scientific Advisory Board (Grupo CONACYT COVID-19)	**Dr. Oscar Sanchez Siordia** Director, Mexican National Geo-Intelligence Laboratory

	Institutional Member of Grupo CONACYT COVID-19
Mexico Census Bureau	**Dr. Sergio Carrera** Director, Integration, Analysis and Research Mexico Census Bureau
U.S. Census Bureau	**Dr. Bethany DeSalvo** Chief, Small Area Modeling and Development Social, Economic and Housing Statistics Division U.S. Census Bureau
National Institute of Mathematics (CIMAT)	**Dr. Graciela Ma. De los Dolores González Farías** Director, CIMAT Campus Monterrey
U.S. Department of Homeland Security	**Duane C. Caneva, MD, MS** Chief Medical Officer Department of Homeland Security
U.S. Department of Homeland Security	**Tom McGinn DVM** Senior Veterinarian Office of the Chief Medical Officer (OCMO) Countering Weapons of Mass Destruction (CWMD) Department of Homeland Security
U.S. Department of Homeland Security	**Alexander L. Eastman, MD, MPH, FACS, FAEMS** Senior Medical Officer - Operations Office of the Chief Medical Officer Countering Weapons of Mass Destruction Office U.S. Department of Homeland Security

- **Table 1.- CBTS R-13 U.S.-Mexico Taskforce**

- Definition of taskforce meeting schedule (Figure 1):

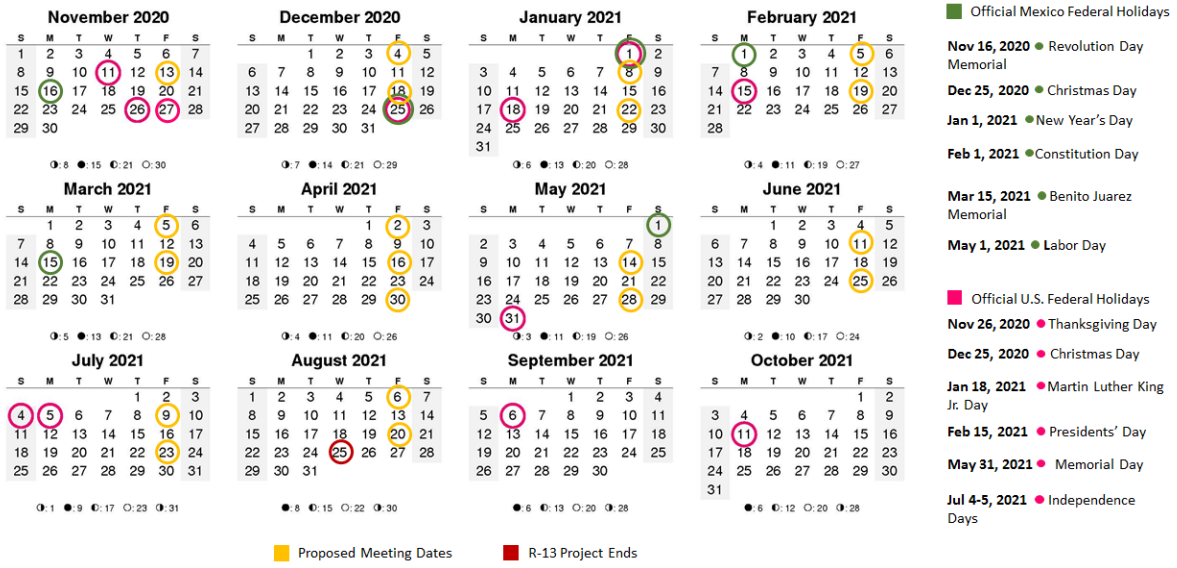


Figure 1.- Taskforce Meeting Schedule.

Milestone 4 – Data-Lake

- Finished conceptual design of the Data-Lake System shown in Figure 1, composed of two interconnected components:

1. An on-premise system (see Figure 2)
2. A cloud-based system (see Figure 3)

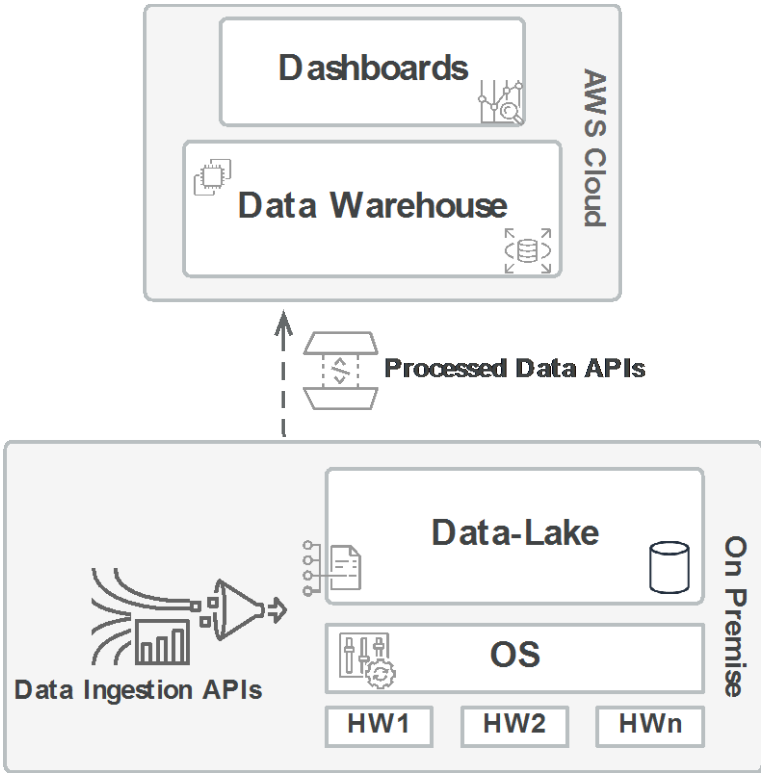


Figure 2.- Data-Lake System Overview

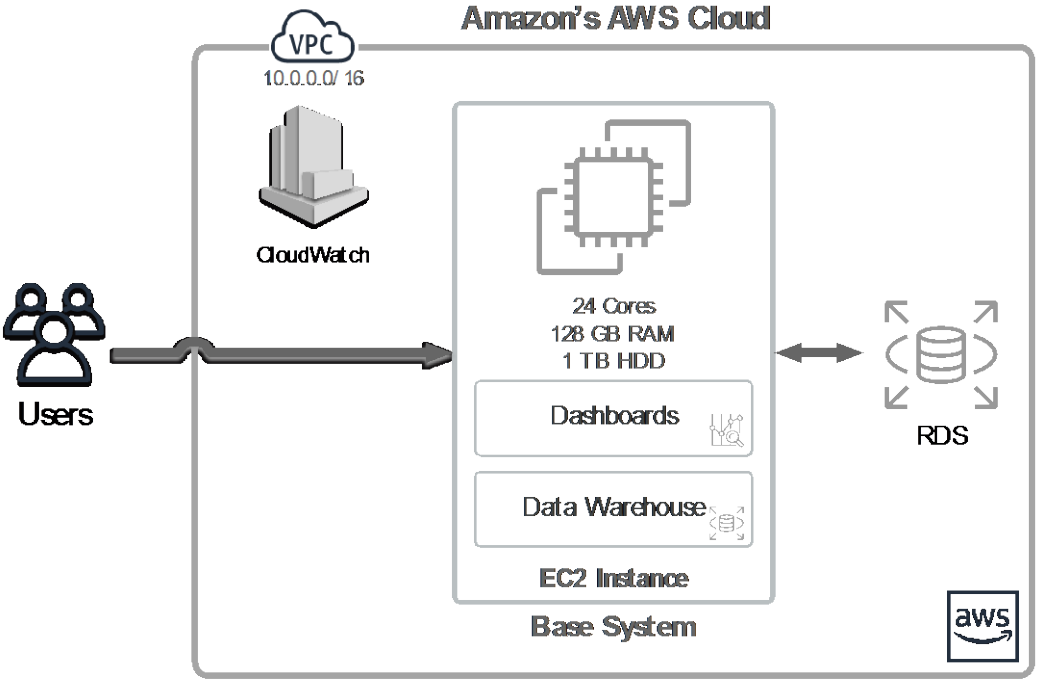


Figure 3.- R13 Data-Lake System Cloud Overview

- Completed installation of on-premise Data-Lake System (Hardware)

- Completed acquisition of cloud services for the Data-Lake System and installation is in progress.
- Completed the creation of a private TAMU-hosted Git repository to have a secured and centralized collaborative environment for code development. It was decided that Plenumsoft's Americas will provide administrative support to the SGL team.
- Defined major sub-activities for subcontractors to deliver their milestones as shown in Figure 4 and Figure 5 below:

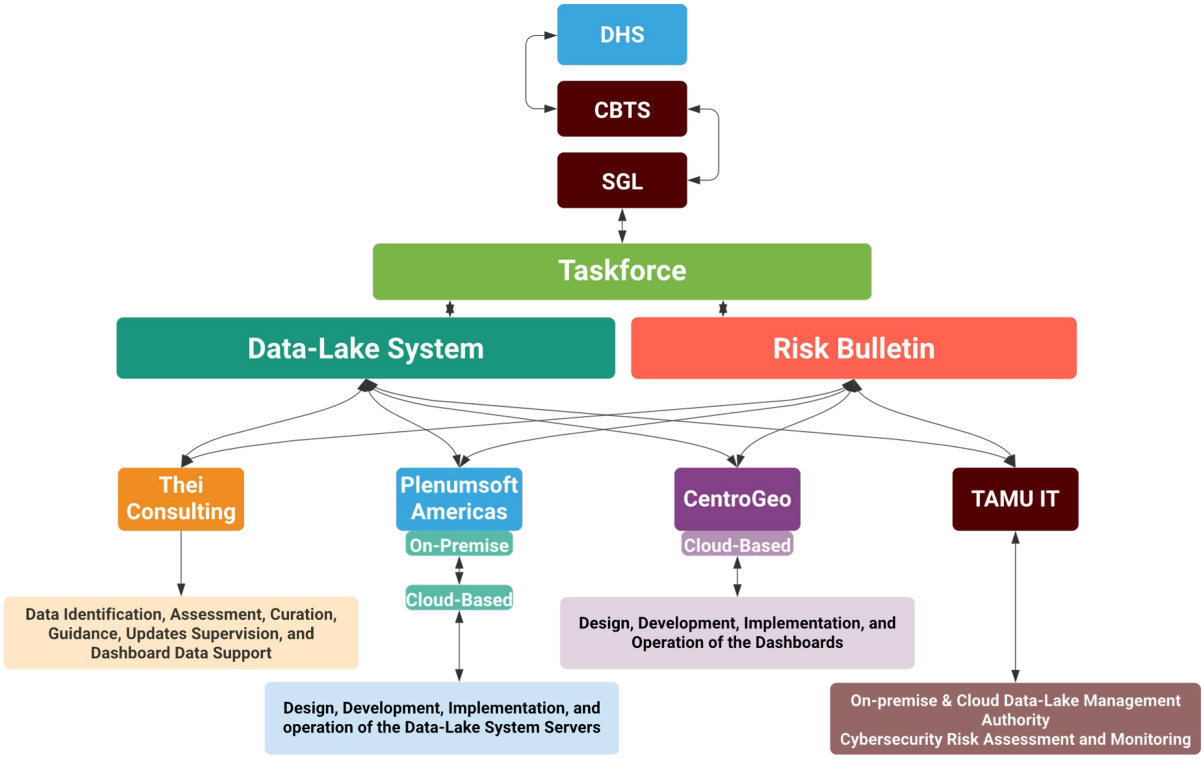


Figure 4.- General project overview structure

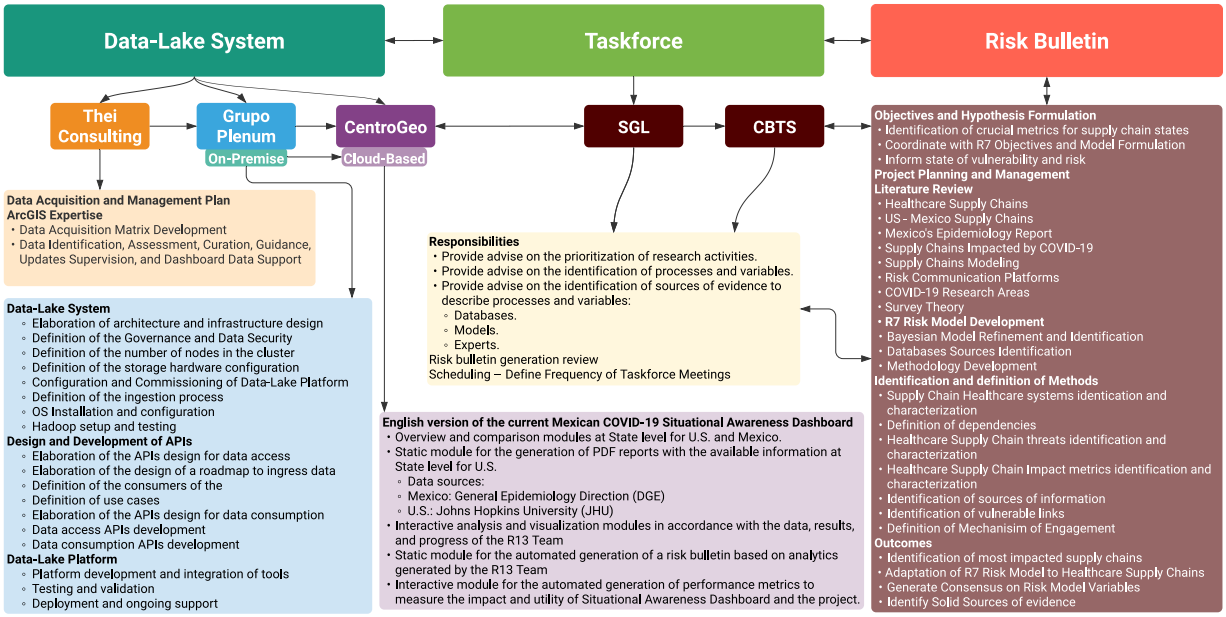


Figure 5.- Project structure details

- Secured services and access to:
  - Panjiva
  - IBISWorld
  - ProQuest News Aggregators
  - Standard and Poor's NetAdvantage
  - The Bureau of Economic Analysis (BEA)
  - US Census Bureau's USA Trade Online
  - US International Trade Commission (USITC)
  - Federal Government of Mexico's COVID19 Coronavirus.gob.mx
  - Other Public Databases
- Completed licensing and acquisition processes of Thomson Reuters's Eikon.
- Completed preliminary assessment of Panjiva Platform
  - Designed, developed, and coded initial report for the Panjiva platform
    - Report generation based on Markdown for cross-platform compatibility
- Generated first-order statistics for the following HTS codes using information from the Panjiva platform
  - 6210.10.5000 – PPE
  - 6307.90.6800 – Medical Protective Clothing
  - 6307.99.9889 – N95
  - 9019.20 – Medical ventilators
  - 9022.12 – CT scanners
- Web scraping and sentiment analysis from https://www.worldometers.info/coronavirus/ , and news.google.com

- Wrote and tested five different web scrapping scripts in R and Python as an initial proof of concept to validate the feasibility of our web scraping hypothesis

- Identified and selected sources of information and data aggregators available through the Texas A&M Library system. See Table 2 for an extended description of the available sources of information

Type	Database/Resource	Description
General DB	Web of Science	Comprehensive Citation Index for multiple disciplines
	ProQuest	Databases with access to dissertation and theses, eBooks, newspapers, periodicals, historical collections and other aggregated databases
	ProQuest TDM Studio	Pending application for academic access. This service provides a direct access to the whole collection of ProQuest's databases using R & Python scripting programming languages to accelerate the automation and ingestion of copyrighted cleared and full text of News from major national newspapers and publications.
News aggregator	Factiva	Current international news database produced by Dow Jones, one of the leading global providers of economic and financial information. combines over 32,000 sources to give students, faculty, and librarians access to premium content from 200 countries, in 28 languages.
	Nexis Uni	Nexis Uni features more than 17,000 news, business, and legal sources—including U.S. Supreme Court decisions dating back to 1790.
	News Bank Inc	NewsBank consolidates current and archived information from thousands of newspaper titles, as well as newswires, web editions, blogs, videos, broadcast transcripts, business journals, periodicals, government documents and other publications
	Newspaper Source Plus EBSCO	Access to full-text newspapers
Industry reports and statistics	IBIS World	IBISWorld provides reports on industries, including statistics, analysis, and forecasts.
	U.S Bureau of Labor Statistics	Principal fact-finding agency for the U.S. government in the broad field of labor economics and statistics and serves as a principal agency of the U.S. Federal Statistical System.
	Statista	Database that contains international statistics, facts, and market data taken from free and proprietary sources.
	BCC Research	Market research reports that includes major economic, scientific, and technological developments in industrial, pharmaceutical, and high technology organizations.

	RKMA	Market research handbooks focused on various consumer-related markets. Each handbook includes market forecasts, sector trends, and statistics.
	Fitch Solutions	Country and industry business forecasts, company profiles, personnel listings, risk-assessments, growth projections, analysis of the business operating environment, and more.
Financial data vendors	Thomson Reuters Eikon	Software package that provides access to a range of data, and market-leading Reuters news
	Panjiva Platform	Panjiva Inc. is a global trade data company based in New York City. It is a subscription-based website with import and export details on commercial shipments worldwide.
	Bloomberg Terminal	The Bloomberg Terminal brings together real-time data on every market, breaking news, in-depth research, powerful analytics, communications tools and world-class execution capabilities — in one fully integrated solution.

Table 2.- Initial sources of evidence identified to support the development of risk-based analytics

- Co-development of risk model with R7 to identify critical variables and processes associated to health infrastructure and the health of the workforce supporting trade supply chains between the U.S. and Mexico. Identification of variables and processes will facilitate the classification of available sources of evidence in the U.S. and Mexico, see Figure 6.

- Translating the official Mexican COVID19 dashboard into English for easier access and understanding by the US public and stakeholders
    - An initial live version of the translated website is being developed by CentroGeo and is due on 11-27-2020

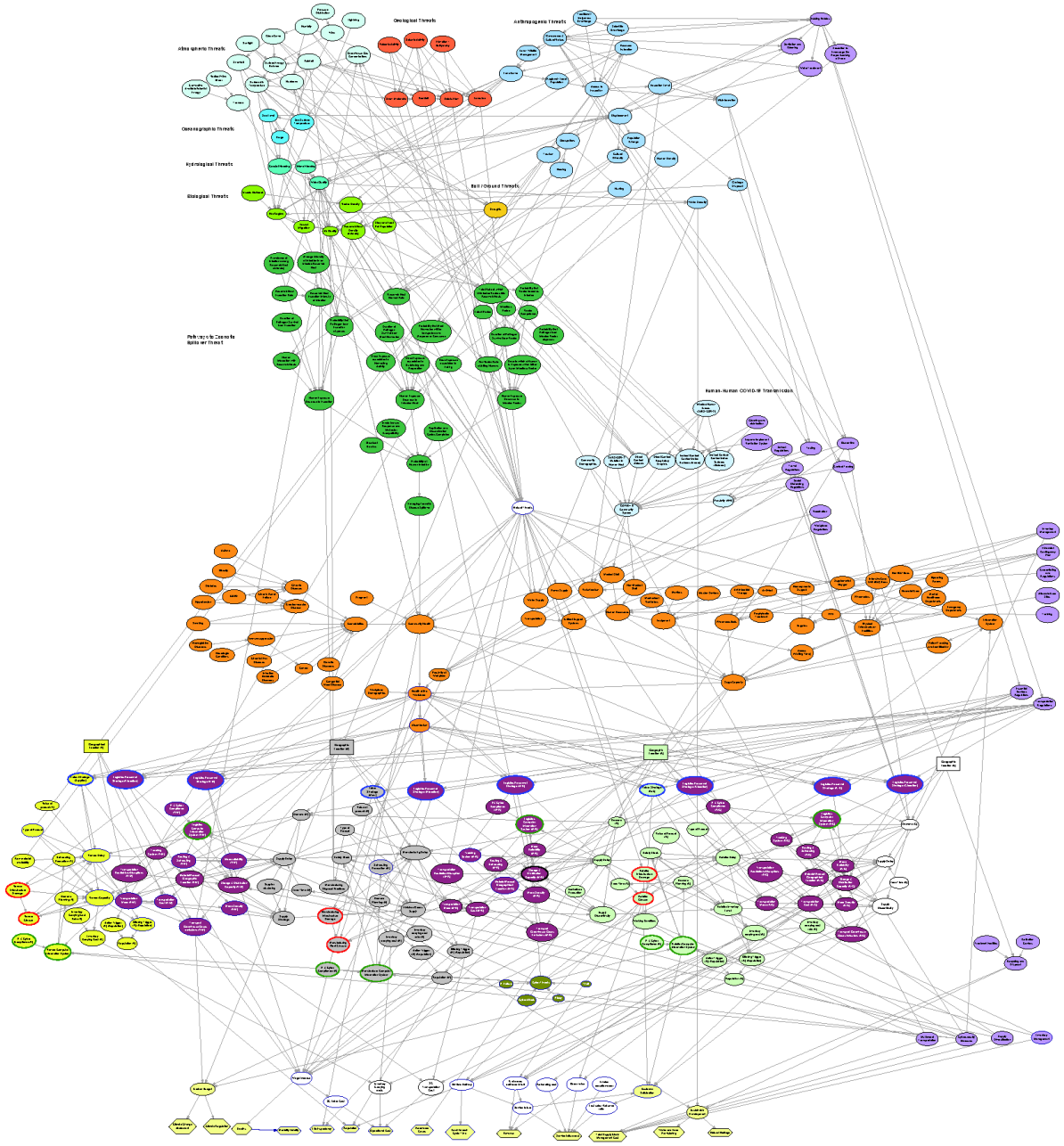


Figure 6. Preliminary Risk Bayesian network model

Milestone 5 – Bulletin

- An assessment of available literature on COVID-19 and U.S. healthcare supply chain was conducted by exporting bibliographic references to generate a co-occurrence network.
    - Source: Web of Knowledge.
    - Search terms: Healthcare/Health care AND Supply Chain* AND COVID* OR Sars* OR Coronavirus.
    - Refined by COUNTRIES/REGIONS: USA
    - Search results = 24

- Date: 11/02/2020

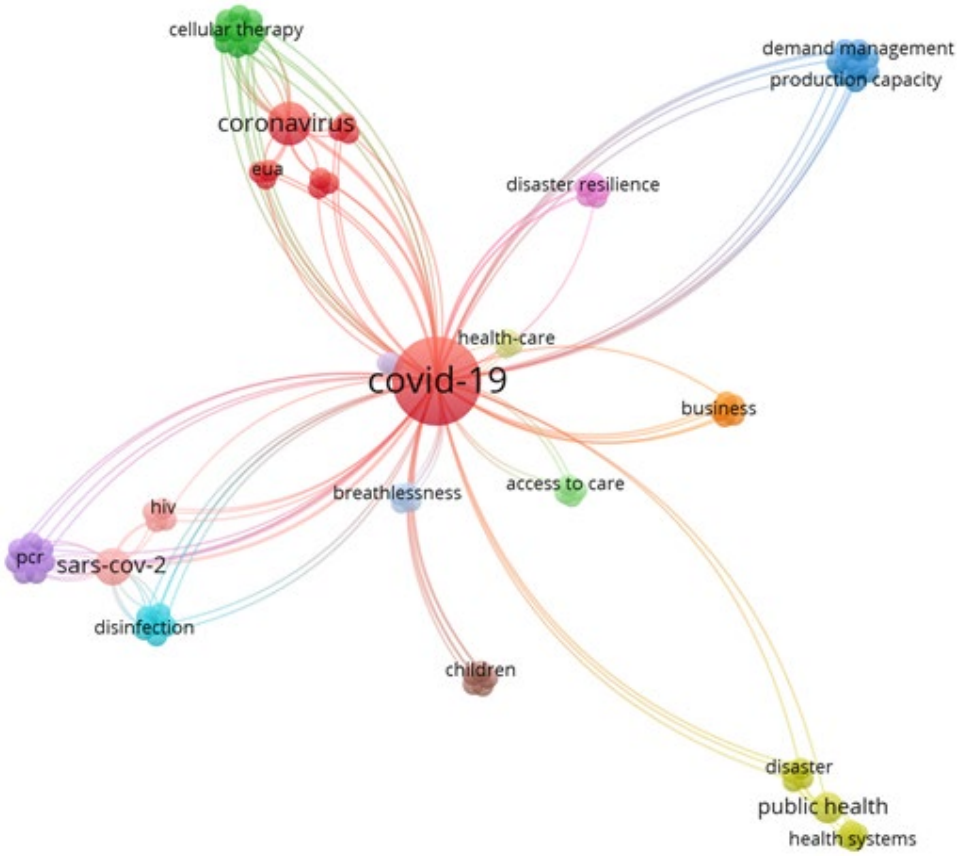


Figure 7. COVID-19 and U.S. Healthcare Supply Chain keyword co-occurrence networks

- Top 10 keywords (excluding search terms):
  - Adult ICU Patients.
  - Analgesia.
  - Acute Respiratory Distress Syndrome (ARDS).
  - Cerebral Hemodynamics.
  - Clinical Practice Guidelines.
  - Control-Release Oxycodone.
  - Controlled Trial.
  - Critically ill.
  - Intensive-Care-Unit.
  - Isoflurane Sedation.
- An assessment of available literature on COVID-19 and Mexico healthcare supply chain was conducted. No search results were found.
  - Source: Web of Knowledge.
  - Search terms: Healthcare/Health care AND Supply Chain* AND COVID* OR Sars* OR Coronavirus.
  - Refined by COUNTRIES/REGIONS: MEXICO
  - Search results = 0
  - Date: 11/02/2020

- An assessment of available literature on COVID-19 and U.S. supply chain and workforce was conducted by exporting bibliographic references to generate a co-occurrence network.
    - Source: Web of Knowledge.
    - Search terms: Supply Chain* AND Workforce AND COVID* OR Sars* OR Coronavirus.
    - Refined by COUNTRIES/REGIONS: USA
    - Search results = 4
    - Date: 11/02/2020

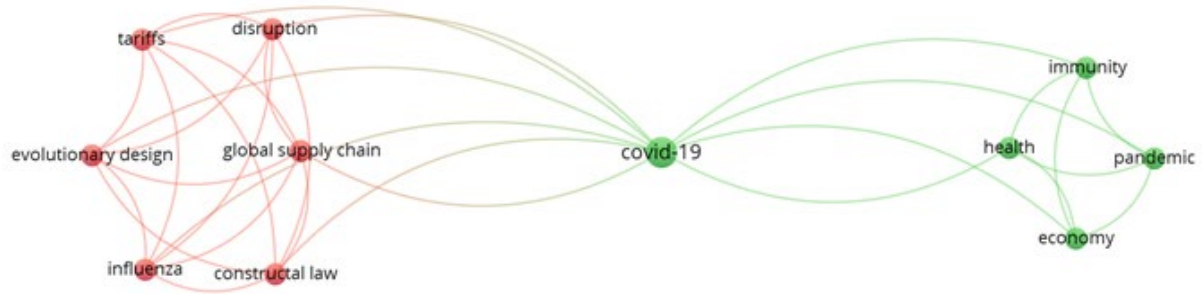


Figure 8. COVID-19, and U.S. Supply Chain and Workforce keyword co-occurrence networks

- Top 10 keywords (excluding search terms):
    - Constructal Law.
    - Disruption.
    - Evolutionary Design.
    - Global Supply Chain.
    - Influenza.
    - Tariffs.
    - Agriculture Safety and Health.
    - COVID-19 Health Practices
    - Economy.
    - Health.
- An assessment of available literature on COVID-19 and Mexico supply chain and workforce was conducted. No search results were found.
    - Source: Web of Knowledge.
    - Search terms: Supply Chain* AND Workforce COVID* OR Sars* OR Coronavirus.
    - Refined by COUNTRIES/REGIONS: MEXICO
    - Search results = 0
    - Date: 11/02/2020
- The initial risk-based analytics for decision makers identified for development and delivery are listed below. See Figure 13 for preliminary graphical examples.
    - Periodical Semantic Analysis
    - Automated Report and Interactive Dashboard Component

        - e.g., R13 Risk Dashboard with relevant results from the last day, week, month, quarter, year
    - Moving Interactive Window of Semantic Evolution over Time
    - Geographical linkage and representation
    - Social & Supply Chain Vulnerability State of Vulnerability
    - US Imports/Exports Analysis from Panjiva for specific products
- Started planning surveys and platform to be used in conjunction with R7 to acquire experts' inputs and opinions for validation of the preliminary risk-model and analytics. It is expected to use Qualtrics (https://www.qualtrics.com/) as TAMU provides premium access to SGL faculty and staff.
- Identified the main U.S. products imports economic value (USD) from Mexico according to the United States Census Bureau USA Trade data (August 2020).
    - Top 10 U.S. states based on imports from Mexico trade value (USD)
    - Top 10 U.S. products imports from Mexico trade value (USD)
    - Top 10 U.S. states based on medical instruments imports from Mexico trade value (USD)
- Defining and creating a Data Management Matrix to help on the identification of
    - A) Identification of same variables from Mexican Database in the US to define a plan for harmonization between Mexico & US.
    - B) Identification and characterization of variables available in the US that are not available in Mexico
    - C) Identification and characterization of variables available in the US (not available in Mexico)
    - The goal is to produce both a risk-based 1) analytics and 2) maps, focusing on data that is 'available' available.
- Identified US COVID-19 Case surveillance data
    - Individual-level data
    - Public data are only available at the national level
    - Updates monthly
    - Demographic
        - Sex = 98 % cases and 99% of deaths
        - Age = 99% of cases and deaths
    - Race and Ethnicity information is incomplete and not nationally representative
        - 52% of the cases
        - 80% of the deaths
    - Epidemiological
    - Disease exposure
    - Severity
    - Test information
    - Comorbidities
- Characterization of emerging zoonotic diseases:
        - "Emerging infectious diseases (EIDs) are a significant and **growing threat** to global health, global economy and global security" (Heymann, D. L. et

al., 2015; Morens, D. M. & Fauci, A. S., 2012).

- "Analyses of their trends suggest that their **frequency** and **economic impact** are on the **rise**" (Pike, J. et al., 2014; Jones, K. E. et al, 2008).
- "The majority of EIDs (and almost all recent pandemics) originate in **animals**, mostly **wildlife**, and their emergence often involves dynamic interactions among populations of **wildlife**, **livestock**, and **people** within rapidly changing environments" (Wolfe, N. D. et al., 2007, Jones, B. A. et al., 2013; Karesh, W. B. et al., 2012).
- Allen et al. (2017) developed a weighted boosted regression tree model to predict the **probability of disease emergence**. The model incorporates spatial predictors such as proxies for human activity, environmental factors, and the zoonotic pathogen pool from which novel diseases could emerge. The model estimated a **high Risk** of emerging infectious disease at the central region of China where the city of **Wuhan** is located.

- Model development:
  - A Bayesian Network conceptual model was constructed to represent pathways and barriers of zoonotic disease spillover. This model was inspired by a mathematical model developed by Plowright et al. (2017).
  - Atmospheric, anthropogenic, oceanographic, hydrological, biological variables were also included in the Bayesian Network model to represent the cause-effect relationship between these variables and the pathways and barriers of zoonotic disease spillover.

- COVID-19 testing.
  - Number of tests per confirmed case:
    - The World Health Organization hosted a COVID-19 virtual press conference on March 30th, 2020. In this conference, Dr. Tedros Adhanom Ghebreyesus suggested a positive rate between **3 – 12%** as a general benchmark of adequate testing. This equals to **8 – 33** tests per confirmed case.
    - Ashish Jha and colleagues at the Harvard Global Health Institute published an article explaining why U.S. needs to have at least a positive rate between **5 – 6%** to open the economy and stay open. This equals to a minimum of **17 – 20** tests per confirmed case.
    - Di Bari et al. (2020) studied the effects of different COVID-19 swab testing policies in in four regions of northern Italy. The author concluded that a **broader policy** for swab testing may contribute to containing COVID-19 threat.
    - Liang et al. (2020) applied linear regression to a cross-sectional dataset comprising 169 countries. The author found that "**higher COVID-19 mortality** is associated with **lower test number**, lower government effectiveness, aging population, fewer beds, and better transport

infrastructure. **Increasing** COVID-19 test number and improving government effectiveness have the potential to reduce Covid-19 related mortality.

- U.S. is performing 16 tests per confirmed case at national level. Mexico is performing 2 tests per confirmed case at national level. These test numbers are dated from November 5th, 2020 (Our World in Data, 2020).

- Excess mortality.
  - U.S. excess mortality from March 1st – August 16th (Our World in Data, 2020):
    - 2020 cumulative confirmed COVID-19 deaths = 169,000.
    - Cumulative excess mortality in comparison with average 2015-2019 = **275,000**.
    - U.S. population = 331 million.
  - Mexico excess mortality from January – November 2020 (Mexican Department of Health, 2020):
    - 2020 cumulative confirmed COVID-19 deaths = 97,056.
    - Cumulative excess mortality in comparison with average 2015-2018 = **203,231**.
    - Mexico population = 129 million.

- Surge Capacity: the concept of surge capacity relates to the health care systems' ability to "increase **staff, stuff, structure, and system** (4S) rapidly and effectively in the affected areas" (Khorram-Manesh, 2020).
  - Staff
    - "Critical care personnel involve a multidisciplinary team of specialists that include physicians, nurse practitioners, critical care nurses, and ancillary staff such as pharmacists, nutritionist, respiratory therapists, social workers, and physical therapists" (Seda & Parrish, 2019; Rubinson L et al., 2005)
  - Stuff
    - This component of Surge Capacity was breaking down into equipment, pharmaceuticals, and supplies. According to Seda & Parrish (2019), essential equipment can include mechanical ventilators, monitors, and infusion devices. Pharmaceuticals such as antimicrobial therapies, antivirals, and prophylactic treatments are needed to support critical interventions. Essential supplies to provide critical care include personal protective equipment, supplemental oxygen, and hemodynamic support.
  - Structure
    - According to Shahverdi, B., et al. (2020), several authors have provided methods to quantify the physical capacity of specific units within hospitals such as emergency departments, pharmacies, intensive care units, neonatal care, operating rooms, and mental healthcare departments. Capacity measures include waiting times for patients to be treated.
  - System

        - Critical support systems like power, water supply, and transportation shall be considered to assess the capability to supply health care services (Shahverdi, B., et al., 2020).
        - A robust information system is required to ensure communication, and patient tracking and identification (Hick et al., 2009; Nager & Khanna, 2009)
    - Model Development
        - A Bayesian Network conceptual model was constructed to represent the surge capacity of a health care system using the 4S described previously. These capacities were connected with variables such as inland flooding that can have an impact on surge capacity.

One of the most important objectives of the project is to provide a communication system and platform to facilitate the restoration of broken supply chains impacted by COVID-19 while fostering the creation of new ones to reactivate trade between the U.S. and Mexico.

As mentioned on the project's workplan, this risk-bulletin report will include a report card that will be used to define the status of threats, system vulnerabilities and impacts as these relate to each component of the health supply chain systems (e.g. risk factors). It is expected that this bulleting will be jointly produced with the advice of the members of the Taskforce and based on risk-based analytics stemmed from the Data-Lake System, to provide scientific, technological, and strategic cultural support to secure the operation of the U.S.-Mexico health supply chain systems. The team is currently working on the initial definition and proposition of the proposed risk-score card shown in Figure 9, and Figure 10, respectively.

Figure 9 shows a visual mockup of a preliminary risk scorecard that expands the definitions to include more details about metrics related to each threat. The objective is to have this score card on the website with updated values on a periodical basis. Essentially, a score will be assigned to each fundamental component of the risk framework using several parameters, on this example we have expanded some scores to a series of variables related to each component, followed by a weighted sum or other function to arrive at the final index.

Again, this is just a preliminary version and it might change as we move through the taskforce meetings and other developments of the project.

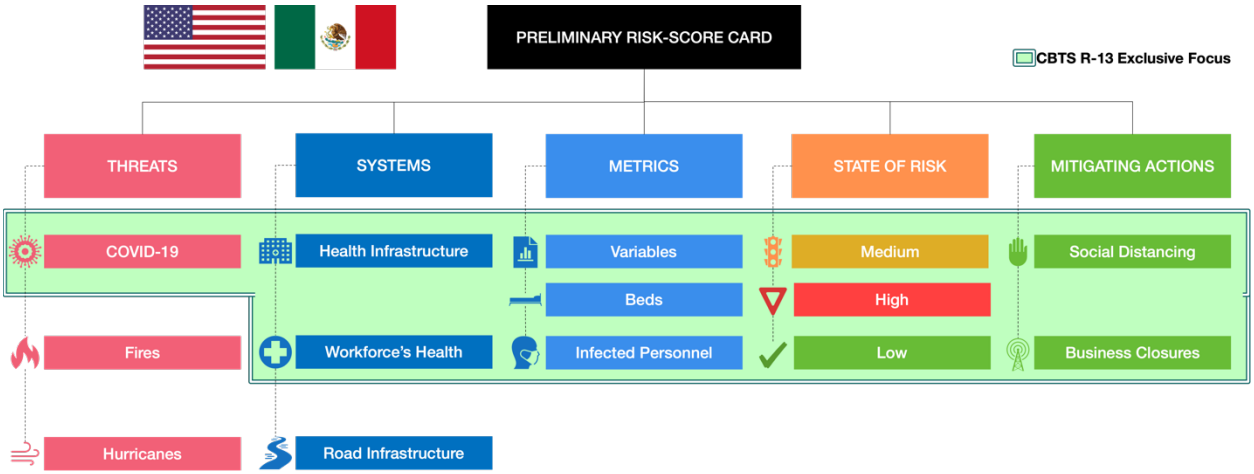


Figure 9. Simplified proposed scorecard definition to use in for future risk-bulletin

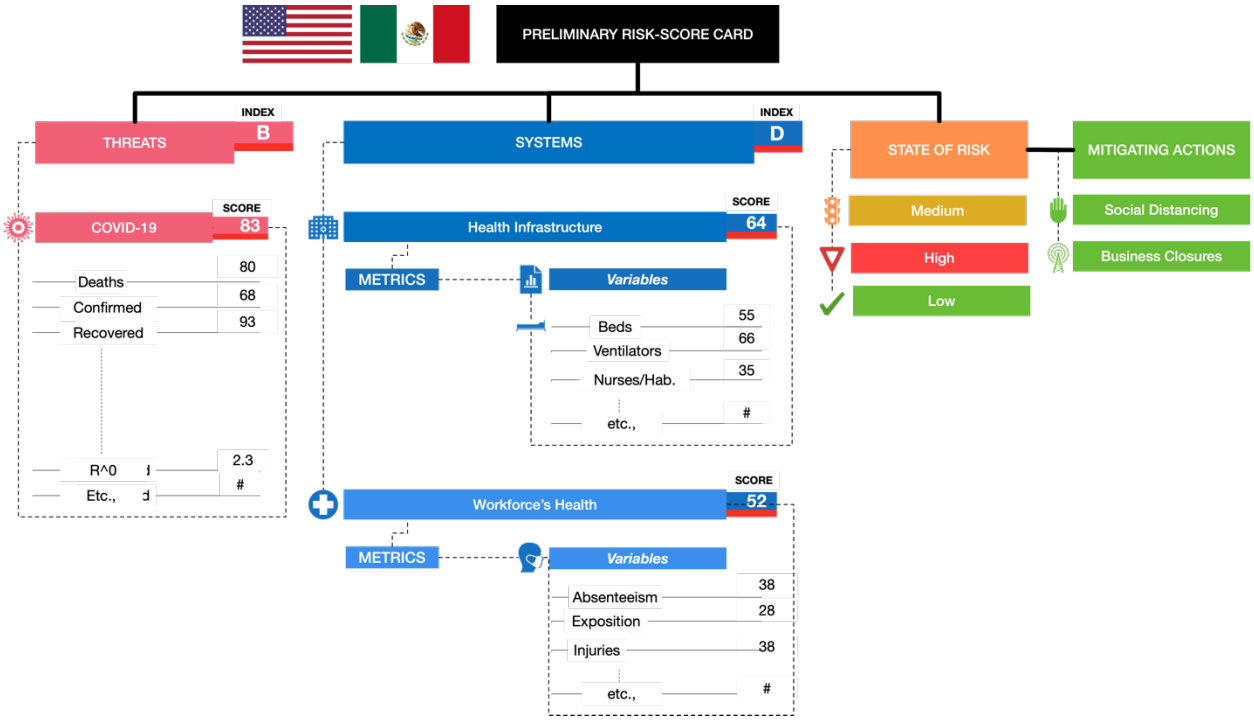
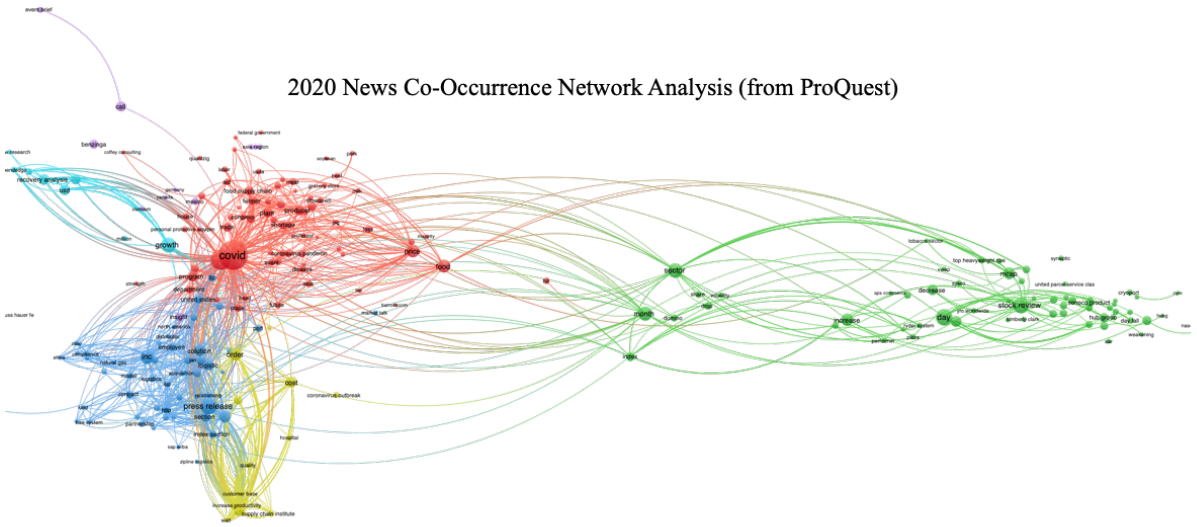
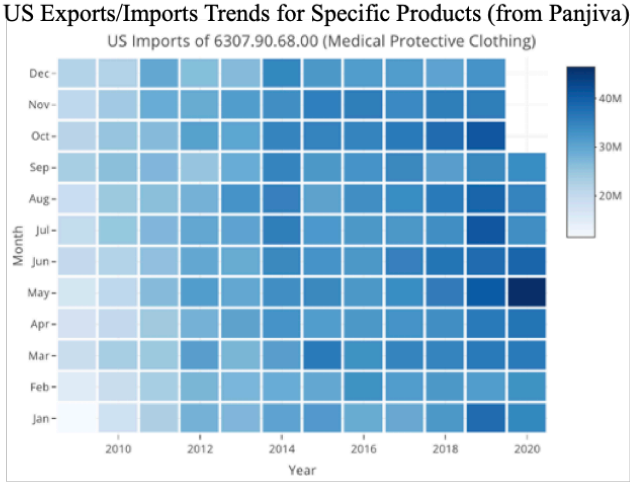


Figure 10. Simplified expanded proposed scorecard definition to use in for future risk-bulletin



Title word map monthly/weekly (September, from ProQuest)

US Exports/Imports Trends for Specific Products (from Panjiva)



Weekly Top COVID-19 Research Areas /Topics (from ProQuest, and NIH's CORD-19 dataset)

Category	# Papers	# New Papers	# News
Patient & Medical Care	11,694	335	53,375
Mortality & Risk Factors	10,482	288	57,113
Vaccine & Therapeutics	8,712	251	54,766
Test & Monitoring	8,221	195	32,224
Non-pharmaceutical Intervention	8,172	245	...
Forecast & Modeling	6,939	190	...
Transmission & Incubation	6,381	154	85,665
Ethics & Social Considerations	4,516	140	8,907
Review Papers	3,106	81	7,500
Pathology	2,004	47	...

Figure 11. Preliminary examples of Risk-Based Analytics to be processed through the Data Lake System (in collaboration with R7)

III. Performance Discussion:

Weekly research updates corresponding to the project's outputs have been delivered in the form of PowerPoint presentations summarizing the project progress by members of the Stochastic Geomechanics Laboratory (SGL). Minutes of every workmeeting have been captured on a word document, capturing the key contributions to each Milestone of the project. Monthly summaries have consisted of PowerPoint presentations and word documents of the advances of the project. In addition, CBTS PIs have attended monthly status updates meetings. Moreover, both types of document updates and summaries have been stored in a dedicated Microsoft Teams channel to the project, available to all PIs, graduate students and supporting staff. Content of these documents were used as basis to populate each monthly report. Futhermore, the dedicated Microsoft Teams channels have allowed SGL's team to collaborate, expedite communications, manage information exchange, and improve resources' archiving, among other benefits. The key contributions and tasks by month and milestone have been delivered to CBTS on a monthly basis with expanded details of our progress.

The outputs from this project's research work are:

- ***1) Weekly updates, monthly summaries, and quarterly IPRs***
- ***2) Creation of the Taskforce***
- ***3) Creation of an operational Data-Lake***
- ***4) Bulletin***
- ***5) Semi-annual report***
- ***6) Final report***

Metric 1 – CBTS leadership will develop rubric to be fulfilled every time the Taskforce meets. This rubric will include three main sections: datasets, models and expert opinions, to reflect the quantity and quality of the evidence being collected to formulate the Risk model. Minutes from the Taskforce meetings will include the rubric and a list of action items indicating the partners involvement required to complete the identification of key processes involved in the supply chain for the health infrastructure and for the health of the workforce.

Metric 2 – CBTS leadership will develop a rubric to assess the development and operation of the data-lake. This rubric will include three main sections: volume of data being processed, volume of model predictions being processed, and volume of expert opinion's being processed, for the identification of the key processes involved in Risk model depicting the supply chain for the health infrastructure and for the health of the workforce.

Metric 3 – CBTS leadership will develop a rubric to assess the impact of the dissemination of the monthly Bulletin. This rubric will include three main sections: use of datasets, use of models and use of expert's opinions, as represented in the outcomes of the Risk analytics guided by the current Risk model.

Outcomes from the work in the near, intermediate, and far term are listed in the table below:

Outcomes		
Short-term	**Intermediate**	**Long-term**
Integration of U.S.-Mexico triple helix ***taskforce*** to support health supply chain systems	Expansion of U.S.-Mexico triple helix *taskforce* to support related supply chain systems to health	Expansion of U.S.-Mexico triple helix taskforce to all trade supply chain systems
Risk analytics ***data-lake*** on U.S.-Mexico health supply chain systems	Risk analytics *data-lake* on U.S.-Mexico related supply chain systems to health	Risk analytics *data-lake* on U.S.-Mexico all trade supply chain systems
COVID-19 Risk Bulletin to provide scientific, technological, and strategic cultural support to secure the operation of the U.S.- Mexico health supply chain systems.	COVID-19 Risk Bulletin to provide scientific, technological, and strategic cultural support to secure the operation of the U.S.-Mexico related supply chain systems to health	COVID-19 Risk Bulletin to provide scientific, technological, and strategic cultural support to secure the operation of all the U.S.- Mexico trade supply chain systems

IV. Stakeholder Engagement:

Project champion
Tom McGinn, DVM, Senior Health Advisor, Countering Weapons of Mass Destruction, Department of Homeland Security.

The main engagement took place at the kickoff meeting and at the presentation of the R-7 and R-13 Data-Lake System shared milestone during the first R-13 Taskforce meeting.

CBTS has engaged with the project team, and DHS champions, customers, and stakeholders continually; The PIs held weekly interactions through research status updates presentations and meetings with the subcontractors. In addition, students working on the project met as needed to provide research outcomes. Lastly, monthly taskforce teleconferences and monthly project updates have been occurring during this period of performance.

V. Transition Progress:

The project poses a significant potential for transition of technology for organizations similar to DHS where decision-making based on mapping of Risk is critical. This project aims at setting the stage to produce an ambitious Data-Lake Platform. It is anticipated that user-specific platforms will be developed on subsequent phases of this project where full quantitative Risk assessment and management can be conducted. Which opens significant opportunities for transitioning to quantitative simulations of risk scenarios of multiple supply chains. The inclusion of supply chains, other than health, is also anticipated, which will open a wide spectrum of opportunities for multiple sectors to trace supplies and services across the U.S.-Mexico ports of entry; these supply chains may be tied to other processes that share dependencies on threats, system vulnerabilities and impacts. For instance, the food supply chain may be under the same climate threat, may depend on the same transportation and logistics system vulnerabilities, and may have some social, economic and environmental impacts tied to the health supply chain systems. That opens an opportunity to engage with potential users that can sponsor the expansion of the *data-lake* through service fees of membership. The collection

of Risk-analytics for multiple sectors when presented as inter-dependent supply chains, can offer a very powerful tool which value is anticipated to grow as other supply chains are included into the Risk analytics. Moreover, once the data-lake enters into operation and start producing Risk analytics, it can be used as proof of concept to apply to other sources of research sponsorship such as NSF, the National Academies, or private foundations. The value will rely not only in the analytics per-se, but in the ability of CBTS to bring together partners across the U.S.-Mexico border.

VI. Project Risks:

The major potential limitation for successful completion of the project is the time constraint, which is why this effort is thought of as a 'proof of concept' to explore its potential to expand in the future. Due to the pressing need and opportunity provided by COVID-19, we limit the milestone to three milestones. Specifically, Milestone 3.- Data-Lake System, is a development now jointly defined between R7 and R13 as the 'Data Lake System,' and to qualitative risk analysis, which would produce the conceptual model for risk assessment risk management, but would not require its quantitative use. Nonetheless, risk-based analytics and key information will be presented interactively, as discussed in Milestones 2 and 5. Because of the value of the project to integrate all evidence collected across projects and organizations we anticipate that interest and participation on the project may not pose a significant problem. However, early collaborations across CBTS projects have showed a slow engagement since each project is trying to establish itself leaving little room for cross-collaborations.

VII. Project Timeline:

Please update your high-level Gantt chart as below that includes technical and programmatic tasks, milestones, and outputs. Track actual completion dates against htose originally proposed. Describe any setbacks and mitigation.

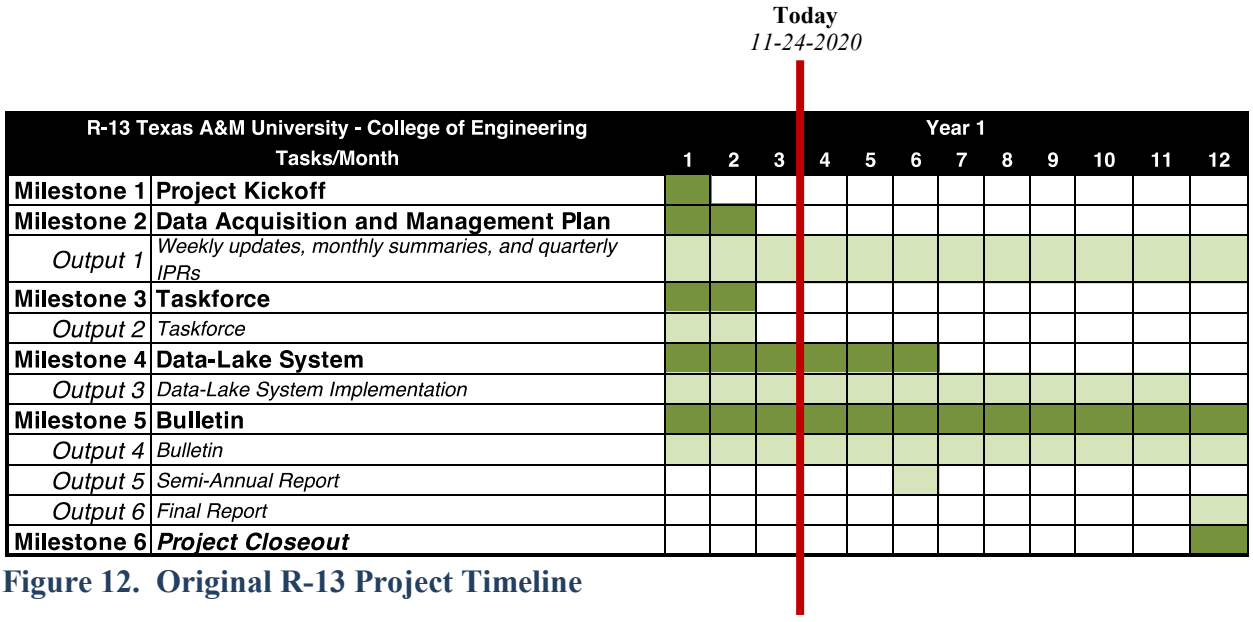


Figure 12. Original R-13 Project Timeline

VIII. Intellectual Property: If applicable, include a certification that no patentable inventions were created during the budget period.

Not applicable yet

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