

GSA Framework for Managing Climate Change Risks to Federal Agency Supply Chains

1. Contents

- 1. Contents 1
- 1. Introduction..... 3
 - 1.1. Intended Audience 4
 - 1.2. What This Framework is Not..... 5
- 2. Supply Chains 5
 - 2.1. Overview and Scope of Supply Chains 5
- 3. Climate Change and Weather 6
 - 3.1. The Interaction between Weather, Climate Change, and Supply Chains..... 6
 - 3.1.1. Historical Climate..... 6
 - 3.1.2. Extreme Weather Events..... 6
 - 3.1.3. Climate Change..... 6
- 4. Risk management Framework 7
 - 4.1. How to Use This Framework 7
 - 4.2. Identify: What Are the Climate Change Risks to Critical Supply Chains? 9
 - 4.2.1. Identify Critical Supply Chains 9
 - 4.2.2. Identify the Climate-Sensitive Elements of the Supply Chain 12
 - 4.2.3. Identify Key Climate Threats..... 13
 - 4.3. Assess: What is the Likelihood and Consequence of Climate Change Threats? 15
 - 4.3.1. Understand the Elements of Risk and the Link to Climate Change 15
 - 4.3.2. Assess the Likelihood of Climate Change Threats 17
 - 4.3.3. Assess the Consequences of Climate Change Threats 18
 - 4.3.4. Bring it all Together: Use Likelihood and Consequence to Identify Priority Risks..... 22
 - 4.4. Plan: What Can Be Done to Reduce the Consequences of Climate Change? 24
 - 4.4.1. Identify Who is Accountable for the Supply Chain..... 24
 - 4.4.2. Develop Climate Change Risk Management Strategies..... 25



| | | |
|--------|---|----|
| 4.4.3. | Evaluate, Select, and Implement Risk Management Strategies | 27 |
| 4.5. | Monitor and Modify: How Effective Are the Risk Management Strategies? | 29 |
| 4.5.1. | Track the Impact of Weather Events over Time | 29 |
| 4.5.2. | Revisit and Update the Assessment and Plan..... | 30 |

1. Introduction

GSA developed this supply chain risk management framework to provide guidance to Federal agencies ready to assess climate or weather-related risks to supply chains and develop plans to minimize those risks. The framework also helps delineate risk management responsibilities between GSA and customer Federal agencies—while GSA may play a role in some risk management activities, most of the responsibility falls to the agency end-user of the supply chain services and products. The intent of the framework is to provide guidance for Federal agency offices or staff in managing supply chain risk at the contract-level, rather than the GSA master contract-level.

This framework is intended to be used in conjunction with standard supply chain risk management planning. The process is intended to reveal 1) whether changes to existing risk management practices may be necessary to accommodate climate change-related risks; and 2) what those changes should be.

Context

Federal agencies are required by [Executive Order \(EO\) 13653](#), to develop and maintain adaptation plans that: (1) evaluate climate change-related risks to, and vulnerabilities in, agency operations and missions in both the long- and short-term; and (2) outline actions the agency will take to manage such risks and vulnerabilities. EO 13653 specifically requires adaptation plans to describe how the agency will consider the need to improve climate adaptation and resilience with respect to suppliers and supply chains. Although many agencies understand and actively manage more traditional risks to their supply chains (e.g., price fluctuations, supply shortages, delivery delays, etc.), most have not specifically assessed climate change-related risks.

1.1. Intended Audience

The audience for this framework is multidisciplinary and includes GSA customers involved in procuring goods and services as well as those within federal agencies who work to maintain operations through irregular events and disruptions. While one person or a small group of people may be leading this process, Table 1 contains a list of stakeholders who may be consulted at certain stages of the framework. This list is not meant to be exhaustive but rather provide illustrative examples of the types of people who it may be beneficial to consult. Individual supply chain consultation needs will vary.

Table 1. Potential stakeholders for risk management process

| Stakeholder | Expertise |
|---|--|
| Acquisition offices | Establishment of contracting vehicles for acquiring goods and services |
| Budgeting offices | Financial impacts to operations from supply chain disruptions Budgetary options for adaptive management |
| Continuity of Operations (COOP) managers and emergency management staff | Emergency risk management procedures for supply chains and agency operations |
| Environmental policy staff | Climate and environmental impact expertise |
| External consultants | Climate change expertise (tailoring climate change data to agency needs, conducting a vulnerability assessment, etc.) Supply chain risk management strategies |
| Facilities maintenance and operations staff | Product and service usage, importance to agency objectives Risk management strategies |
| Fleet managers | Vehicle asset management strategies, asset importance to supply chain objectives |
| Information and Communications Technology (ICT) managers within the Federal family or suppliers | ICT asset and systems management and risk management capabilities |
| Original Equipment Manufacturers (OEM), resellers, and service providers | Insight into product or service primary sources and manufacturing processes |

| | |
|------------------|---|
| Planning offices | Short- and long-term supply chain planning (both past and future) |
|------------------|---|

1.2. What This Framework is Not...

- **A comprehensive explanation on supply chain risk management.** It is assumed that you have a solid understanding of supply chain management and current agency supply chain management practices, so this framework focuses on how climate change risks can be factored into those existing processes. The framework does not provide background information on supply chain risk management practices other than as they pertain to climate readiness.
- **Detailed technical guidance for conducting an agency-specific risk assessment.** This is a high level conceptual framework that is flexible enough to be used by any Federal agency for any critical supply chain.

2. Supply Chains

2.1. Overview and Scope of Supply Chains

Supply chains cover the entire network of goods and processes that originate with raw materials and end with the delivery of goods and services. The elements of supply chains include, but are not limited to:

- Raw materials
- Production facilities
- Transportation services and infrastructure to move goods
- Delivery services
- Access to utilities (especially water and electricity)
- Logistics at each step of the chain

In the context of the Federal government, the supply chain may end with either the delivery of services or goods to the agency or with delivery beyond the agency, such as services provided to taxpayers or international military operations.

Many agencies lack clear insight into their supply chains, particularly when broadening scope beyond the first tier of service providers or suppliers. This lack of visibility into supply chains is exacerbated by the increasingly global nature of supply chains, making it increasingly difficult for agencies to effectively manage risks in their supply chains.

3. Climate Change and Weather

3.1. The Interaction between Weather, Climate Change, and Supply Chains

3.1.1. Historical Climate

Historical climate—the long-term average temperature and precipitation conditions in a given location—is one of many factors that already influences supply chains. For example, historical climate patterns influence where and how agricultural materials are produced, and thus where those products are sourced.

3.1.2. Extreme Weather Events

Extreme weather events and other natural disasters such as hurricanes, floods, tornadoes, earthquakes, and blizzards also already affect how agencies manage their supply chains. When these events occur, they can damage raw materials, disrupt transportation routes, or affect the final delivery of goods and services.

Agencies already use many risk management strategies to reduce the risks to their supply chains from extreme weather events, such as:

- Continuity of Operations (COOP) planning
- Extreme weather “mock events” or planning exercises
- Multiple sources of supply and/or flexibility in sourcing (and the inherent value of sourcing through GSA due to their flexibility in sourcing)
- Explicitly pushing risk management responsibilities to contractors

These tools will be useful in combatting any added risks from climate change.

3.1.3. Climate Change

Climate change is expected to affect long-term climate trends as well as the frequency, severity, and location of extreme weather events and other disruptions (e.g., nuisance flooding). Both, in turn, could create risks to supply chains such as limited supplies, increasing costs, and inability to provide critical services.

For example, over the long term, climate change could affect growing seasons and thus change the timing and geographic availability of agricultural commodities. Risks of gradual long-term climate shifts may be particularly acute if they affect raw materials that are only available in limited locations around the globe.

Extreme weather events, meanwhile, are becoming more frequent in some locations,¹ which could cause more frequent supply chain disruptions and potentially increase the costs of goods.

Risks presented by climate change or extreme weather may be similar to those presented by

¹ For more information, see the 3rd National Climate Assessment Extreme Weather findings. Available at: <http://nca2014.globalchange.gov/highlights/report-findings/extreme-weather>.

other threats (e.g., political or economic instability, aging transportation infrastructure, poor communications) and for which there may already be compensation built into risk management. The mechanisms that agencies already use to manage their supply chain risks will be critical to combatting any added risks from climate change.

4. Risk management Framework

4.1. How to Use This Framework

Use this framework to gain a better understanding of how climate change and weather-related impacts can disrupt supply chains, as well as how agencies can cover climate change-related risks in their supply chain risk management processes. Throughout the framework, take advantage of publications, methodologies, and tools available to your agency that can enrich your analysis.

This framework assumes that you will walk through each of the steps for one critical supply chain at a time. If it is useful to assess risk for multiple supply chains, the steps could be followed multiple times for each supply chain or it may be useful to consider different supply chains simultaneously (especially when gathering climate data that would be relevant to more than one supply chain).

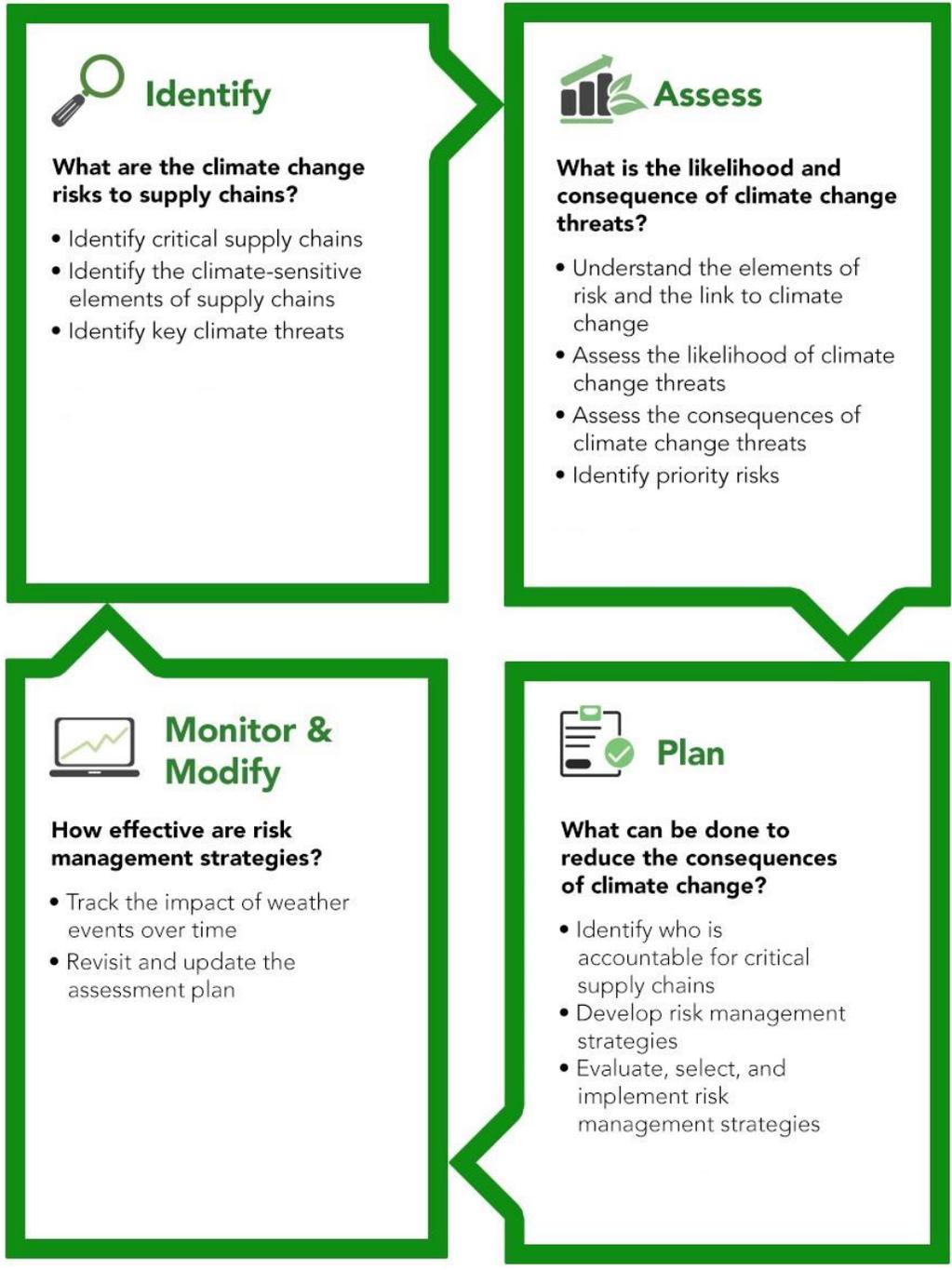
Use the *companion workbook*, a user-friendly Excel file, to document and organize information on climate change risks as you work through the framework. *The workbook assumes that you are referring to this framework as you fill in information.* Refer to examples in the companion workbook to help you understand the objective of the workbook, the types of information you should be collecting and recording, and the outputs of the *companion workbook*.

The framework (shown in Figure 1) includes four steps to manage climate change impacts on supply chains:

1. Identify: What Are the Climate Change Risks to Critical Supply Chains?
2. Assess: What is the Likelihood and Consequence of Climate Change Threats?
3. Plan: What Can Be Done to Reduce the Consequences of Climate Change?
4. Monitor and Modify: How Effective Are the Risk Management Strategies?

These steps should align closely with existing risk management protocols.

Figure 1. Supply chain climate risk management framework



4.2. Identify: What Are the Climate Change Risks to Critical Supply Chains?

In order to manage risk, a first step is to identify the risks. The primary elements of identifying climate change risks to supply chains are:

1. Identify critical supply chains
2. Identify the climate-sensitive elements of supply chains
3. Identify key climate threats

You will need to understand your agency's procurement methods, the goods and services acquired by the agency and provided either internally or externally of the agency, and as much geographic specificity about the steps in the chain as possible. The better your understanding of the supply chain, the better the risk assessment will be. Contractors and subcontractors may be able to provide additional specifics about each step in the supply chain.

4.2.1. Identify Critical Supply Chains

Some Federal agencies have already identified critical supply chains. If your agency has already identified which supply chains are critical, move on to [identifying the climate-sensitive elements of the supply chain](#).

If your agency has not identified critical supply chains, some factors to consider include:

- What are the critical services provided by your agency?
 - What supply chain(s) support these critical services?
- What historical disruptions have had the greatest impact on the agency's ability to fulfill critical services? Your agency's Office of Mission Assurance or continuity of operations planners may be good source of this information.
 - What disrupted supply chain(s) most impacted your agency's mission?
- Which goods and services are most time-sensitive for delivery?
- Which goods and services require the most significant investment

Context

Hundreds, if not thousands, of global supply chains support Federal agencies' operations on a day-to-day basis. However, not all of these supply chains are vital for agencies to fulfill their core functions. By identifying the critical supply chains, agencies can most effectively prioritize the at-risk supply chains that would result in the most significant consequences if disrupted.

Additionally, it is important to notify GSA if your agency purchases critical products and services through GSA channels. Although the core risk-management responsibilities still lie with your agency, there may be opportunities to partner with GSA to address vulnerabilities.

of time and resources by the agency, its contractors, and subcontractors to acquire?

- What are your agency's top budgetary "spend" areas?
 - Which contracts (and contractors) support these spend areas?

Only critical supply chains need to be advanced through the rest of this process.

Map Out Critical Supply Chains

Map out, through maps, flow charts, or other forms, the steps between raw materials and product or service delivery for the critical supply chain to the extent possible. Also determine where, *geographically*, each link in the supply chain resides, if possible, using online mapping applications. Supplier/contractor addresses in the Federal Procurement Data System can provide some key locations in which supply chains exist. Identify the locations on which the supply chain is reliant, such as important ports of entry, production facilities, or key transportation routes. If needed, engage contractors or external consultants to assist with this process.

Context

Information on the supply chain steps and geographic locations is helpful in characterizing the potential exposure of each link to different weather and climate variables.

Additional Information

Many supply chains have a global reach, with the production, transport, and supporting energy and IT networks spanning numerous parts of the world. This complexity can make it challenging to understand your agency's supply chain. In many instances, agencies do not have visibility beyond the first one or two layers of the supply chain due to the structure of relationships to contractors (i.e., they do not have insight into the actions of subcontractors several layers down). It can, therefore, be difficult to comprehensively identify and assess the full extent of climate change risks to the entire supply chain.

In these circumstances, consider the level of risk to supply chains that your agency is able or willing to tolerate (i.e., the minimum information regarding the sourcing, locations, and transportation within supply chain elements that your agency considers necessary to continue to operate as well as what information is *not* needed). This level of risk tolerance will help determine if more detail is needed to manage supply chain risk.

4.2.2. Identify the Climate-Sensitive Elements of the Supply Chain

Consider what elements of the supply chain are sensitive to climate by answering these broad yes/no questions:

- Does weather (e.g., temperature, rainfall or drought, snow, hurricanes, coastal flooding) directly influence any step in the supply chain (e.g., consider if any raw materials are agricultural commodities)?
 - Are the raw materials in the supply chain sensitive to changes in climate or extreme weather?
 - Are the raw materials in the supply chain in geographic locations that are highly sensitive to climate or weather?
 - Are the modes of transportation used likely to be affected by climate or extreme weather (e.g., does the supply chain depend on seasonal ice roads)?
 - Is delivery of goods or services likely to be affected by weather?
- Does the timing or availability of any materials depend on weather (e.g., temperature, rainfall, snow)?
- Is the supply chain sourcing, inputs, and transportation flexible to accommodate disruptions?
- Can materials be sourced from other locations or use different delivery modes? The less flexible it is, the more likely it is to be sensitive to climate change.

Based on the responses to these questions, determine if the critical supply chain is sensitive to weather and climate.

Context

The goal at this stage is to determine what type of climate change information to collect. There is an opportunity later in this framework to assess in more detail how sensitive the supply chain is to particular climate change threats.

Additional Information

GSA's Professional Services Schedule, 00CORP, contains Category 899 1, [Environmental Consulting Services](#). The services include climate change adaptation and resiliency planning and implementation support, including identifying climate risks and impacts, applying and interpreting climate and impact assessment model outputs, development of solutions to manage climate risks, and other related services. Throughout the process of assessing climate risks to supply chains, consider whether your agency would benefit from seeking out these services.

4.2.3. Identify Key Climate Threats

Determine which climate change threats could affect the critical supply chain and should be considered in more depth.

Examples of the kinds of climate threats that can affect supply chains are:

- Extreme heat waves
- Changes in temperature (e.g., affecting growing seasons, freeze/thaw cycles, plant hardiness zones)
- Extreme precipitation events (and resultant flooding, erosion, landslides, and/or sedimentation)
- Sea level rise
- Tropical storms and hurricanes
- Drought
- Wildfires
- Heavy winds (e.g., gust strength, duration of sustained winds, frequency of wind events)
- Humidity
- Winter weather

Identify climate threats that (1) are geographically relevant (i.e., could occur at any point along the supply chain); and (2) could affect the supply chain elements or activities. Also consider the timing of projected climate changes. Many contracts only extend a few years, so increases in the frequency and severity of extreme weather events might be more pressing than gradual changes in temperature over many years.

Information collected in this step will be informative for the following sections when identifying the likelihood and magnitude of consequences of climate change threats. It may be beneficial to bring in an external consultant to assist with identifying and processing the climate change

Context

A range of weather and climate change-related threats can affect supply chains both domestically and internationally. While historical climate information can provide a strong understanding of past exposure to climate threats, it cannot provide a confident forecast of climate impacts to future investments or long-term operations. While finding the right information for agency needs can be challenging, there are several publicly available resources that are useful for considering climate risks, listed below.

Resources

The [National Climate Assessment](#) provides information on United States regional and state-level changes in the frequency and intensity of climate change threats.

If the identified supply chain is geographically-constrained (e.g., shipping along a given route, manufacturing in a specific city), it may be useful to identify locally-specific climate data to gain a more specific understanding of the potential impacts to the supply chain. Currently, the most comprehensive “one-stop shop” for climate data is the [U.S. Climate Resilience Toolkit](#). Specifically, the Climate Explorer provides an easy way to explore geographic-based data layers, and the Tools section provides a host of additional data resources.

For international climate change projections (with regional impacts), see the Intergovernmental Panel on Climate Change’s (IPCC) [Climate Change 2014: Impacts, Adaptation, and Vulnerability](#) report.

Climate Change Scenarios

information.

Projections of future climate are usually scenario-based (as opposed to predictions based on singular assumptions) and provide a range of values that account for the uncertainties involved in climate modeling, including:

- The quantity of future greenhouse gas (GHG) emissions (which depends on the rate and nature of population and economic growth, technological change, and mitigation policies);
- Climate variability; and
- Model uncertainty.

Risk analyses are most robust when they consider a plausible range of future climate scenarios rather than a single predicted value. To learn more about climate scenarios, see the “How Do Climate Models Work” video on [EPA’s Future Climate Change webpage](#).

Timescale of Climate Change Threats

Different climate change impacts will occur over different timescales. Some climate change impacts are already occurring and will increase significantly in the short and long term, such as the increased frequency of extreme weather events (e.g., hurricanes, blizzards, heat waves). Other changes in climate (e.g., sea level rise, increases in the average temperature, and changes in precipitation trends) will be more gradual (occurring over many decades). Do not underestimate long-term changes. They could pose more permanent threats to ecosystems, economies, transportation, and other systems essential for the supply chain.

4.3. Assess: What is the Likelihood and Consequence of Climate Change Threats?

4.3.1. Understand the Elements of Risk and the Link to Climate Change

Risk is traditionally a function of two elements:

1. The **likelihood** of a threat occurring, and
2. The **consequence** of the resulting event.

Climate change may affect both elements of risk. It may increase the likelihood of disruptive weather events by increasing their frequency. For example, flooding events that once occurred approximately every 100 years may begin to occur every 50 or 20 years in some locations. Likewise, climate change may affect the consequence of weather-related disruptions to the supply chain by increasing the severity of weather events. For example, Atlantic hurricanes have already increased in intensity, frequency, and duration since the early 1980's and this trend may continue as sea surface temperatures continue to rise.²

The goal of assessing risk is to help agencies identify priority risks based on qualitative ratings of each threat's likelihood and consequence. To help with the priority risk identification, agencies can use a "risk map" similar to that in Figure 2

Figure 2. Risk prioritization matrix. Once you determine the likelihood of a threat and its potential consequences, you can map the threat onto this figure as a method of prioritizing risks (Source: adapted from [Australian Industry Group](#))

| RISK PRIORITIZATION MATRIX | | | | | | |
|----------------------------|-----------|-----------------------|--------|----------|---------|--------------|
| | | Consequence of Impact | | | | |
| | | Insignificant | Minor | Moderate | Major | Catastrophic |
| Likelihood of Occurrence | Very High | Medium | Medium | High | Extreme | Extreme |
| | High | Low | Medium | High | High | Extreme |
| | Moderate | Low | Medium | Medium | High | High |
| | Low | Low | Low | Medium | Medium | Medium |
| | Very Low | Low | Low | Low | Low | Medium |

² For more information, see the 3rd National Climate Assessment (2014). Available at: <http://nca2014.globalchange.gov/highlights/report-findings/extreme-weather>

source not found. to visually see how the intersection of likelihood and consequence indicates the level of risk and the priority for management.

Use the *companion workbook* to document the likelihood and consequence of climate threats and to map identified risks into a risk prioritization matrix.

4.3.2. Assess the Likelihood of Climate Change Threats

To assess the likelihood of climate change impacting a specific supply chain, use climate change information gathered within the “Identify Key Climate Threats” section to determine the degree to which the supply chain may be exposed to climate change threats. Core questions to answer about the likelihood of future impacts include:

- Over the past few decades, how often has this type of weather event occurred and impacted your agency’s supply chain (at *any* magnitude of impact)?
- How is the frequency of this weather event projected to change in the regions in which the supply chain operates?
- How rapidly are changes in the frequency of these climate change threats projected to occur?
- Does this represent a low, moderate, or high increase in the frequency of events as compared to today?

A helpful way to begin to determine the frequency of climate change threats is to identify historical frequency of events. Possible resources for this information include state climatology offices, the [U.S. Climate Resilience Toolkit](#), and other resources mentioned in the “Identify Key Climate Threats” section. However, this information can be difficult to sort through and there is a significant amount of climate data available. You may want to consider hiring an external consultant to help determine the future likelihood of climate events.

Once you understand the historical frequency, consult the resources listed above to understand how your identified climate change threats may change in frequency in the future. Note that changes in frequency should be relative to current frequency. For example, if high heat events today happen with high frequency and climate change projections suggest a slight decrease in frequency, your rating of the likelihood of high heat

Defining Likelihood

Within this framework, ratings of “low,” “medium,” and “high” likelihood, or ratings in between, are subject to your understanding of the weather and climate change threats as they pertain to the supply chain you are assessing. If this qualitative likelihood scale is not parallel to the terminology used for other risk assessments within your agency then you are free to use any terms appropriate to best capture likelihood.

The National Climate Assessment section on [Our Changing Climate](#) presents information on observed and future climate trends regarding temperature, precipitation, extreme weather, and other climate threats. This resource, in addition to others found in previous steps, may provide useful insight into the *frequency* of climate-related impacts and whether they are projected to increase, decrease, or stay the same.

Because this section is focused on understanding the frequency of any level of impact (from minor to extreme), thresholds for frequency may change from threat to threat. For example, a hurricane occurring in an area once per year may be considered a “medium” or “high” frequency, while one day per year with temperatures above 100°F may be considered relatively low frequency.

events may continue to be “High” or may drop to “Moderate.”

These low, medium, and high rankings of likelihood (or whichever terms you would like to use to describe likelihood) for each climate change threat will feed into the prioritization of climate change risks to the supply chain.

4.3.3. Assess the Consequences of Climate Change Threats

To determine if the consequences of climate change impacts on the supply chain would be non-existent, minor, moderate, or catastrophic, consider conducting a **self-assessment questionnaire or a workshop**. You may want to consider hiring an external consultant to help develop and administer the questionnaire and/or plan and facilitate the workshop. Information on how to develop a questionnaire or a workshop is outlined in the following sections.

Self-Assessment Questionnaire

Develop and distribute a questionnaire to agency staff and contractors (if appropriate). Some key questions to include in the self-assessment are listed below. Some of these questions may not be relevant to your agency or the supply chain in question while other questions may need to be added to obtain a complete picture of the consequences.

Supply Chain Sensitivity

- Has the supply chain previously experienced weather-related disruptions?
 - What portion(s) of the supply chain experienced the disruption?
 - For each component that has experienced disruptions:
 - What type of event caused the disruption(s)? (Extreme temperatures, heavy precipitation,

Context

The ultimate goal of collecting information on the consequences of climate change impacts on the supply chain is to determine if the consequences would be non-existent, minor, moderate, major or catastrophic. These rankings will feed into the prioritization of climate change-related risks to the supply chain.

To assess the magnitude of consequences of climate change on a supply chain, consider at a minimum the following (see the left panel for more information):

- How sensitive is the supply chain to disruptions from the identified climate threats (i.e., if a threat were to occur, how easily is the supply chain disrupted)?
- What are the potential consequences of supply chain disruptions? Consequences are likely to fall into two main categories:
 - Ability to carry out the agency’s mission
 - Financial hardships caused by the disruption

Approaches to Information Gathering

There are several possible approaches to collect information, depending on available financial and human

flooding, snow, storm surge, high winds, wildfire, or other)

- How severe and how long was the disruption?
 - Were services and goods still delivered as expected?
 - Were multiple sources of supply built in to the supply chain so that disruptions were minimized?
 - Does flexibility in sourcing exist now that did not exist then?
 - What are the redundancies in sourcing?
 - Do they exist at each link of the chain?
- Considering climate change projections and the frequency/severity of weather events in areas relevant to the supply chain, are any *new* exposures to climate change anticipated?
 - What links in the supply chain may experience new threats?
 - What types of events at each link could be expected?
 - If events occur, could the disruptions be severe?
 - Do multiple sources of supply exist?
 - What are the gaps?

Mission Consequences

- Did past disruptions affect your agency's ability to fulfill critical services?
 - Would future increases in magnitude of the event affect

resources. The options recommended in this framework and described at left include:

- **Self-assessment questionnaire** – Gather information from agency staff and contractors (if appropriate) via a questionnaire.³ Self-assessment questions can be distributed to gather information about historical and potential future weather-related vulnerabilities to the supply chain. Follow-up interviews can help to clarify responses.
- **Workshop** – assemble staff (e.g., those in emergency management, contracting, and/or procurement offices) and/or contractors to discuss the impact of past weather events and the resultant impacts. This option requires more resources and agency support, but allows for more interaction and brainstorming.

Rating Consequence Magnitude

Similar to rating the likelihood of climate change threats, ratings of the magnitude of threat consequences depends on the perception of what makes the impact “minor,” “moderate,” etc. Below are some examples of consequence ratings. These can be altered based on the context of your agency, mission, or supply chain(s). For example, in some markets (e.g., telecommunications), a disruption of only a few hours has severe consequences for operations, while other markets can operate with similar disruptions with minimal impact.

³ The Paperwork Reduction Act requires agencies to obtain Office of Management and Budget (OMB) approval if identical information requests are sent to ten (10) or more individuals.

your agency's ability to fulfill critical services?

- If an event has not occurred before, would your agency be able to continue serving its mission during an event?
 - Are there back-up providers or stockpiles of supplies elsewhere?
 - Could emergency contracts be signed to fill any supply gaps?
 - Does continuity of operations planning already sufficiently address this risk?
 - Is there flexibility in sourcing or backups built into the structure of the supply chain so that goods and services can continue to be sourced if one supply route is disrupted?
 - Would any of the back-up services cause unwanted secondary impacts, such as pollution, shortages or delays for other operations, etc.?

Financial Consequences

- What were the financial implications of past supply chain disruptions?
- What is the expected cost of delay if a supplier is unable to source goods and services in the time that your agency needs them (based on past experience or expert judgment)?
- What is the expected cost of goods and services if climate threats disrupt the availability of source or finished materials? Is the change in costs expected to be temporary or permanent?
- What are potential overtime labor costs for staff to address the supply chain disruption?

No/Insignificant Impact:

- Services/Physical assets are still available at the same quality
- Human health and safety remains at the same quality

Minor Impact:

- Services/Physical assets are still available at the same quality but at higher cost
- Human health and safety may be compromised
- Services disrupted at temporal scale of hours
- Facilities still usable, but damaged

Moderate Impact:

- Services/Physical assets are available at varying levels of quality but at a temporarily higher cost
- Services disrupted at temporal scale of days
- Facilities partly usable or completely unusable for up to a few days
- Human health and safety may be compromised

Major Impact:

- Services disrupted at temporal scale of weeks, months, or years, with long-term increase in service costs
- Facilities out of use for weeks, months, or years
- Human health and safety may be compromised

Catastrophic Impact:

- Services disrupted at temporal scale of weeks, months, or years
- Permanent or long-term increase in service costs

Overall

- Based on answers to the questions above, what is the overall potential consequence of the climate threat to the supply chain (“None,” “Minor,” “Moderate,” “Major,” or “Catastrophic”)? Assign a rating for each supply chain and threat (e.g., extreme heat threat to prefab buildings supply chain, flooding threat to prefab building supply chain).

Workshop Scenario Planning

In addition to presenting questions for discussion, workshop facilitators may find a scenario planning exercise (or two) to be a valuable component for information gathering. Ideally, the workshop will include participants from multiple departments, coming at the exercises from different angles (e.g., logistics, emergency management, procurement/contracting, budget). Possible scenarios to explore in this setting could be:

- Using a known weather vulnerability (one that has previously occurred), present a scenario in which a particular link in the supply chain is disrupted.
 - Identify the disruptions and the impacts throughout the remainder of the supply chain.
 - How can disruptions be minimized?
 - What is the flexibility in sourcing?
 - What areas could be more flexible while remaining efficient?
 - What are the vulnerabilities that you currently cannot adequately address?
- Using projected climate vulnerability (e.g., using information gathered from the national or international climate reports), present a scenario in which a particular link in the supply chain is

- Facilities out of use for weeks, months, or years
- Human health and safety may be seriously compromised

disrupted.

- Identify the cascading disruptions and the impacts throughout the remainder of the supply chain.
- How can disruptions be minimized?
 - What is the flexibility in sourcing?
 - What areas could be more flexible while remaining efficient?
- Would the agency be able to continue serving its mission during an event?
 - What contract modifications or offerings are needed to support the mission effectively?

By utilizing one of the above approaches, or any other that best fits your needs and capabilities, you should at this point have qualitative ratings of the likelihood and magnitude of consequence of each climate change threat. Combining these pieces of information in the next step will inform each threat's level of risk and relative priority.

4.3.4. Bring it all Together: Use Likelihood and Consequence to Identify Priority Risks

Once you have qualitative ratings for the likelihood and consequence of each threat, identify those with high risk that should be a priority for mitigation by plotting them on a simple risk map like the one shown previously (and repeated below in Figure 3). The *companion workbook* automatically plots threats based on user-entered ratings of likelihood and consequence.

Context

Using risk maps is useful for visualizing priority risks and generating discussions about prioritizing risks. The map, along with supporting information gathered for climate threat likelihood and consequence, can be shared with stakeholders to verify results and identify risk management strategies.

Figure 3. Risk prioritization matrix. Once agencies determine the likelihood of a threat and its potential consequences, they can map the threat onto this figure as a method of prioritizing risks. (Source: adapted from [Australian Industry Group](#))

| RISK PRIORITIZATION MATRIX | | | | | | |
|----------------------------|-----------|-----------------------|--------|----------|---------|--------------|
| | | Consequence of Impact | | | | |
| | | Insignificant | Minor | Moderate | Major | Catastrophic |
| Likelihood of Occurrence | Very High | Medium | Medium | High | Extreme | Extreme |
| | High | Low | Medium | High | High | Extreme |
| | Moderate | Low | Medium | Medium | High | High |
| | Low | Low | Low | Medium | Medium | Medium |
| | Very Low | Low | Low | Low | Low | Medium |

While the risk map is informative, it is not an exact science, does not capture all the elements of risk, and should not be the only approach to identify priority risks. Agency staff who have experience with past extreme weather events may be the best suited to “gut check” the results and elevate risks that they advise should be advanced to the planning step. Risks that are moderate to high likelihood and moderate to high consequence should be reviewed in more detail and agencies should consider how to manage these risks.

4.4. Plan: What Can Be Done to Reduce the Consequences of Climate Change?

Determine what can be done to reduce the risk of climate change by working through three sub-steps:

1. Identify who is accountable for the supply chain
2. Develop climate change risk management strategies
3. Evaluate the risk management strategies to select which strategies to implement

The intended outcome of this process is a prioritized list of feasible and effective risk management strategies. To facilitate implementation of the strategies, assign responsibility to the appropriate person, department, or agency, and set a timeline for implementation.

4.4.1. Identify Who is Accountable for the Supply Chain

Before developing risk management strategies, consider who is responsible for the supply chain in question. It may be:

- A single department or several departments internal to your agency (e.g., acquisitions, supply chain management, emergency services, and mission assurance).
- External agencies, who may play a role if the good/service is procured through a government-wide contract vehicle (e.g., GSA Multiple Award Schedules, NASA SEWP).
- Contractors who are handling the sourcing, production, and delivery logistics of the supply chain.

At this point in the process, it is beneficial to be more rather than less inclusive of additional groups.

Once the responsible group(s) are identified, collaborate with them to develop risk management strategies. Everyone brings their unique perspectives and levers for action to the conversation, so participation across groups and agencies is likely to facilitate a more robust set of risk management strategies. For example, while GSA may be able to offer

Context

Identifying all parties who are accountable for or use the supply chain will prepare you to consider the risk management strategies that each of these groups could potentially take on. This will allow you to develop a more robust set of strategies in the next step.

multiple sources of supply, it is up to the ordering agency to develop contingency plans if anything were to go wrong and to decide their individual tolerance for potential disruptions.

4.4.2. Develop Climate Change Risk Management Strategies

Develop the risk management strategies to directly address the known risks—either those already experienced or those identified through the risk assessment process. By mapping the strategies to the risks, you get a direct link from problem to solution.

Strategies should be specific and action-oriented, with a clear assignment of responsibility (e.g., to a specific group or a specific person) and a timeframe for implementation. Types of strategies for Federal agencies include:

- **Risk mitigation** – Many Federal agencies have advanced emergency management divisions that could integrate the identified climate change risks into their work. For example, Continuity of Operation Plans (COOPs) and other contingency planning documents/practices can prepare an agency to respond to future supply chain disruptions. Additionally, building in multiple sources of supply (e.g., through multiple award contracts) can help to mitigate the risk from a single vendor failing to deliver goods or services during a weather/climate event.
- **Risk transference** – As Federal agencies increase their reliance on contractors, some are also pushing risk management responsibilities onto their contractors by building in provisions requiring delivery without lapse even with factors previously considered outside of the contractor's control (e.g., an 'Act of God'). Consider if current contracting terms offer an acceptable level of protection against risks or guarantee delivery regardless of weather events. For example, contract penalties for failing to meet contract requirements can shift

Context

There is a wide range of risk management strategies available to Federal agencies. In this step, you will brainstorm a full suite of strategies that may help reduce the risk of climate change to the supply chain. Thinking broadly during this process will help to ensure that no opportunity is left unexplored. Note that many strategies to address climate change impacts may be very similar to strategies your agency already employs to address other risks it faces. Consider whether there are current risk management strategies that can be adjusted to handle climate threats.

some risk back to the contractor. Depending on the perceived risk, it may or may not be warranted to specifically call out climate change risks in the contract and to require the contractor to have a risk management plan. Implementing these strategies may increase the contract costs.

- **Risk avoidance** – Would an alternate, less risk-prone supply chain (e.g., flexibility in contractors, order fulfillment, capacity, visibility, dispersion) be able to meet your needs? Alternatively, contractors could be evaluated during the contract evaluation process on whether or not they consider climate change risks. A simple, binary answer could help inform the selection of the most all-around qualified contractor. Alternatively, you may be able to find relevant information for contractors who report to [CDP](#) or the [Global Reporting Initiative](#) (GRI) or you may be able to require contractors to report to CDP or GRI.
- **Risk acceptance** – At times, it may be too costly to avoid or mitigate risks. In these situations, consider whether risk acceptance is a potential strategy. In this situation, the agency acknowledges the risk and decides to accept its consequences if it occurs.
- **Adaptive management** – Track threats, impacts, costs, and effectiveness of adaptations and post-disaster response to inform the aforementioned categories of adaptation. This type of disciplined tracking of climate or weather impacts serves as an interim adaptation strategy to help both determine whether and what adaptation actions are necessary as well as develop a quantitative basis for investments and/or reimbursements.

To develop strategies, review examples and best practices from other agencies and engage a diverse range of staff within the organization. Staff with longer tenures frequently know the issues that arise during extreme

weather events and can identify solutions to the problems.

4.4.3. Evaluate, Select, and Implement Risk Management Strategies

Develop a priority list of risk management strategies through a systematic evaluation process. If your agency has established evaluation criteria for projects through other processes then a variation on those criteria may be an effective tool. If no such criteria exist, the following criteria may provide a useful starting point:

- **Technical and Political Feasibility** – How practical is it for a particular strategy to be implemented, accounting for technical, policy, legal, and insurance considerations?
- **Cost and Benefits** – What are the costs associated with upfront implementation and ongoing operations and maintenance? If implemented, what is the value of the damages from climate change that would be avoided? In order to increase efficiency, the Federal government strives to spend efficiently while ensuring that investments are made to reduce their exposure to major impacts. Agencies do not want to spend too much to prepare for events but also do not want to have to pay more to continue doing business during extreme events.
- **Efficacy** – If implemented, to what extent would the strategy reduce the risk?
- **Flexibility** – If implemented, how easy would it be to revise the strategy at a later date? What is the adaptive management potential of the strategy?
- **Sustainability** – If implemented, what would be the environmental benefits of the strategy? Does the strategy advance the "triple bottom line" of sustainability (i.e., what are the impacts to the economy, society, and particularly the environment)?

Context

Federal agencies are unlikely to be able to fund or implement their entire "wish-list" of risk management strategies. In order to narrow the menu of strategies to a prioritized list, you can use a systematic evaluation process.

The number of evaluation measures should be limited to allow for the output to be digestible and meaningful.

Other Considerations when Selecting Risk Management Strategies

While evaluation metrics are a useful tool for informing the decision-making process, they should not be the sole basis of decisions. The input of the staff who work on these programs on a daily basis and of the decision makers who understand the needs of agencies and the communities with which they work are also important factors to consider when selecting strategies.

In addition, consider phased implementation of the risk management strategies. Prioritize strategies with co-benefits for near-term implementation. These win-win strategies increase resiliency to climate change and help to achieve other program objectives. It can also be easier to secure funding since they accomplish multiple goals. The near-term strategies can then lay the groundwork for more ambitious or comprehensive strategies that become necessary as the rate and impacts of climate change increase. Phased

- **Implementation Timeframe** – How soon does this strategy need to be implemented in order to be effective?

Depending on your needs, the evaluation can be qualitative or quantitative in nature. A qualitative evaluation process is generally sufficient for selecting priorities while a quantified evaluation may be necessary in order to justify funding. A qualitative evaluation may use a simple three point or five point scale (e.g., low, medium, high or positive, neutral, negative) or rely on a narrative description of the pros and cons of the strategies.

Using the evaluation findings and other considerations (see side bar), select the most promising and feasible strategies to implement. The final strategies selected should be specific and action-oriented, with a clear assignment of responsibility (e.g., to a specific group or a specific person) and a timeframe for implementation. This information can be recorded in the *companion workbook*.

implementation is a fiscally responsible way to break down climate change risk management into steps, implementing those that are the most needed first and building upon them as the frequency and severity of climate change impacts increase in the future.

4.5. Monitor and Modify: How Effective Are the Risk Management Strategies?

The Monitor and Modify step provides a “living” route to determine whether the selected risk assessment strategies are effective and to revisit the process if the approach is not helping to achieve risk management goals. This step includes the following sub-steps:

1. Track the impact of weather events over time
2. Revisit and update the assessment

This step is an iterative process repeated over the long term at an interval dictated by the needs of your agency, supply chain, or other factors.

4.5.1. Track the Impact of Weather Events over Time

Track impacts as incidents occur, and analyze for trends over time. Identify specific metrics, upfront, to help assess the effectiveness of risk management practices. Example metrics include:

- Delay in delivery of goods or services, in days
- Number of delays that are greater than *X* days (set your own threshold)
- Unplanned additional labor resulting from delay or disruption, in hours
- Cost of delay or disruption, in dollars. Sources of costs may include:
 - Increased insurance premiums
 - Labor (e.g., overtime, additional staff)
 - Replacement of damaged or destroyed goods
 - Replacement of damaged or destroyed infrastructure
 - Emergency contracts
- Cause of delay by type of weather event
- Number of delays by weather event type

This exercise should be streamlined into existing processes wherever possible. For example, risk management evaluations could be made prior to

Context

Tracking the frequency, severity, costs, and other consequences of supply chain disruptions from weather over time can help you understand shifting vulnerabilities and measure whether extreme weather is placing an increasing burden on operations. It can also help you understand if the risk management strategies are effectively managing the climate change-related risks.

the beginning of a new contract schedule.

4.5.2. Revisit and Update the Assessment and Plan

Risk management is a “living” process (see sidebar). After analyzing the data collected during monitoring, revisit the initial *Identify* step and, if new or unresolved risks are identified, *Assess* and *Plan* accordingly.

As risk management practices are implemented and as climate changes over the coming decades, use the tracking information to periodically reassess:

- The effectiveness of risk management strategies, and
- Newly available climate projections.

Where possible, analyze whether adopted strategies have reduced the time, cost, or other factors associated with obtaining goods and services during extreme weather events. If strategies are not effective, revisit them.

In addition, revisit climate change projections to ensure the latest science still supports your assessment of risk. Uncertainty regarding future climate projections increases as the time period assessed is farther in the future (see Figure 4). Agencies should review the latest climate science (e.g., the National Climate Assessment, released every four years) and consider how changes in the science may impact the relevance of risk management strategies.

Context

Risk management as a “living” process means iteratively updating strategies as time reveals their effectiveness. After you have evaluated strategy effectiveness, revisit the previous steps of the strategy (identify, assess, and plan) to consider whether strategies need to be altered to sufficiently address climate risks.

Figure 4. Near-term climate projections have a tighter range of projections, while distant climate projections have a wider range of projections.

