Guidance for Containers and Container Orchestration Tools

Joel Weisz, Standards Manager Emerging Standards
PCI Security Standards Council

Randy Bartels, VP, Security Services
KirpatrickPrice

PCI Security Standards Council®

Special Interest in Containers Orchestration Tools

Agenda

Overview of History and SIG Process

2021 SIG Paper

2023 SIG Process

History

- Community driven
- Over a dozen guidance documents produced since 2010
- Documentation is used by the entire payment card industry

History

- Community driven
- Over a dozen guidance documents produced since 2010
- Documentation is used by the entire payment card industry

History

- Community driven
- Over a dozen guidance documents produced since 2010
- Documentation is used by the entire payment card industry

SIG Process

SIG Proposal
from Community

Selection of
Proposals for Vote

PCI Security Standards Council®

SIG Process

SIG Proposal from Community

Selection of Proposals for Vote

Objectives Created from Proposal

Content Developed through Iterative Process

PCI Security Standards Council®

Role Of SIG Participants

SIG Members

Provide subject matter expertise and user experiences develop content

Payment Brands' Technical Working Group & Management Committee

Review and final approval

PCI SSC Chair

Facilitates discussions, preparation of deliverables, and approvals

Role Of SIG Participants

SIG Members

Provide subject matter expertise and user experiences develop content

Payment Brands' Technical Working Group & Management Committee

Review and final approval

PCI SSC Chair

Facilitates discussions, preparation of deliverables, and approvals

Role Of SIG Participants

SIG Members

Provide subject matter expertise and user experiences develop content

Payment Brands' Technical Working Group & Management Committee

Review and final approval

PCI SSC Chair

Facilitates discussions, preparation of deliverables, and approvals

Role Of SIG Participants

SIG Members

Provide subject matter expertise and user experiences develop content

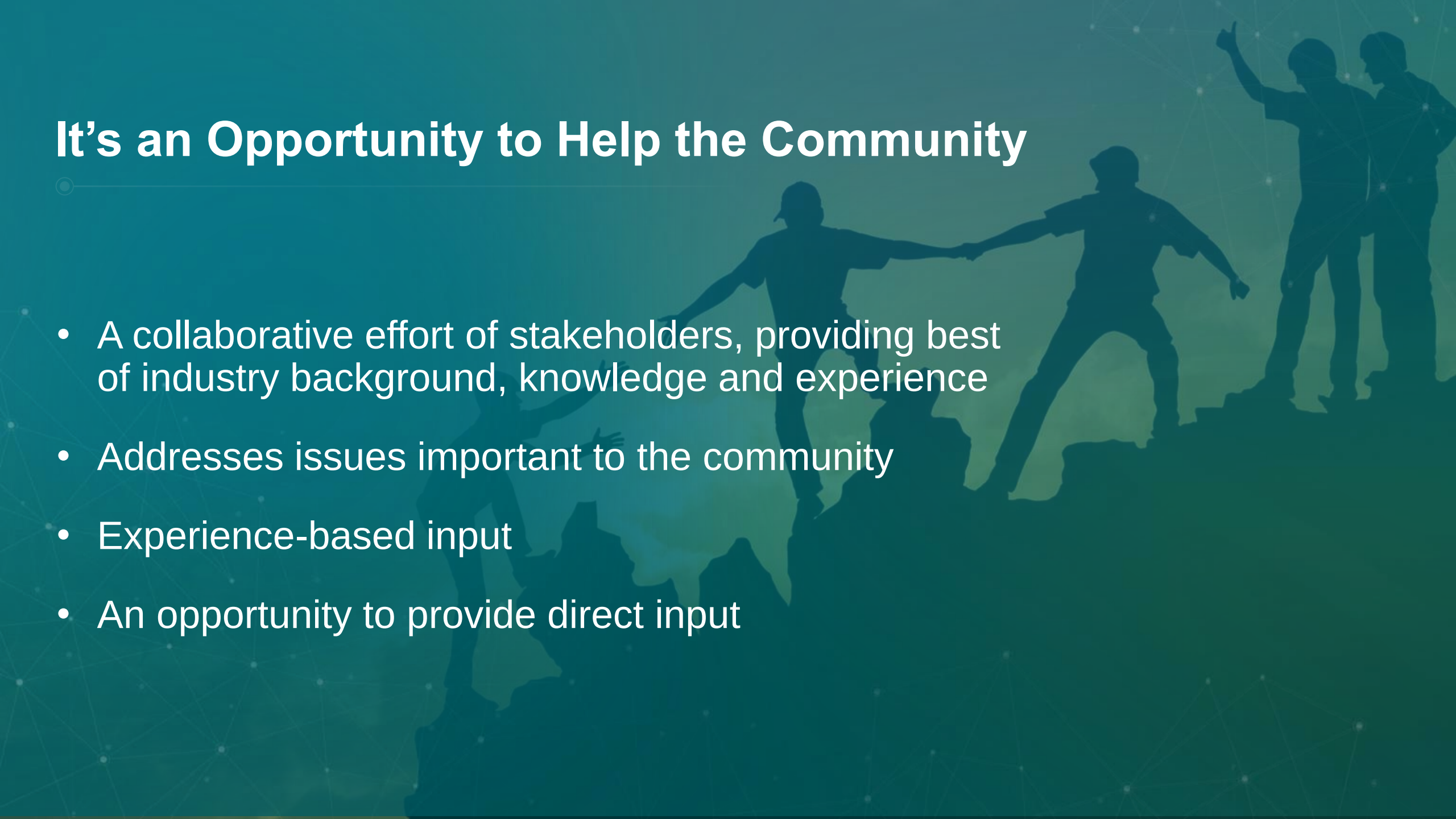
Payment Brands' Technical Working Group & Management Committee

Review and final approval

PCI SSC Chair

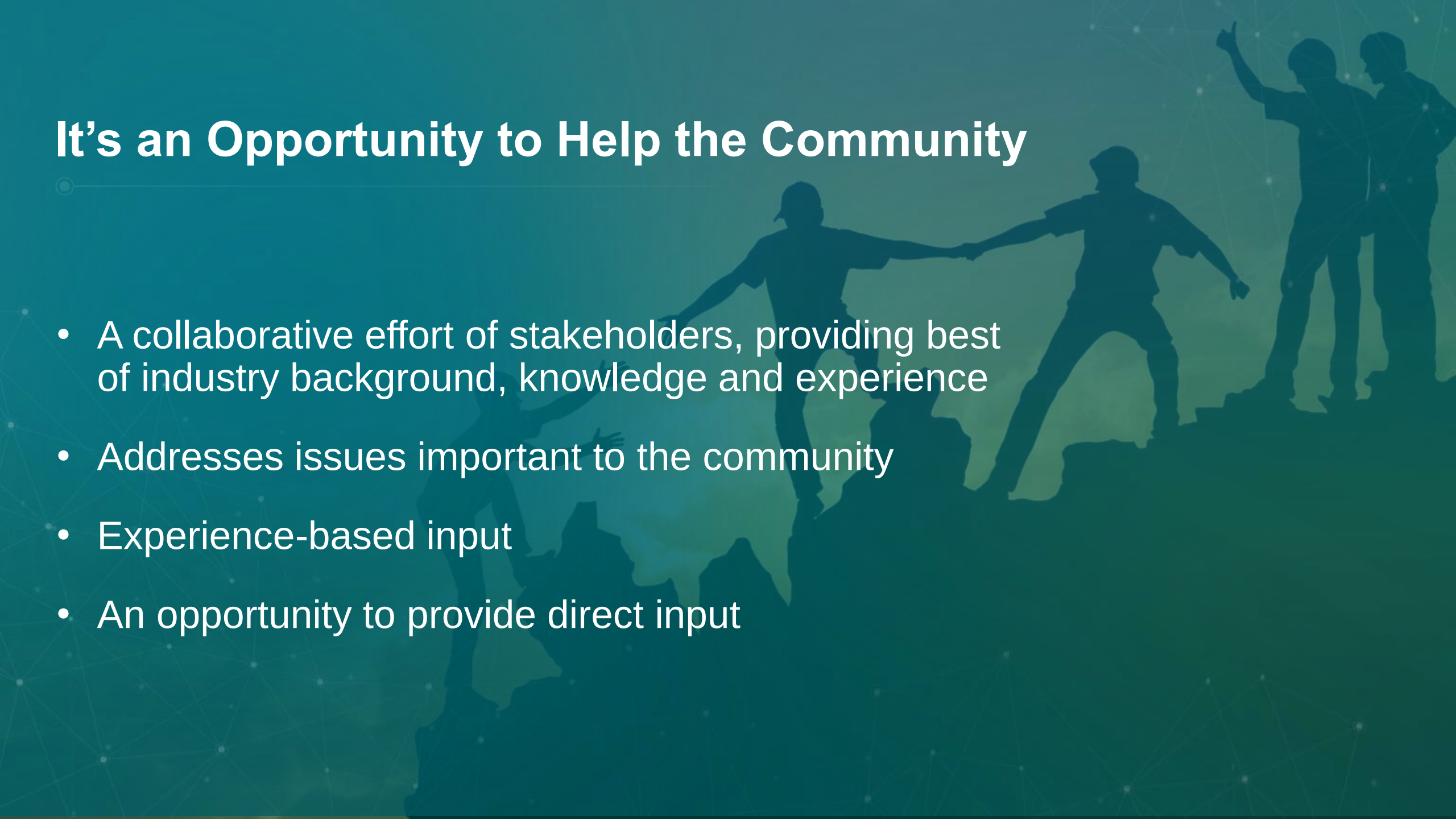
Facilitates discussions, preparation of deliverables, and approvals

It’s an Opportunity to Help the Community



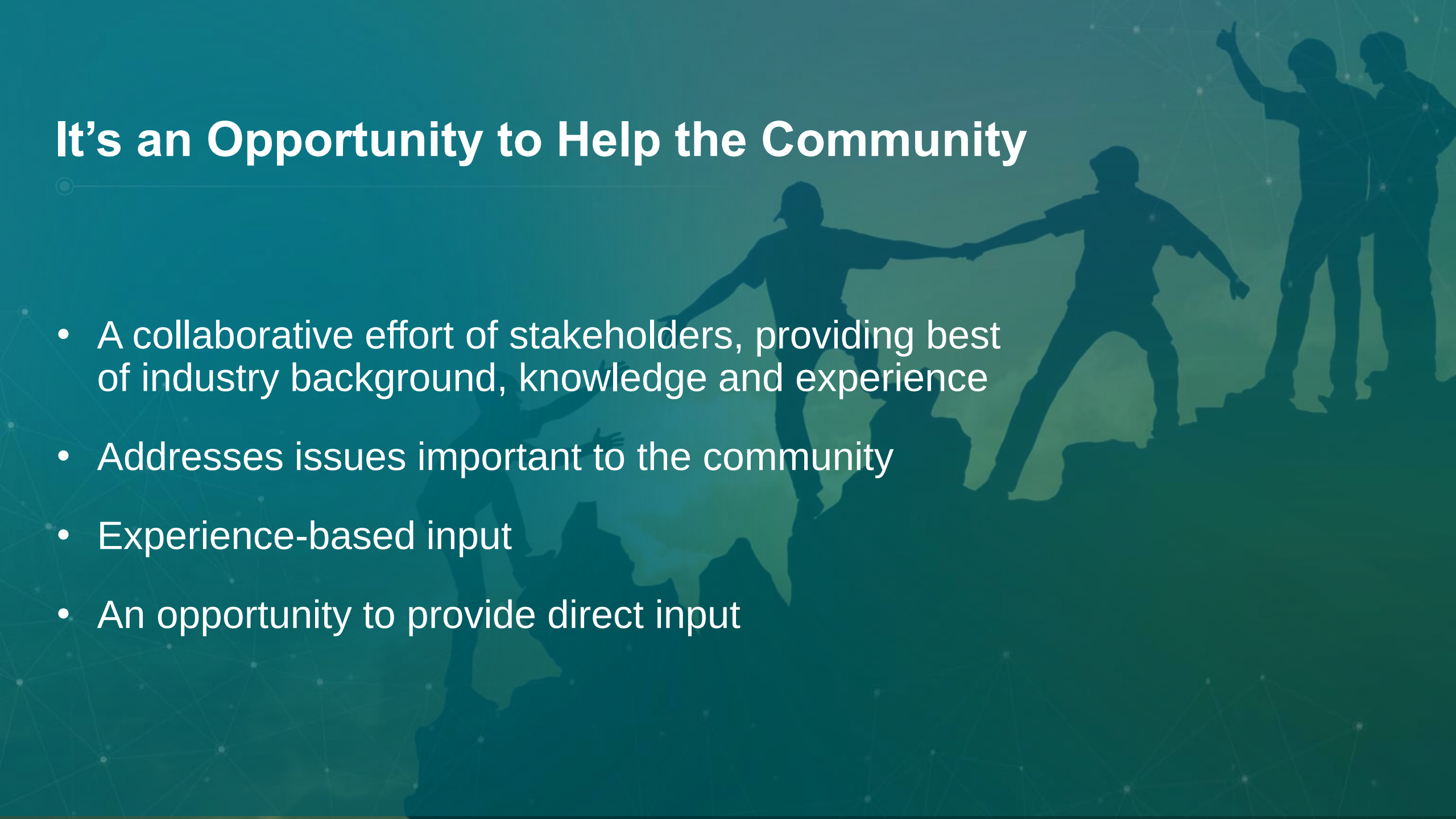
- A collaborative effort of stakeholders, providing best of industry background, knowledge and experience
- Addresses issues important to the community
- Experience-based input
- An opportunity to provide direct input

It’s an Opportunity to Help the Community



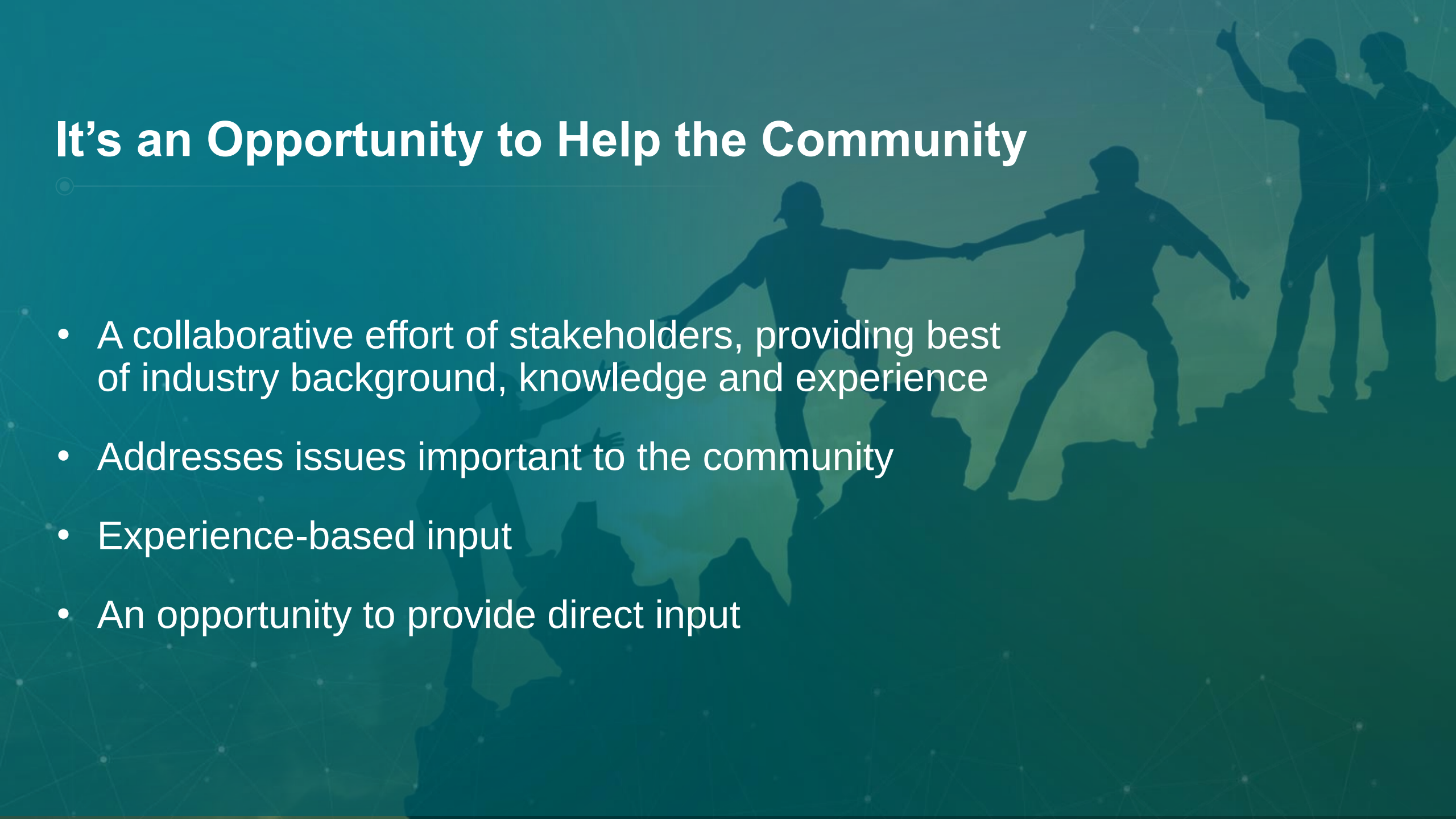
- A collaborative effort of stakeholders, providing best of industry background, knowledge and experience
- Addresses issues important to the community
- Experience-based input
- An opportunity to provide direct input

It’s an Opportunity to Help the Community



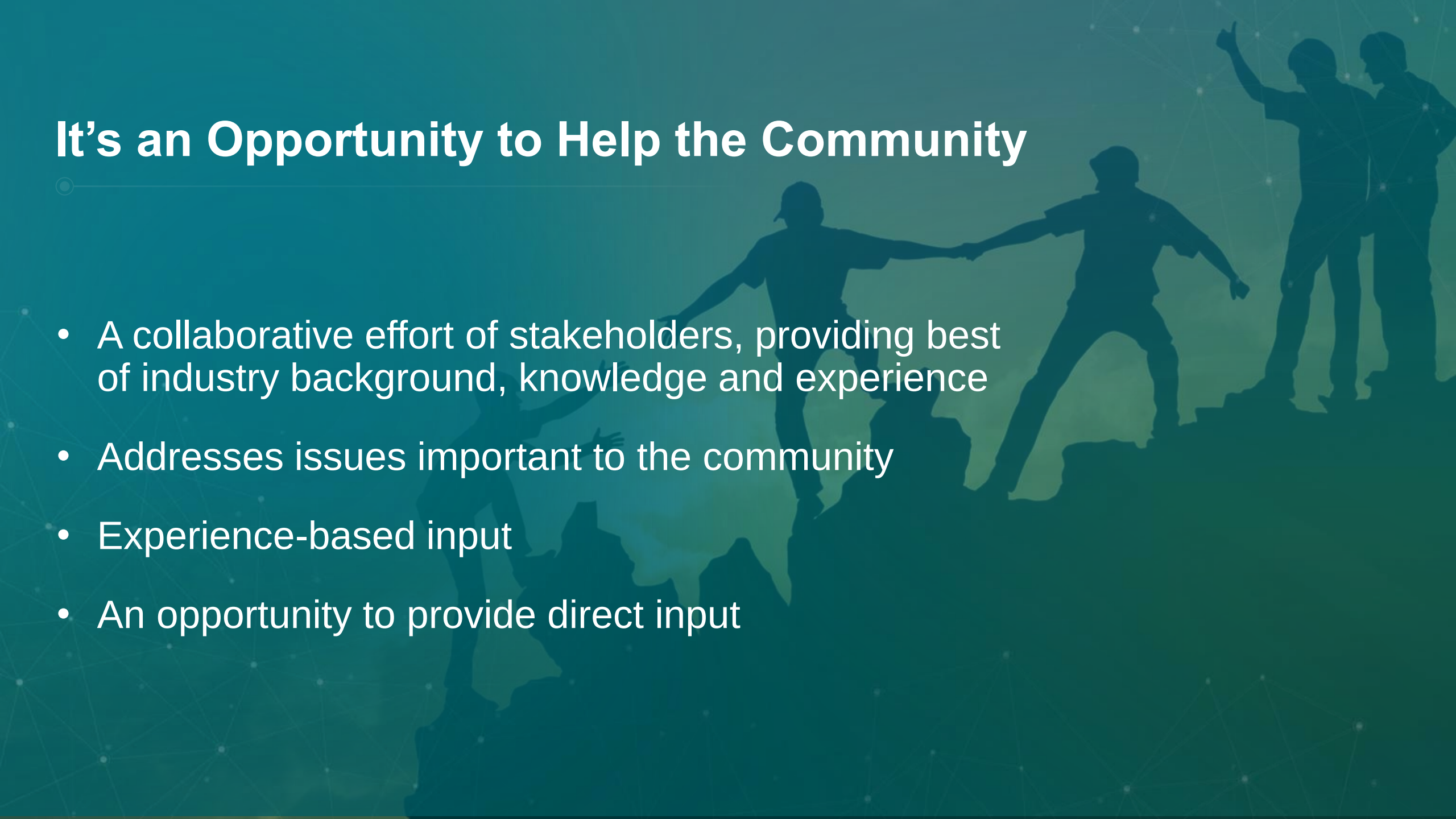
- A collaborative effort of stakeholders, providing best of industry background, knowledge and experience
- Addresses issues important to the community
- Experience-based input
- An opportunity to provide direct input

It’s an Opportunity to Help the Community



- A collaborative effort of stakeholders, providing best of industry background, knowledge and experience
- Addresses issues important to the community
- Experience-based input
- An opportunity to provide direct input

It’s an Opportunity to Help the Community



- A collaborative effort of stakeholders, providing best of industry background, knowledge and experience
- Addresses issues important to the community
- Experience-based input
- An opportunity to provide direct input

Guidance for Containers and Container Orchestration Tools

Process and Results

PCI Security Standards Council®

Containers

A little background

- Dependency
- Elasticity

Containers

A little background

- Dependency
- Elasticity

Containers

A little background

- Dependency
- Elasticity

Container Orchestration Tools

A little more background

- Orchestration is used for containers at scale

- Complexity creates risk

Container Orchestration Tools

A little more background

- Orchestration is used for containers at scale

- Complexity creates risk

Container Orchestration Tools

A little more background

- Orchestration is used for containers at scale

- Complexity creates risk

Guidance Purpose

Why do we need this document?

- Stakeholder questions:
  - What are containers?
  - What are container orchestration tools?
  - What are the best practices for secure implementation of these technologies?

Guidance Purpose

Why do we need this document?

- Stakeholder questions:
  - What are containers?
  - What are container orchestration tools?
  - What are the best practices for secure implementation of these technologies?

The Result

What did we do?

- Foundational
  - Combination of background information and best practices
- Industry specific guidance
  - Consideration of payment environments
- Applicable
  - Based on industry specific use cases

The Result

What did we do?

- Foundational
  - Combination of background information and best practices
- Industry specific guidance
  - Consideration of payment environments
- Applicable
  - Based on industry specific use cases

The Result

What did we do?

- Foundational
  - Combination of background information and best practices
- Industry specific guidance
  - Consideration of payment environments
- Applicable
  - Based on industry specific use cases

Foundational Background Information

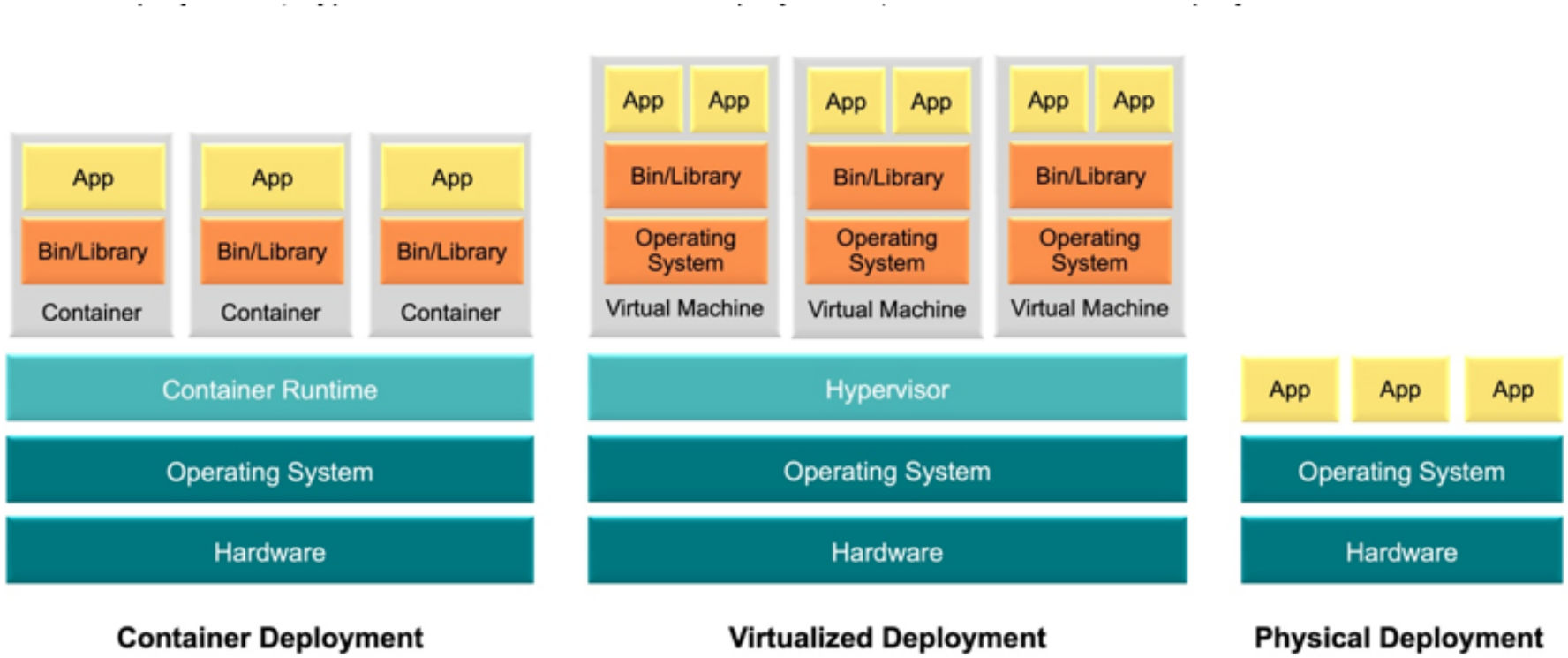


Figure 1: Architectural Differences between Traditional, Virtualized, and Containerized Deployment

PCI Security Standards Council

Threats, Best Practices, and Use Cases

Threat	Best Practice	Applicable to Use Case			
		Baseline Case	Development and Management of Containerized Applications	Containerized Services that Transmit or Process Account Data	Containerization in a Mixed Scope Environment
10.2 Vulnerabilities present on container orchestration tool hosts (commonly Linux VMs) will allow for compromise of container orchestration tools and other components.	**a.** Host operating system of all the nodes that are part of a cluster controlled by a container orchestration tool should be patched and kept up to date. With the ability to reschedule workloads dynamically, each node can be patched one at a time, without a maintenance window.	x			
10.3 As container orchestration tools commonly run as containers in the clusters, any container with vulnerabilities may allow compromise of container orchestration tools.	**a.** All container images used for applications running in the cluster should be regularly scanned for vulnerabilities, patches should be regularly applied, and the patched images redeployed to the cluster.	x	x		
11. Resource Management					
11.1 A compromised container could disrupt the operation of applications due to excessive use of shared resources.	**a.** All workloads running via a container orchestration system should have defined resource limits to reduce the risk of "noisy neighbors" causing availability issues with workloads in the same cluster.				x
12. Container Image Building					
12.1 Container base images downloaded from untrusted sources, or which contain unnecessary packages, increase the risk of supply chain attacks.	**a.** Application container images should be built from trusted, up-to-date minimal base images.		x		

PCI Security Standards Council

Threats, Best Practices, and Use Cases

Threat	Best Practice	Applicable to Use Case			
		Baseline Case	Development and Management of Containerized Applications	Containerized Services that Transmit or Process Account Data	Containerization in a Mixed Scope Environment
10.2 Vulnerabilities present on container orchestration tool hosts (commonly Linux VMs) will allow for compromise of container orchestration tools and other components.	**a.** Host operating system of all the nodes that are part of a cluster controlled by a container orchestration tool should be patched and kept up to date. With the ability to reschedule workloads dynamically, each node can be patched one at a time, without a maintenance window.	x			
10.3 As container orchestration tools commonly run as containers in the clusters, any container with vulnerabilities may allow compromise of container orchestration tools.	**a.** All container images used for applications running in the cluster should be regularly scanned for vulnerabilities, patches should be regularly applied, and the patched images redeployed to the cluster.	x	x		
11. Resource Management					
11.1 A compromised container could disrupt the operation of applications due to excessive use of shared resources.	**a.** All workloads running via a container orchestration system should have defined resource limits to reduce the risk of "noisy neighbors" causing availability issues with workloads in the same cluster.				x
12. Container Image Building					
12.1 Container base images downloaded from untrusted sources, or which contain unnecessary packages, increase the risk of supply chain attacks.	**a.** Application container images should be built from trusted, up-to-date minimal base images.		x		

PCI Security Standards Council

Example Use Cases

3.2.2 Development and Management of Containerized Applications

3.2.2.1 Description

Creating and managing a container-based workflow for application development and deployment involves several steps, including the initial creation of the container images to be used by the application, the flow of the images as artifacts through the companies CI/CD pipeline, secure storage of the images in a container registry, and their ongoing management and updating.

Phases of the deployment process include:

- Initial development targets application deployment using a container based on a common base image. The container image is used by Continuous Integration processes in the SDLC.
- The container image is placed into a container registry during testing and deployment.
- The container image is deployed into a production environment to be managed by a container orchestration system.

3.2.2.2 Graphic Representation of the Use Case

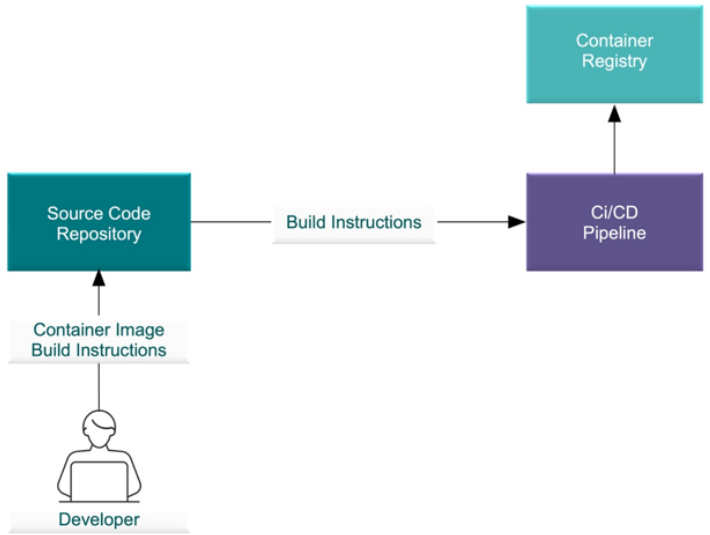


Figure 6: Container Build Process

PCI Security Standards Council

Example Threat Scenarios

3.2.2.3 Example Threat Scenario

When building container images, a common requirement is to use secrets—for example, credentials or API keys—to access private data stores to retrieve information. If those secrets are embedded in the resulting container images, attackers can extract the secrets and gain unauthorized access to resources including source code repositories, CI/CD systems, or even container orchestration APIs.

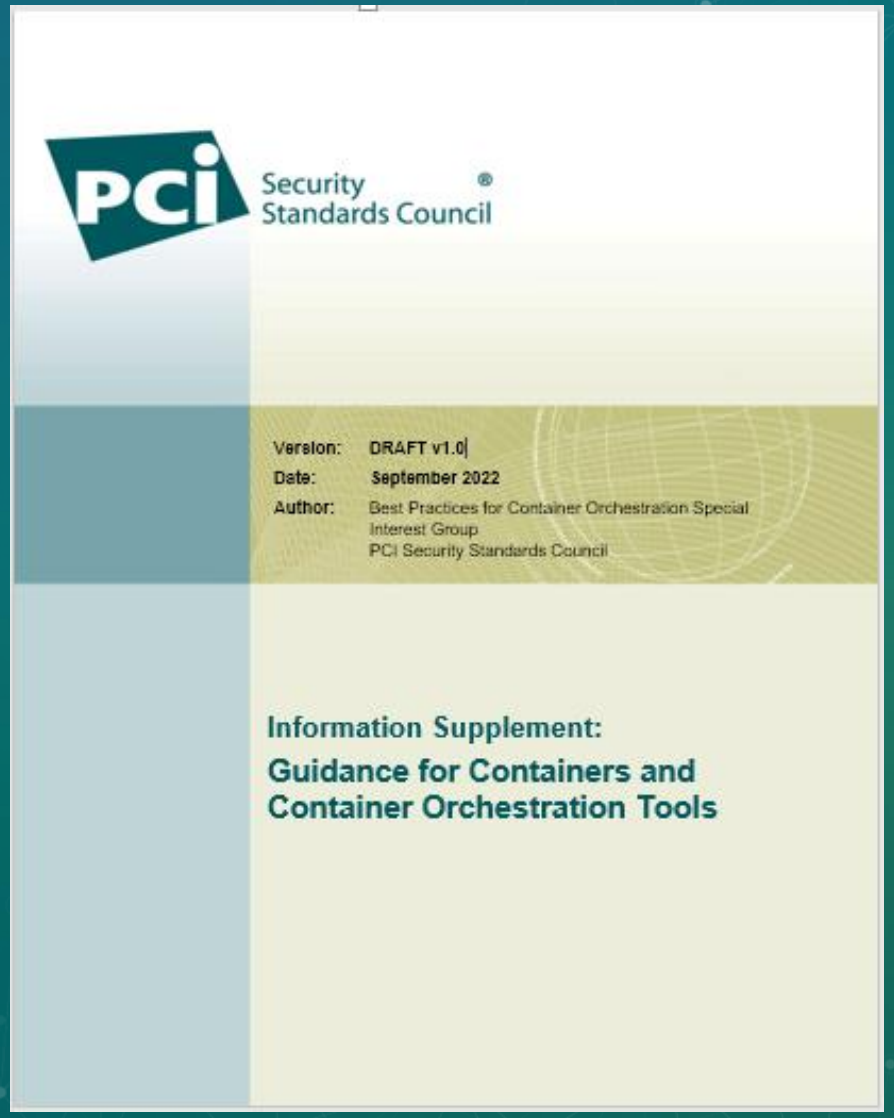
Example implementation of selected best practices:

Best Practice	Result of Best Practice to Address the Security Threat
6.1.a All secrets needed for the operation of applications hosted on the orchestration platform should be held in encrypted dedicated secrets management systems.	Where secrets are required for running containers, a dedicated secrets management system is employed to ensure that secrets are securely encrypted and made available to only the containers which require them. These systems can determine which containers require access to a specific secret and then inject those secrets into the running container as a mounted file.
12.4.a Secrets should not be included in application images. Where secrets are required during the building of an image (for example to provide credentials for accessing source code), this process should leverage container builder techniques to ensure that the secret will not be present in the final image.	If an attacker can access source code repositories, CI/CD systems, or the container API, proper management of secrets—for example, not being included in application images, including binary files—prevents these secrets from being used to access additional resources. Ensuring that secrets are not embedded in images can be achieved by using techniques such as multi-stage builds. Here separation between source code compilation and the final container image is achieved by having multiple build processes, and only copying compiled application programs and necessary configuration files to the final stage.

PCI Security Standards Council

Summary of Guidance

- Useful to our diverse stakeholders
- Background on containers and container orchestration tools
- Best practices to address threats
- Real world use cases and scenarios



2023 SIG Process

SIG Proposal from Community

September 1 2022

Review and Consolidation

October 28 2022

Selection of Proposals for Vote

January 30 2023

SIG 2023

February 2023

PCI Security Standards Council

Member Driven Effort!

PCI Security Standards Council®