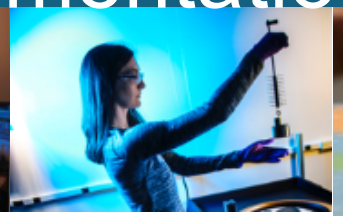
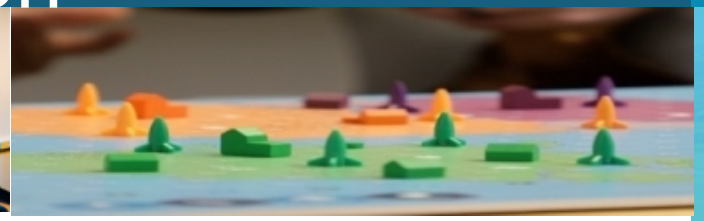
SAND2023-04632C

PEGASIS
PROGRAM for EXPERIMENTAL GAMING & ANALYSIS of STRATEGIC INTERACTION SCENARIOS

Sandia National Laboratories

CASTLE – A Framework for Building Online Strategic Wargames for Conflict Analysis and Experimentation





PRESENTED BY

Jon Whetzel

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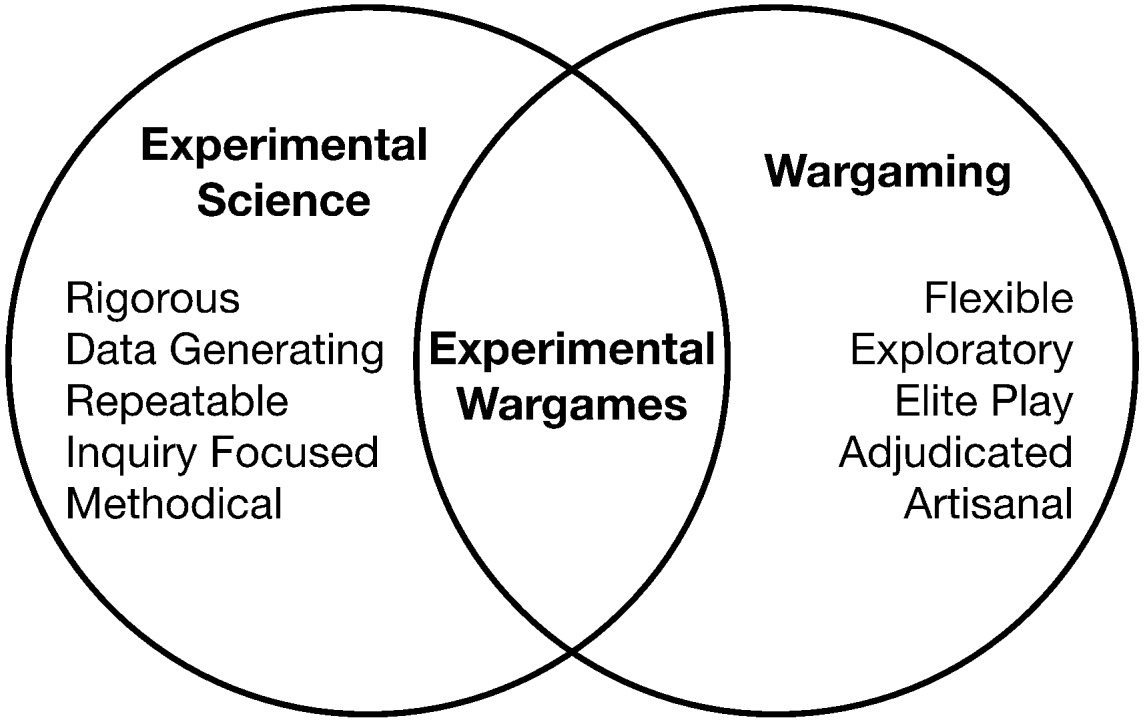
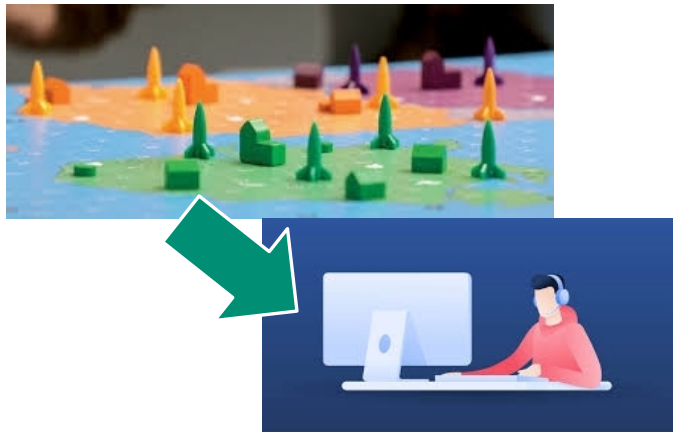
Experimental Wargaming: Bridging of Art & Science

Experimental Wargames are games designed to quantitatively study national security scenarios of interest where the situation, potential responses, and abstraction driven by research question(s) of interest



Wargaming Can Benefit In Building Online Games

- Creating online wargames provide several upsides:
  - Participants can engage with these wargames anytime/anywhere
  - Ability to open wargames to a wider audience
  - Leverage ability to actively and passively record data for analysis
  - Enables to scale-up number of playthroughs and participants



- Advancements in past 10 years make more feasible than ever
  - Industry-grade video game development tools now available to public
  - More colleges and universities now offering game development curricula
  - Compute cloud resources to host games online for minimal cost
    - Both in open (public) and classified (government) spheres

CASTLE – An experimental wargaming toolkit

- Sandia created software available for licensing to commercial & government entities
- Unity Asset Package to rapidly develop wargames
  - Exclusive to strategic board/card game varieties
- Built to support multiplayer games using Nakama by Heroic Labs
- Through Unity, games can be published to multiple platforms (e.g., desktop, mobile, web)
  - We have focused exclusively on web
- Designed to support data logging to networked NoSQL databases via REST
  - Passive logging of all game-level events
  - Active logging through survey generation

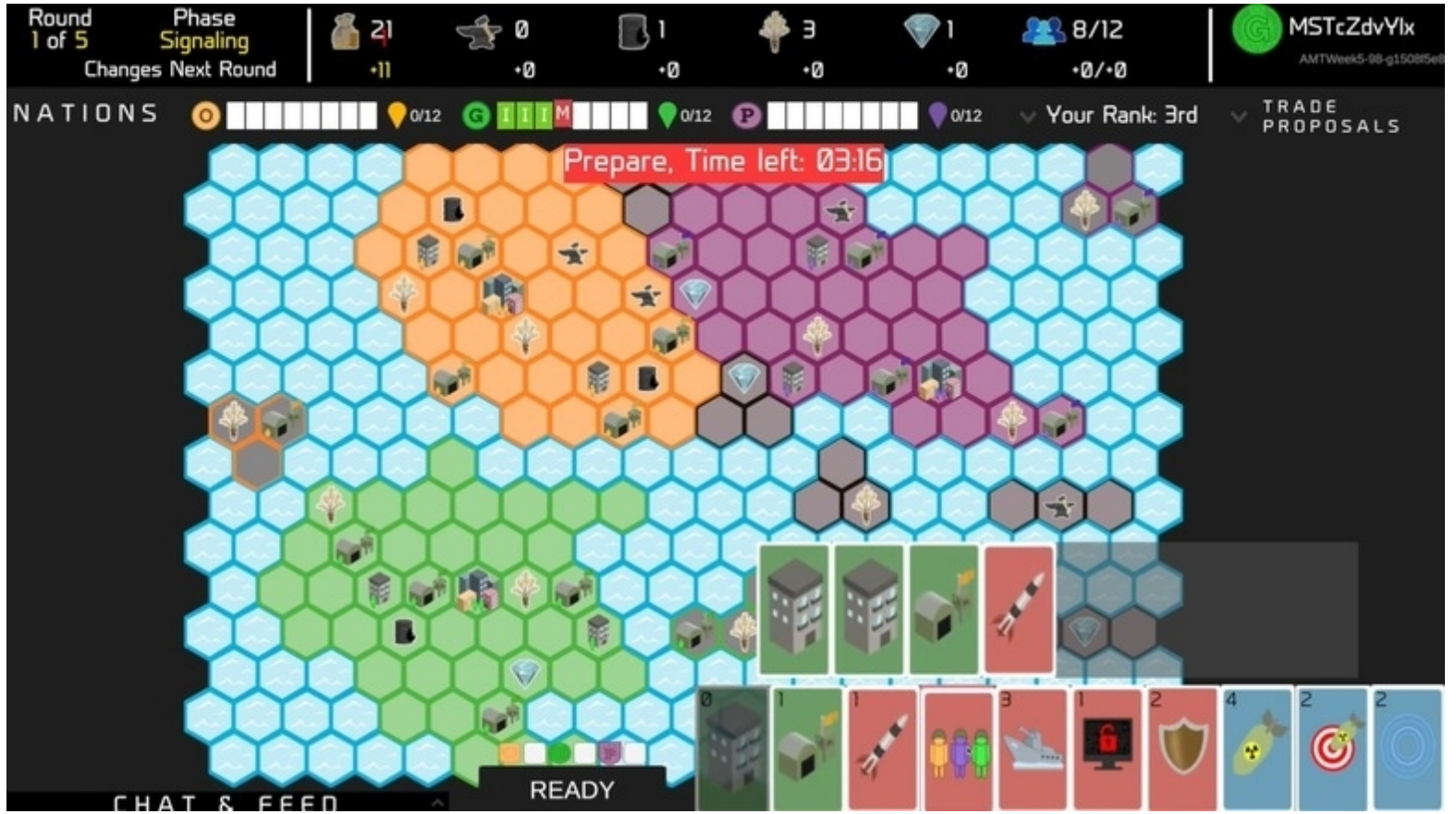
CASTLE

Unity

Nakama

Contact team at wg-pegasis-info@sandia.gov on how to obtain CASTLE

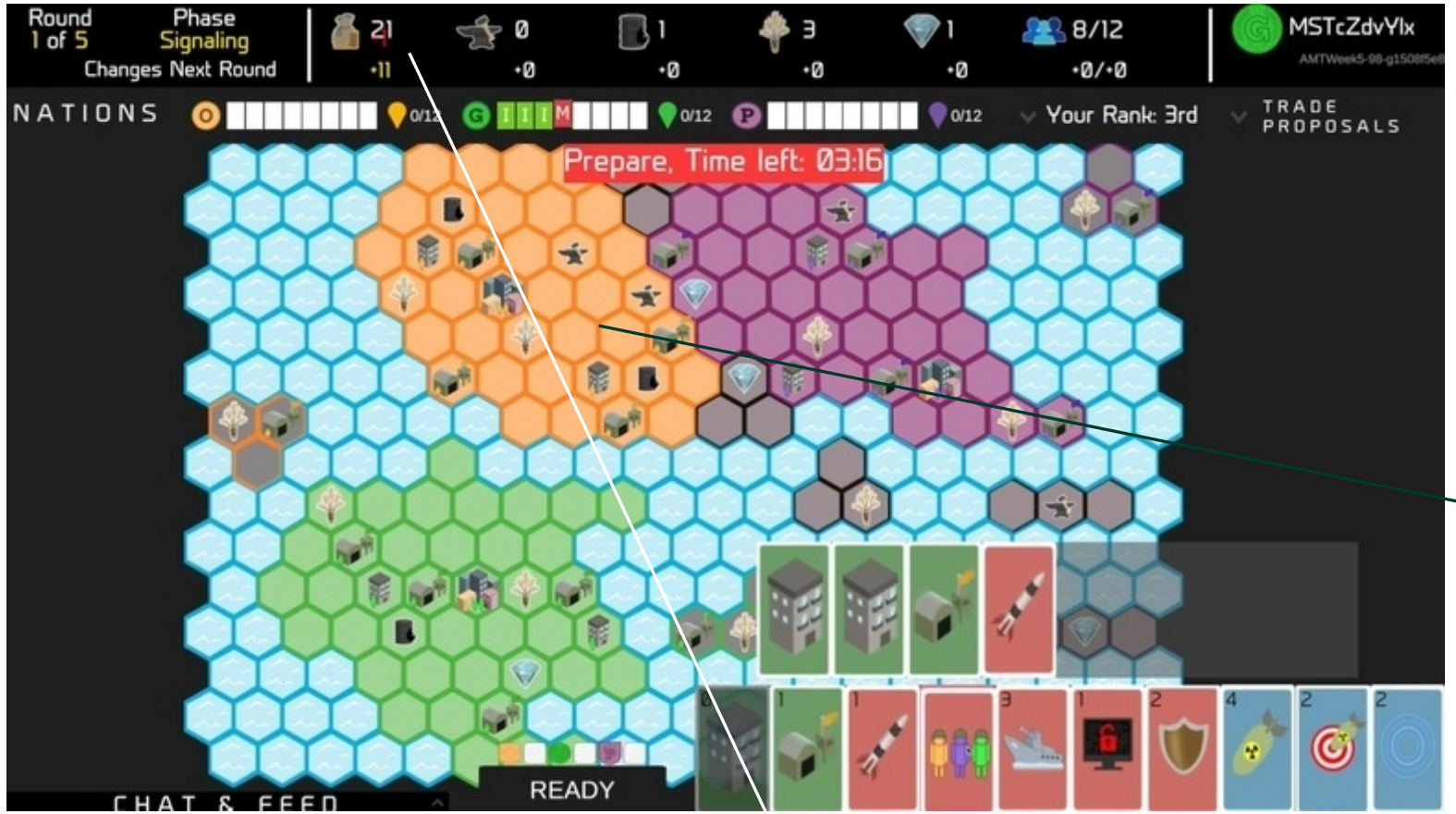
How CASTLE Works



Game image from online version of SIGNAL – an experimental wargame developed by the Project on Nuclear Gaming (https://pong.berkeley.edu/)

Three major components of a game: Players, Actions, and Cells

How CASTLE Works



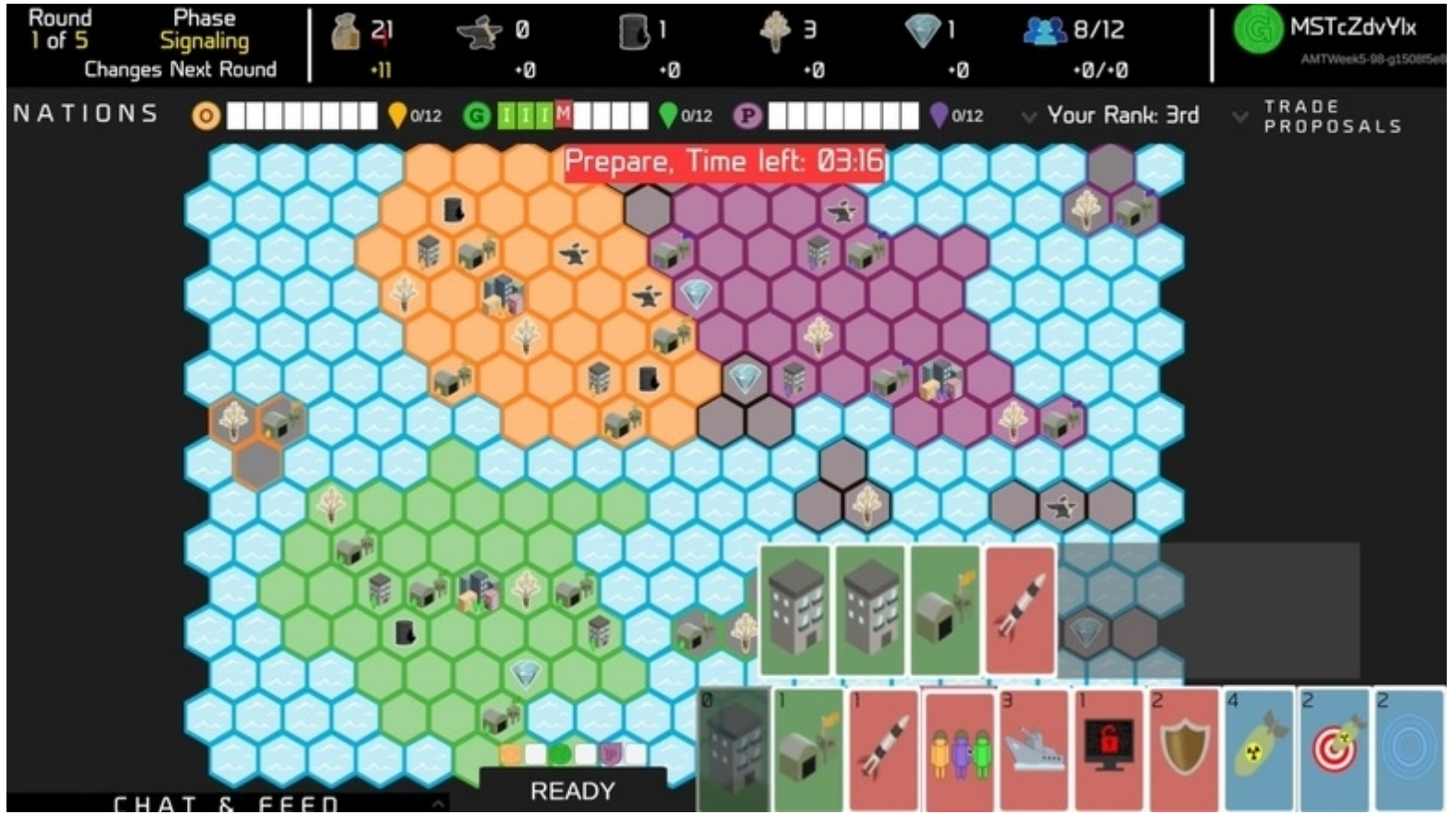
Player: Represents an actor who has a particular role and owns a number of cells.

Each player have any number of “Stats”, represented by a name and value (e.g., integer, Boolean, Float)

Example: We have a player Orange who has a cluster of cells on the map

Orange has a number of “stats”

How CASTLE Works



The action deck available to Orange

Action: Represents an event with a source and target player, impacting a source and target cell.

A collection of actions is a “Deck”

Each player possess a “Deck”

How CASTLE Works

Cells: Represents a physical space on the board

A cell can be aware of what other cells are adjacent to it

Cells can have any number of stats like a player

This cell has ”Oil” with a value of 1

This cell has ”Empty” with a value of 0

How CASTLE Works

- CASTLE handles all the work needed for networking game instances together
  - Each game instance sends and receives actions taken by the players
  - Game actions broadcasted via websocket to Nakama server
  - Each game instance updates their own game state from the action

Action Event

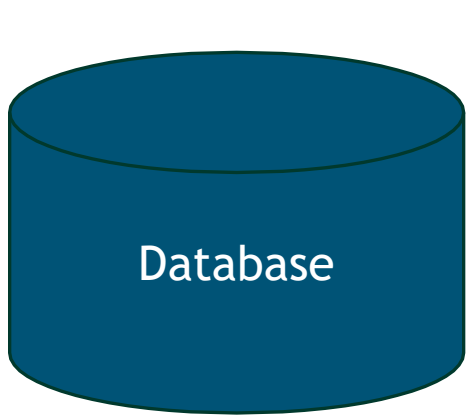
Nakama

Example: Orange fires missile at Green in Round 1

How CASTLE Works

- Same action message can be transformed into JSON string for storage

```
{ GameID: A04B63, Round: 1, Action: [name: "missile", sourcePlayer: "Orange", sourceCell: "A3",
targetPlayer: "Green", targetCell: "J5"]}
```

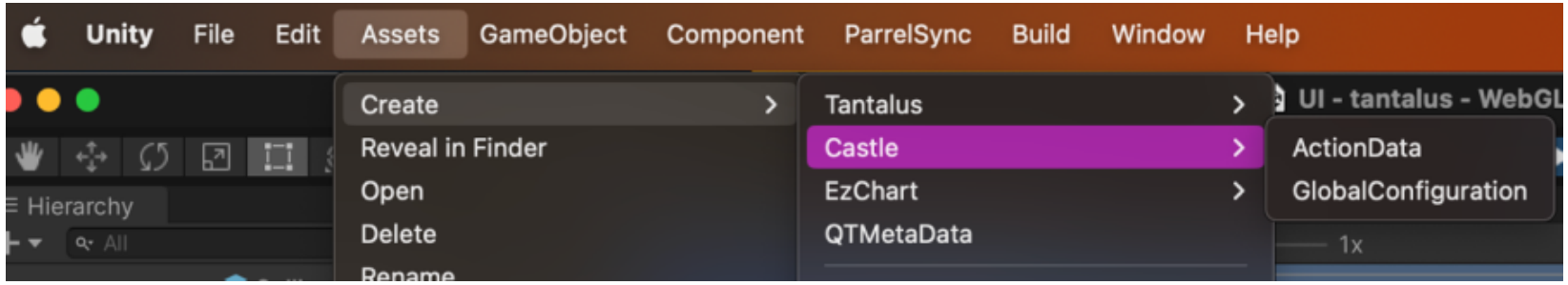


Azure Cosmos DB

aws

Example: Orange fires missile at Green in Round 1

How CASTLE Works



- Unity plugin to create the Players, Actions, and Cells for your game
- Import networking and management code to handle message passing
- CASTLE can serialize and broadcast game messages for data storage

- What CASTLE **does not** provide:
  - UI creation / management: Users write UI code to handle any player input and feedback
  - Managing game state: Users define game rules on how actions impact players and cells
  - Analysis code: Work in progress for future CASTLE release to extract and summarize data

Bottom line: CASTLE is for those comfortable programming in Unity

Active Research Supported by CASTLE

- Current research: Identifying cyber adversary strategic responses using data-driven, human-in-the-loop methods (aka Tracing House)
- Interest in studying what we call the “Communication-Capability” tradeoff
  - Defenders need to communicate cyber threats to be effective.
  - In the cyber domain, increased communication can decrease the effectiveness of the capability.
- Research Question: How does the communication-capability tradeoff impact the techniques and strategies used by actors to manage conflict in a cyber context and the effectiveness of cyber threats?

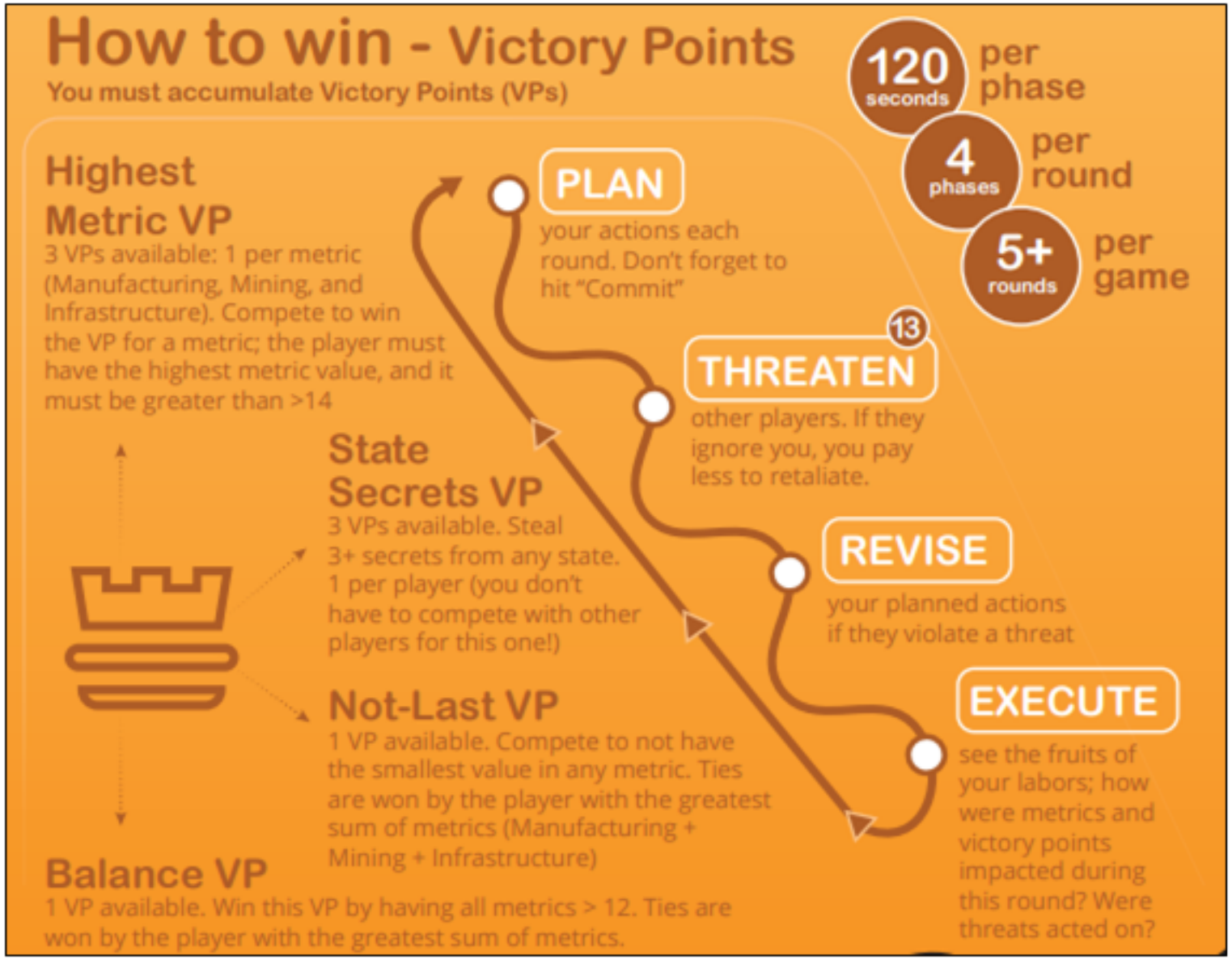
CASTLE will generate synthetic data regarding cyber deterrence decision making and thus better understand the communication-capability tradeoff. This allows for better informed strategic decision making regarding cyber threat communication.

https://www.tantalusvideogame.com

Tantalus: How to Play

- Three player game where you must build your nation (e.g., mining, infrastructure, manufacturing)
- Use resources to invest in your country, steal secrets to gain advantage, or attack other players
- Players can use resources to threaten against attacks -- retaliations become lower cost attacks

Tantalus: How to Win



Tantalus Demonstrates CASTLE Flexibility in Game Designs

- Concept of cells abstracted to things players can influence (cells have no spatial meaning)
- Actions do not need to follow the card/deck design literally – design principles persist
- Actions can be handled differently (e.g., Threats vs Attacks/Invest) but have same underlying structure

Summary

- CASTLE is a Unity Asset Package for helping the wargaming community build online multiplayer wargames
- CASTLE is available for commercial or government use
- Sandia has demonstrated using CASTLE for two experimental wargames: SIGNAL and Tantalus – this is an active area of development for us
- Play Tantalus and looking forward to sharing our results next year

CASTLE TANTALVS

Thank you!

- Jon Whetzel
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- PEGASIS
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- Special thanks to CASTLE development team: Nathan Fabian, Allen Bagwell, Elliot Ridgway, and Lourdes Marie Osman

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