**Hex Wars**

**Design Document**

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# Overview

Hex Wars is a simultaneous turn based game with two major phases:

* Game Building – this builds the map, adds all the population centers and other game items, adds the players, etc.
* Order Execution – This executes all the orders submitted by the players.

Underneath the scenes there are a few design choices that deserve special notice:

* Map building algorithms – the algorithms generate a unique map each game and has parameters that can tweak aspects of the game such as: map size, how many players, how many game items, etc.
* Persistence – JSON is used for all persistence. There is a master game file that knows the exact game state and then player files which only show what each player knows.
* Orders – Every order is unique and fits within the ordering framework. Every order should have unit tests.
* The player and admin GUI uses whatever files are appropriate: the player file or the game file.

# Game Building

## Map Building

The map creation tried to work within a few main goals:

* The map
  + scales with players
  + player to region density is configurable
  + population center density is configurable
  + has a configurable number of regions
* Regions
  + vary in size, but within limits
  + regions vary in shape (dynamic growth)
  + regions are as evenly distributed as possible
  + 1 city per region, cities aren’t on a region border if at all possible
* Players
  + distributed as evenly as possible
  + terrain allocation is player aware (player capitols start on favored terrain)

There are lots of small bits in the code that work to create a good map. For instance, regions grow dynamically, but generally each region hex has to be adjacent to two other hexes of that region. These tweaks in the code came from trial and error and the best way to learn them is in the code.

A key decision in the map building was assigning terrain *after* the players were allocated so that the terrain spread accounted for each player’s favored terrains. It was easier to distribute players evenly then force terrain to adapt than vice versa. It also allows the game board to tailor to the kingdoms chosen, such as a more forest heavy board if lots of players chose forest friendly kingdoms.

# Economy

Every cost in the game is based around how many hamlets of production it should cost. For example, maintaining a typical unit would cost 3/4ths of a hamlet’s production. Listing any costs in this document would quickly get out of date, but here is the gist of the relative costs.

DiplomatInspireLoyalty = 1H per 5 levels

DiplomatInciteRebellion = 1H per 5 levels

DiplomatNegotiateFealty = 1H per 5 levels

TakeRegionCensus = 7H

MapRegion = 5H

ArmyRecruit = 2H + possible degrade (except capitol recruits)

MoveWizard = free

MoveDiplomat = 1H per 10 levels

MoveAgent = 1H per 10 levels

Train Agent = 1.5H

Train Diplomat = 2H

Train Wizard = 3.0H \* level

ImprovePower = 5H

ImproveEmbassy = 3H

ImprovePopCenter = 2H

CreateArmy = 2H

HireWizard = 6H

HireDiplomat = 2H

HireAgent = 2H

CounterEspionage = 1H per 5 levels

SabotageEmbassy = 1H per 5 levels

SabotagePopCenter = 1H per 5 levels

AssassinateAgent = 1H per 5 levels

AssassinateDiplomat = 1H per 5 levels

AssassinateWizard = 1H per 5 levels

AgentScoutControlLevel = 1H per 5 levels

AgentScoutEmbassies = 1H per 5 levels

AgentReconLocation = 1H per 5 levels

# Kingdom Design

EachKingdom is based around 250 Hamlet’s worth of values. For those areas where the cost is obvious, such as hiring a diplomat, those values were used. Other values were more subjective, but here’s how the values are determined with an example kingdom:

(D)iplomat: 1H per level, max level depends on power

(A)gent: 1H + 1H per level

(W)izard: 6H per wizard, 3H per level. Max level #wizards. +/-3HP for +1 level

(P)ower: 4H per level

(A)rmy (S)tart/(R)einforcement: 4H per 1H initial combat strength, 2H per 1H reinforcement (per turn rate depends on individual unit strength)

(R)egional embassy bump: 5H per level

Movement: 13/hex average, 5H per +/-1 average cost

Wizard train: 3.5H per level, +/-1H per wizard per -10% change

Agent train: 1.5H, 2H per +/-10%, max 9-21 hand picked

Diplomat train: 2H, 2H per +/-10%

Troop cost: .75H per unit, 6 units average, 5H per +/-10% change

Standard setup: 250H

Averages:

Diplomacy = 50H

Agent = 12H

Wizard = 5 Wizards + 5 starting levels

Giants: D=53H, A=5H, R=15H, W=24+3H, G=29H, AS=35H, AR=17H, P=56H

move=20H, wiz train=-3H, agent train=-2H, diplo train=2H, troop cost=0H

Total=250H // really fast, good military, good diplomacy

How some of the values are allocated is subjective based on the flavor of the kingdom. For example: the Giants military power was allocated to a smaller set of powerful units, whereas the Orc Horde had a large number of weaker units.

# Order Execution

All player orders are executed simultaneously, though individual orders are executed in a preset order. For instance, military attacks always come before diplomatic actions. If two players are executing the same order, it’s random who goes first. See the *orderSequence.json* file in the code for the definitive list, but in general the sequence is:

* Military attacks
* Diplomatic actions
* Army recruiting
* Figure movement
* Army movement
* Figure Training
* King orders
* Hiring
* Agent actions

Some notes about orders given for various pieces in the game:

* Figures (Wizards, Diplomats, and Agents) can typically only execute a single order. A figure may sometimes have its order forced, such as escaping the fall of a town.
* Armies can execute one of each type of order (move, fight, etc), though there various exceptions like being able to recruit more than once or the ability to fight multiple battles.
* The King can only execute one Policy order per turn: raising power, creating armies, establishing embassies, or moving the capitol.
* A Population Center can execute as many relevant orders (usually hiring or improvement) as desired.

## Wizard Spells

All spells are orders and adding a new spell is fairly straight forward. If a spell has interactions with other orders (like combat spells and attack orders) then you have to update the code for each spell or order affected.

# COSTS, Production, and Maintenance

All order costs (or gains) are taken when the order is executed. Production and maintenance happen at the end of the turn, production first, then maintenance.

Production is a simple addition of the production value of each of the player’s population centers to the player’s treasury. Since production is the last thing done in the turn, any orders that would affect the population centers will affect production.

Maintenance takes place immediately after production.

# Regions and Control

Each region is a distinct entity on the board and every hex is within a region. Every population center is in a hex and thus is part of a region. Each region has 1 city, typically referred to as the regional city.

Each player has some level of control over the region as determined by how many levels worth of population center they control. The game design encourages players to control (or dominate) a region to gain various bonuses.