

Incomplete specification

Assumption

MVP

MID

LOW

USER INTERFACE

EPIC 1.1: I would like to open the main menu so that I can select any option or settings.

US[1][LOW] : As the player, I would like, in the main menu, to select to play against Campaign AI so that I can choose my preferred difficulty.

AC : Players should be able see the option to be labelled "Campaign AI".

AC : Players should be able to select a level of Campaign AI to play against.

AC : Players should be able to see the first option of Campaign AI to be labelled as "Basic Campaign AI".

US[1][LOW] : As the player, I would like, in the main menu, to choose to play with a Battle Resolver so that I can have battles be automatic.

AC : Players should be able to see the option to be labelled "Battle Resolver"

AC : Players should be able to select a level of Battle Resolver to play with.

AC : Players should be able to see the first option of Battle Resolver to be labelled as "Basic Battle Resolver".

US[3][LOW] : As the player, I would like, in the main menu, to load a previously saved game file, so that I can play a previously saved game.

AC : Players should be able to load a previously saved game.

AC : Players should be able to see the option labelled as "Load".

AC : A loaded saved game must present precisely the same getters as the loaded game.

US[1][MVP] : As the player, I would like, in the main menu, select the "New Game" option, so that I can start a new game.

AC : Players should be able to see the option labelled as "New Game"

AC : Players should be able to start a new game.

EPIC 1.2: I would like information to be displayed to me at convenient times while I am playing the game.

US[1][MVP] : As the player, I would like an overlay telling me the gold in my treasury so I can make informed decisions about spending.

AC : Players should see an integer denoting treasury gold in some corner of the screen.

US[1][MVP] : As the player, I would like to tell apart the different provinces I own so that I know what to attack and defend.

AC : Different provinces should be coloured differently depending on the faction they are owned by.

US[1][MVP] : As the player, I would like to see different icons for the different elements in the game so that I am able to tell them apart.

AC : Players should see a different icon for each type of unit.

US[2][MVP] : As the player, I would like to see which buildings I have built and can build in a selected province so that I don't have to remember this information.

AC : Players should be able to see built buildings with their level

AC : Players should be able to see a display which allows them to select what building they want to build/upgrade, and makes it clear which buildings they do not have enough gold to build.

US[2][MVP] : I would like to see which troops are currently occupying a selected province so that at a glance I understand how defended my provinces are.

AC : Players should see how many and which troops are in the selected province.

US[2][MVP] : As the player, I would like to see the wealth and the level of tax on a selected province so that I know how to set optimal tax rates.

AC : Players should be able to see an integer for the wealth of a province

AC : Players should be able to see a String denoting the tax level on a province

US[1][MVP] : As the player, I would like to see which buildings/units are being trained in the building/training slots of a province so I can change my strategy if needed.

AC : Players should be able to see the building and unit a province is creating in each of its slots, and it should be clear when the slot is empty.

US[1][MVP] : As the player, I would like an overlay to be displayed upon victory/defeat so that I know how the game has ended

AC : Players should see an overlay at the end of the winner's turn, which says VICTORY or DEFEAT as appropriate.

AC : If the player has not won, the player should see who has won.

AC : The player should see and what victory conditions the winner achieved.

US[1][MID] : As the player, I would like province information to be displayed on the map only when necessary so that my UI is not cluttered.

AC : The player should see the displayed province information only when that province is selected, or the mouse is hovering over the province.

US[1][MID] : As the player, I would like to see the number of movement points for units so I know how much further they can be moved.

AC : The players should have a way to see the movement points available for units in the province.

US[2][MID] : As the player, I would like to see the results of engagements so that I can strategize my next turns.

AC: Players should see the results of all engagements via visual or text information.

US[3][MID]: As the player, I would like to see information about units and infrastructure before I build them so I can predict how they will affect me.

AC : In the training/building menu, for each item, players should see brief descriptions of their stats/effects including numerical statistics where appropriate.

AC : In the training/building menu, players should see the gold cost of each item they can build/train.

US[1][LOW]: As the player, I would like to see the current year / turn number so I know how long the game has been progressing for.

GAMEPLAY

EPIC 2.1: I would like to construct infrastructure for the provinces I own.

US[5][MVP] : As a player, I would like to be able to build and upgrade infrastructure in provinces to obtain the bonuses they give.

AC : Players should be able to select a building/upgrade to begin construction in the province if

- There is at least <building/upgrade cost> in the treasury
- The maximum upgrade for this building has not yet been obtained
- No other building is currently under construction in this province
- Other building specific restrictions are satisfied

AC : Immediately after the command to build is made, the cost is to be subtracted from the treasury

AC : Buildings should take <building time> turns to construct. Players should see them in the list of constructed buildings on the turn that they are finished. <Building time> = <Original building time> - <#max level mines in faction>

US[1][MID] : I would like to cancel buildings that are being trained in a province so that I can choose to build something else.

AC : Upon cancelling, players should see the cancelled building no longer under construction.

AC : Players should be able to begin construction of a different building on the turn that they cancel.

US[1][MID] : As a player, I would like to build farms so that I can increase troop production and add to overall wealth.

AC : Players should be able to construct farms

US[1][MID] : As a player, I would like to build markets so that I can invest in building creation.

AC : Each market reduces the construction cost of all buildings across the faction in a multiplicative fashion - i.e. if one market reduces construction costs by 2%, and another by 3%, and the current construction cost of buildings in the faction this turn is C , then the new construction cost of buildings in the faction this turn will be $C \times (100\% - 2\%) \times (100\% - 3\%) = C \times 95.06\%$.

US[1][MID] : As a player, I would like to build ports so that all my port provinces can benefit from an increase in wealth.

AC : Players should be able to build ports, but only on sea tiles

US[1][MID] : As a player, I would like to build mines so that I can reduce costs of units.

AC : Players should be able to construct mines to reduce the initial cost of all soldiers in the province in a multiplicative fashion - this is similar to that of markets.

AC : The highest level of mine will reduce the time taken to construct all buildings across the faction by 1 turn, this bonus can be applied multiple times.

AC : The minimum time to build is 1 turn.

US[3][MVP] : As a player, I would like to build Troop buildings so that I can train different types of troops.

AC : Players should be able to recruit heavy infantries, spearmen, missile infantry, melee cavalry, horse archers, elephants, chariots, and artillery.

AC : Different categories of soldiers will require different “chains” of buildings.

US[1][MVP] : As a player, I would like higher level troop buildings to train stronger versions of the same troops for the same gold cost so that I do not have to choose between too many troops on the training screen.

AC : Upgraded troops should be strictly better or equivalent to counterparts in every way.

US[1][MID] : As a player, I would like to build Walls so I can emphasise the protection of more valuable provinces.

AC : Players should be able to build walls to provide buffers to all troops defending that province.

US[1][MID] : As a player, I would like to build Smiths so troops I produce have an edge in battle.

AC : Players should be able to build smiths to provide different battle bonuses to troops. (Further details in epic 2.4)

US[1][MID] : As a player, I would like to build Roads so that my troops can move quickly to reposition to where they are needed.

AC : Players should be able to build roads:

- Dirt roads (level 1)
- Paved roads (level 2)
- Highways (level 3)

AC : Only romans should be able to build highways

US[2][MID] : As a player, I would like the option to build more advanced versions of buildings to invest more into older provinces.

AC : Walls should have upgrade options to “Archer towers” and “Ballista towers”.

AC : “Archer towers” and “Ballista towers” should have a random chance of causing damage to attacking troops.

US[1][MVP] : As a player, I would like to have a consequence of losing control of a province I own while constructing a building in that province so that I will be penalized for poor strategy.

AC : There should be no refund of gold to that faction which had already funded to construct that building if that province was captured while construction of that building was still in progress.

EPIC 2.2: I would like to be in control of my troops.

US[4][MVP] : As the player, I would like to move troops around the map so I can prioritize certain positions.

AC: troops should be displayed once player click a province

AC: Players should be able to see which provinces a unit/group of units is able to travel to on this turn, and select one of the spaces to issue the move command.

AC: Players should be able to specify a start and end destination, and the movement point cost of the shortest path should be subtracted from each of the units being moved. The movement point cost is to be the sum of all provinces in the path (inclusive-exclusive).

AC: Players should not be able to move troops through a settlement that they have conquered in the current/same turn.

US[2][LOW] : As the player, I would like to be able to move units as groups to save time.

AC: Players should have an easy way to select a group of units from those in a province

AC: Only the provinces that the least mobile unit in the group can reach should be selectable as a destination.

AC: All units in the group must have the minimum path movement cost subtracted from their movement points after the move.

US[0][MVP] : As the player, I would like to be able to move individual units around to have fine control over my strategy.

AC: Players should be able to form groups of one unit and move them according to group rules.

US[5][MVP] : As the player, I would like to train troops to replace those that have been expended.

AC: Players should be able to train only the troop types that correspond to the training buildings in the selected province.

AC: The number of training slots a province has should correspond to the level of farm in the province. Players should be able to train different types of troops with different training types in each of the slots.

AC: Players should see the gold price for the troop subtracted from their treasury when the command to train is made. This gold price should be reduced by mines in the province. It should be no less than 1 gold per troop.

AC: Troops trained should take <Training time> turns to train.

AC: At the start of a turn that training is to be finished for a particular troop, this troop should be deployed in the province they were trained in.

US[1][LOW] : I would like to cancel units that are being trained in a province so that I have the choice to train different units.

AC : Upon cancelling, players should see the cancelled unit removed from the list of units in production.

AC : Cancelling should free up a training slot.

AC : Players should be able to train a new unit on the turn that they cancel.

US[3][MID] : As the player, I would like to deploy mercenaries instantly for a higher premium to give myself an extra tactical edge in significant battles.

AC: Each turn, the availability of mercenaries should be determined by a random-chance.

AC: When hiring mercenaries, the required gold to hire should be in the treasury, and immediately removed upon hiring.

AC: The player should be able to choose from their own provinces where the mercenaries are to be deployed. They should be deployed the instant this is chosen.

EPIC 2.3: I would like to tax provinces.

US[4][MVP]: As a player, I would like provinces to have a wealth system to control how much gold I can obtain from my citizens.

AC : Provinces should have a base wealth equal to the contributions from buildings.

AC : Wealth buildings should increase the building wealth and before-tax rate of a province by a scalar amount at the beginning of the turn that the building is completed.

AC : Wealth growth should add / subtract from / to the province's wealth every turn. Negative town wealth growth should never reduce a province's wealth below its building wealth.

AC : If a port is present in a province increase the wealth growth rate of a province by a scalar proportional to the number of ports in the faction.

US[3][MVP] : As a player, I would like to be able to tax provinces in order to earn gold.

AC : Players should be able to select the following tax levels:

- Low tax = +10 town-wealth growth per turn for the province, tax rate = 10%
- Normal tax = No effect on per turn town-wealth growth, tax rate = 15%
- High tax = -10 town-wealth growth per turn for the province (i.e. 10 gold loss to wealth per turn), tax rate = 20%
- Very high tax = -30 town-wealth growth per turn for the province, tax rate = 25%, -1 morale for all soldiers residing in the province

AC : At the start of their turn, before town wealth growth is applied and any wealth increases from built buildings are applied, Players should receive $\text{round}(\text{tax rate} * \text{province wealth})$ in gold.

EPIC 2.4: I would like to see a well developed unit engagement system.

US[2][LOW] : As a player, I would like to know the outcome of all engagement so that I can know what is happening

AC: Displayed via visual information or text information.

US[2][MID] : As a player, I would like smith buildings to provide combat bonuses to troops trained in that province so that I can have an edge in battles

AC : Smith bonuses should be applied when a troops finish training on the same turn or after that smith finishes construction.

AC : Both scalar addition bonuses (e.g. +1 attack damage) and multiplicative bonuses (e.g. 20% loss in speed) should apply due to receiving multiple armour upgrades.

AC : The scalar addition bonuses should be applied first over multiplicative bonuses.

AC : Smith bonus should include 1 or more of the following stackable bonuses:

- Upgraded helmets - enemy unit attack damage reduced by 1 (to a minimum of 1 attack damage)
- Upgraded armour suit - enemy unit attack damage (ranged and melee) reduced by 50% (to a minimum of 1 attack damage), speed of the soldiers wearing the armour reduced by 20%
- Upgraded weapon - wielding units attack damage increase by 20%. Morale of the wielding unit increased by 10%
- Fire arrows - archers shoot arrows reducing morale of enemy soldiers in a skirmish with them by 20%, but lose 10% of missile attack damage (to a minimum of 1 missile attack damage)

US[2][MID] : As a player, I would like walls to provide defensive bonuses in battles so that I am able to hold valuable positions.

AC: Walls double the melee defence of all troops defending a settlement (except when fighting artillery), reduce the missile attack damage of attacking archers by 50% (to a minimum of 1), and reduce the missile attack damage of attacking horse archers to 1.

AC: In all engagements (with or without walls), if both units are melee units, there is a 100% chance of a melee engagement. In all engagements (with or without walls), if both units are missile units, there is 100% chance of a missile engagement.

US[2][MID] : As a player, I would like to upgrade walls to inflict extra casualties on the enemy to further strengthen my position.

AC: Tower engagements:

- Against artillery, towers have 100 health points, and suffer a loss in health points for every engagement with an artillery unit (defined by the configurations for the artillery unit).
- The configurations for artillery units include a missile attack damage value for engagements with troops, and a missile attack damage value for engagements against towers.
- If a tower loses all health points, it is disabled for the duration of the battle.

- Against infantry or cavalry, towers inflict damage against the enemy unit in the same fashion as missile infantry (according to their configured statistics) without suffering damage
- Units fighting towers do not route, and have a chance of escaping from each engagement (returning to the army for another skirmish) of: $\text{minimum}(50\% + (\text{speed} \times 10\%), 100\%)$

US[1][MVP] : As a player, I would like my breaking unit to flee the battle

AC: the probability of unit "breaking" is $100\% - (\text{morale} \times 10\%)$

Note that the morale value in the above formula should be morale after applying all campaign/battle morale adjustments (such as morale loss due to very high tax in the province, fighting an enemy unit with fire arrows, morale loss due to scary units in the enemy army).

Formula: $(\text{casualties suffered by the unit during the engagement} / \text{number of troops in the unit at the start of the engagement}) / (\text{casualties suffered by the opposing unit during the engagement} / \text{number of troops in the opposing unit at the start of the engagement}) \times 10\%$

AC: However, for any engagement, the minimum chance of fleeing the battle is 5%, and the maximum chance of fleeing the battle is 100%, after these calculations/adjustments.

AC: If both units break, they both successfully flee the battle without inflicting further casualties upon each other.

US[1][MVP] : As a player, I would like my breaking unit make attempt to flee and route from battle field

AC: each failure resulting in an engagement in which the fleeing unit suffers casualties, without damaging the pursuing unit

AC: If a unit breaks, there is a base-level 50% chance of it successfully routing for every attempt. The minimum chance a unit can have to successfully route is 10%, and the maximum chance it can have is 100%. The speed of the units in the engagement affect the chance of successfully routing, according to the following formula (but is superseded by the 10%/100% rule outlined above): $\text{chance of routing successfully} = 50\% + 10\% \times (\text{speed of routing unit} - \text{speed of pursuing unit})$

AC: even if towers are destroyed by artillery, walls/towers will be repaired immediately after the battle at no cost to the faction owning (or conquering) the towers.

AC: if a unit successfully routes from the battle, if it is in an attacking army which loses the battle, it will return to the province from which it attacked, but if the attacking army wins the battle, the routing unit will join the army in moving into the new province. The entirety of a defending army which is defeated/routed is destroyed.

US[4][LOW] : As a player, I would like many units which have special features so that I can form interesting strategies.

AC: For all Roman legionary units: "Legionary eagle" - provides +1 morale to all friendly units in the province. For every legionary eagle lost to the enemy (by the unit being destroyed defending a province) all friendly units across all provinces suffer a

0.2 penalty to morale until the settlement is recaptured (down to a minimum of 1 morale)

AC:For all Gallic/Celtic Briton/Germanic berserker units: "Berserker rage" - unit receives infinite morale and double melee attack damage, but has no armor or shield protection, in all battles

AC:For all melee cavalry: "Heroic charge" - where the army has fewer than half the number of units as the enemy, this cavalry unit will double its charge attack damage, and have 50% higher morale

AC:For all pikemen or hoplite units: "Phalanx" - these hoplites or pikemen have double the melee defence, but half of the speed, as they are otherwise configured to have

AC:For all javelin-skirmisher units: "skirmisher anti-armour" - in ranged engagements, troops fighting these skirmishers only receive half the protection from armour they would receive otherwise

AC:For all elephant units: "Elephants running amok" - during any engagement with elephants, there is a 10% chance that the casualties inflicted by a unit of elephants will instead be directed at a random allied unit (as if the elephants were battling the allied unit directly)

AC:For all horse-archer units: "Cantabrian circle" - when enemy missile units engage this unit of horse archers, the enemy missile units will suffer a 50% loss to missile attack damage

AC:For all druid units: "Druidic fervour" - allied units in an army with druids enjoy a 10% bonus to morale, and enemy units suffer a 5% penalty to morale, whilst the druids haven't routed. The effect of this ability is amplified by scalar addition, and can be amplified up to 5 times (e.g. 2 druids results in allies receiving 20% bonus to morale and enemy units suffering 10% penalty, however 6 druids provides 50% bonus and 25% penalty respectively)

AC:For all melee infantry: "Shield charge" - for every 4th engagement by this unit of melee infantry per battle, the value of shield defense is added to this unit's attack damage value

US[2][MVP] : As a player, I would like to have different property of damage and casualties between different type of army

AC: Melee units cannot inflict damage in a ranged engagement.

AC: Ranged units in a ranged engagement inflict casualties against the opposing unit equal to (up to a maximum of the entire enemy unit, with a minimum of none of the enemy unit): $(\text{size of enemy unit at start of engagement} \times 10\%) \times (\text{Missile attack damage of unit} / (\text{effective armor of enemy unit} + \text{effective shield of enemy unit})) \times (N+1)$ ->Where N is a normally distributed random variable with mean 0 and standard deviation 1 (standard normal distribution).

AC: the ranged attack damage above incorporates the effect of any bonuses/penalties (e.g. the 10% loss of missile attack damage from fire arrows).

AC: Melee cavalry/chariots/elephants defending a province with walls, or attacking a province without walls, will have an attack damage value in all engagements equal to their *melee attack damage + charge value*.

AC: Infantry and artillery do not receive a charge statistic (only cavalry/chariots/elephants do).

AC: Units in a melee engagement inflict casualties against the opposing unit equal to (up to a maximum of the entire enemy unit, with a minimum of none of the enemy unit): $(\text{Size of enemy unit at start of engagement} \times 10\%) \times (\text{Effective melee attack damage of unit} / (\text{effective armor of enemy unit} + \text{effective shield of enemy unit} + \text{effective defense skill of enemy unit})) \times (N+1)$ * Where N is a normally distributed random variable with mean 0 and standard deviation 1 (standard normal distribution).

AC: all effective attributes in the formula should incorporate the effect of any bonuses/penalties (such as blacksmith upgrades, formations such as phalanx formation, charge bonuses where applicable for cavalry/chariots/elephants).

AC: Note that a Gaussian distribution can return negative values, therefore it is important that you apply the specified bounds to the minimum and maximum values of these formulas (maximum casualties is entire enemy unit, minimum casualties is none of the enemy unit). This is to prevent damage causing "healing", or the appearance of units with a negative number of troops.

US[1][MVP] : As a player, I would like to have different types of engagement based on chance.

AC: when without walls, if there is 1 ranged unit (artillery, horse archers, missile infantry) and 1 melee unit, there is a base-level 50% chance for the engagement to be a ranged engagement, and a base-level 50% chance for an engagement to be a melee engagement.

AC: when with walls, if there is 1 ranged unit (artillery, horse archers, missile infantry) and 1 melee unit, there is a base-level 90% chance for the engagement to be a ranged engagement, and a base-level 10% chance for an engagement to be a melee engagement.

AC: The base-level chance of engagement to be a melee engagement (where the engagement has both a melee and missile unit) is increased by $10\% \times (\text{speed of melee unit} - \text{speed of missile unit})$ (value of this formula can be negative)

AC: Where the engagement has both a melee and missile unit, the maximum chance for an engagement to be either a ranged or melee engagement is 95% in either case (except where a tower is in an engagement - all battles involving a tower will be ranged engagements).

EPIC 2.5: I would like to play against opponents.

US[2][MVP] As the player, I would like to choose which factions I play as and which I play against and how many so that I have control over what kind of game I would like to play.

AC : The player should be able to choose which faction they play as

AC : The player should be able to select multiple AI factions

AC : The player should not be able to select two of the same faction.

US[4][MVP] As the player, I would like provinces to be fairly distributed among players so that the game is balanced.

AC : Each faction should start with the same number of provinces

AC : Each faction's provinces should be a connected subgraph of the province connections

US[2][MVP] : As the player, I would like the Campaign AI to be able to manage its own treasury in regards to infrastructure so that the game is fair.

AC : Campaign AI should be spending up to 50% of their own treasury balance on infrastructure.

AC : The AI should prioritise the cheapest buildings first.

AC : If there are multiple buildings of the same price, the prioritisation will be by the category of buildings in the following order:

1. Wealth generation buildings, in the following order:
 - a. Ports (if on a sea province)
 - b. Markets
 - c. Farms
 - d. Mines
2. Roads
3. Troop production buildings
4. Smiths
5. Walls

US[2][MVP] : As the player, I would like the Campaign AI to be able to manage its own treasury in regards to unit recruitment so that the game is fair.

AC : Remaining treasury balance, after purchasing infrastructure, should be spent on recruiting units.

AC : The AI should prioritise recruiting recruitable units in the category of fewest units across all provinces.

AC : If there are categories that are equal, the following order of priority should be applied:

1. Spearmen
2. Heavy infantry
3. Missile infantry
4. Cavalry
5. Horse archers
6. Artillery

AC : The AI should prioritise recruiting the unit with the highest initial cost, if there is equal, it should be uniformly randomly chosen.

AC : The AI should prioritise recruiting from the province closest to an enemy province, if there is equal, it should be uniformly randomly chosen.

US[3][MVP] : As the player, I would like the Campaign AI to be able to move its troops accordingly to its own provinces so that the AI can defend its own border provinces.

AC : The AI should move its troops not currently at a border province to the border province with the fewest soldiers.

AC : Should there be multiple border provinces with the same number of fewest soldiers, the adjacent province with the most enemy soldiers should be prioritised. Where this is equal, the AI should uniformly randomly choose a province.

AC : The AI should move all soldiers at once to that province, not splitting the army up, and should move them from the closest non-border province to its destination province.

AC : Should the initial target province to move the support troops into not be the 'border province with the fewest troops', the AI should be able to update and change its target destination province according to those changes.

AC : The AI should always send the troops on the shortest path to the destination province.

US[3][MVP] : As the player, I would like the Campaign AI to be able to move its troops accordingly to attack enemy provinces so that the AI can launch a proper attack.

AC : The AI should always first attack a neighbouring province that has the fewest units.

AC : Should there be multiple neighbouring provinces with the same fewest number of units, the AI will prioritize using the army that has the highest number of troops bordering those provinces to attack.

AC : Should there be multiple armies with the same highest number of units owned by the AI bordering those provinces with the same fewest number of units, the AI will launch an attack from a uniformly randomly chosen province.

AC : Should there be multiple armies bordering the same one enemy province that has the fewest number of units, the army that has the highest number of units will be prioritized to attack.

EPIC 2.6: I would like a Battle Resolver.

US[1][MVP] : As the player, I would like a Battle Resolver to automate the start of a skirmish, so that I can focus on other things in the game.

AC : The Battle Resolver should uniformly randomly choose a unit from each of the armies to start the engagement.

US[2][MVP] : As the player, I would like a Battle Resolver to automate the duration of the skirmish, so that I can focus on other things in the game.

AC : The battle resolver should have both units engage in a sequence of engagements against each other until a unit successfully routes or is defeated.

AC : If an attacking unit skirmishes against a tower, that skirmish should end before the attacking unit routes or is defeated.

AC : In engagements where both units are melee units, it should be a 100% chance of a melee engagement.

AC : In engagements where both units are missile units, it should be a 100% chance of missile engagement.

AC : If a battle lasts over 200 engagements, the outcome should be a draw. The invading army should return to its initial province.

US[1][MVP]: As the player, I would like to see province transferring between players

AC: When invasion has won, the province should be taken over by the attacker.

AC: When invasion has lost, the province should not change ownership.

US[1][MVP]: As the player, when I take over a province, I would like all buildings in that province to benefit me, so I am rewarded for occupying key enemy territories.

AC: When players take over a province with buildings, all global building benefits (e.g. ports and top level mines) should transfer over to the victor.