

NATIONS

Design Document

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Part I

Game overview

1 Introduction

Our two goals are to create

- playable and "cool" strategy game about building empire,
- realistic simulation of processes involved into ruling nation and country in all historical ages.

Nations will balance between those two opposite objectives. As a result we expect a game, which wouldn't make somebody laugh or bore him because of its simplicity, but still would keep up with modern game industry standards in entertainment.

1.1 Background

Concept of this game comes from our fascination in Civilization series. We enjoyed much their game play, but we also lacked connections to historical reality in these games. We just couldn't refrain from developing such a great idea with more complex reference to realism.

2 Description

We want to make player feel like the ruler of nation, not forcing him to take care about detailed decisions about cities and country, like choosing buildings to be built, creating every single road in country, hiring and sending every worker to his job, choosing every technology scientists should develop (which is stupid idea and most games have this modeled in very biased and unrealistic way). He should rather focus on higher level decisions

- where to send armies, where to increase exploration or military support, how country should be governed in social, economical, political, foreign, religion affairs, what science models and science centers should be supported. He will not be able to directly change who people inhabiting his country are, but mentioned country politics will influence their development.

Our goal is to simulate development of societies from their early stage of existence on a given land. Beginning from loose groups forming tribes or wandering societies up to modern age federation countries like USA or EU. This will involve long term processes of integration and expansion of nation, which can always be interrupted by divisions of already formed society into different groups and creation of other nations. Every nation will go through several levels of development, consisting of tribe, kingdom, nation, empire... This will go parallel to technological and social development of those people and entire humanity.

We place a little more attention to realism - in case of opposite solutions, one resulting with "nicer" game play and other with more accurate simulation of reality, we tend to choose second one. We will rather seek for good description and presentation of processes involved, than changing them to fit player's expectations (which are mostly influenced by simplicity of other games' models).

2.1 Key features

We expect game to have following features:

- game play runs in real time at world time speed from month per few minutes up to few months per minute,
- considered world time frame begins from the early antiquity (about 3000 - 2500 BC) until the present times (beginning of XXI century),
- most scenarios cover map of Earth with grid of tiles, sized $2500km^2$ each. More detailed scales are allowed, but algorithms will be created with former scale in mind.
- average game play time for most scenarios is about 8-10 hours and covers some important moment in history,
- scenarios fit historical data with best possible accuracy,
- playing entire covered time frame of game is possible, although low probable to happen (because of time speed rate - 100 years take about 8-11 hours)
- game is playable by many players at the same time over the network (LAN or Internet),
- main focus is set on multi-player scenarios, which begins at some chosen moment and with chosen countries,

2.2 Destination Group

Group of people who would enjoy this game is mostly strategic games maniacs... Of course we will also try to make game very interesting for broader group of players, but with our assumption about "realism over common coolness" it is more difficult. We will first focus on game engine, implementing realistic processes and, after this, making appearance of game more suitable for most players. We assume game's accuracy in world modeling will surpass maybe unavoidable sordidness.

As our game should simulate some real processes in economy and society, we find possibility that it could be interesting for economists or sociologists. Concepts like demand, supply and others from economy should be properly modeled in game. We want at least that game wouldn't appear to specialists from various sciences as nonsense.

Game should be also interesting for historians. When particular scenario would be created with historical data, it should continue in game in some degree similar to historical facts, when political decisions would be the same (it is the hardest task in entire game model and it is possible that such accurate simulation is impossible, but we will try to alter our algorithms and game parameters to fit this condition).

We again assume rather to educate players about various parameters and processes in game, than simplifying them in game.

Part II

Functional specification

Here we describe in more details how game will look like and what exactly player will be able to do.

3 Player's interaction with world

Most processes will run independent of player's initiatives and decisions. They will be initiated by many parameters in world and will initiate others. For example cities will be built by people in nearby profitable places, trade routes will be created between city producing some goods and one where there is much demand of these goods, people will develop bridge building technology in places rich in rivers etc.

Many processes will also be possible to begin by player's actions. He can support some areas by military force, building roads and money to encourage people to build cities there. More directly, he can for example sponsor building of a castle in place which he thinks has strategic military importance.

Managing military units is under most direct control of player, although they can also be switched to automatic mode.

3.1 Army control

Player has full control over armies. He can create them, organize, move, send them to attack or give orders to defend some chosen fortifications.

We distinguish elite soldiers (professional soldiers, mercenaries, veterans experienced in previous wars) from ordinary recruits (conscript soldiers, armed peasants). Obviously former are more expensive to hire and support, but their battle value is much better.

3.1.1 Creating army

When war or other troubles (risings) come, player should mobilize troops - often this means calling up common citizens to arms, in urgent needs also hiring mercenary armies. This will be done by pointing a place on map and choosing option to mobilize army.

Amount of available soldiers depends on population of country and nearby provinces. First, recruits are taken from closest cities and lands, but if it isn't enough, more is gathered from other parts of country. Larger armies are created slower than small. Placing two mobilization points close to each other also slows down the process, because they are using the same terrains to gather soldiers.

During mobilization player can choose type of army (infantry, cavalry, artillery, armored troops, air units, etc.) he wants to have. He can mix them and use various proportions of veterans and recruits. More advanced types of armies would require many, or only, well trained soldiers (air units, etc.), but we count also people from supply, who can be formed from wide range of recruits.

3.1.2 Moving and giving commands

Manipulating armies should be an easy task. GUI model for this should be taken from other games. Simply after pointing unit or group of units, they should change color and become selected. Those units can receive commands like: join into one army, move, attack, etc.

Units can be set to automatically perform some actions on chosen territory. It might be useful for example in protecting some distant colony against natives' attacks.

3.1.3 Fortifications

Defensive improvements are built automatically from public funds in richest and most populated areas, borders.

Separately from that, player can manually initiate investments from the treasury. He must point some place on map and choose building one of following options:

single fortification object - Creating a castle or fort is useful for securing trade routes, narrow passes (in mountains), mouths of rivers.

line of fortifications - Player chooses long line on the map, which should be fortified. It's very expensive, but forces enemy to attack well defended positions or to go around.

3.1.4 Piracy

Pirates' activity brings income from plundering and selling slaves (if slavery is allowed in country). Pirates can plunder coast colonies or even destroy them. They are not controlled directly, but sometimes appear unexpectedly and attack weak placements or ships.

Player can choose against which countries he wants to support piracy. Piracy is not seen very good among other countries, so it should be rather disabled, unless player have distant overseas country or good defensive capabilities.

To find pirate bases one has to increase spending on sea security. Pirate ships and bases can also be discovered by military ships on adjacent field. They can be attacked in such case (or they attack themselves), but if the base is not destroyed, then it disappears from the map.

3.2 Territorial expansion

Expansion of nation is to some degree automatic process, just guided by player. He can point most desired direction or make some things manually, but people will constantly try to settle on new territories. Most common way to increase expansion to some area is to provide it a military protection, clearing routes to allow trade connections (trade routes should be guarded by military or within national borders).

3.2.1 Exploration

Exploration is made automatically when country has some coastline and appropriate ships. It can be encouraged by spending more money for it from public finances. Unknown terrains near borders are always searched with more priority.

Player can also build and control exploration ships manually. In such a case they are controlled just like ordinary military units. Differences are in limitations (which also disappears with technological development) and costs (hiring special crew, preparing extra supplies).

3.2.2 Trade placements

Making placements on distant areas can be performed by building trade placements and sending merchants there. Area must be already explored and can have some native inhabitants (in case of formed country, availability of creating trade placements depends on this country's isolation level).

Trade placements develop slower than colonies, but are much less provocative for natives. They bring income, but do not allow any territorial expansion, only exploration.

They are created automatically if supported by enough money (from budget), but player can always point to some particular area to build them (funded from treasury).

3.2.3 Colonies

Forming colonies can be funded from budget, but it's often performed automatically by people. Colonists from most densely populated and poorest areas of country travel to create new colonies.

Colonies will be created on attractive and well explored terrains. Already developed colonies are preferred (more secure) in migrations.

Player can choose particular terrain to be extensively colonized. He can also send expedition to create colony somewhere - in such a case he pays for costs of expedition from treasury and choose amount of people and military support to be sent.

3.3 Diplomacy

Country has variable diplomatic *relations* to all other countries, which it has encountered. It is not symmetrical and vary from extremely hostile to worshipful. It corresponds to relations of nations inhabiting given two countries. Player can set what is the desired level of relation to particular country, which means changing diplomatic actions and behavior toward it. He cannot expect real relation to change quickly, but it might be useful in establishing some treaties and slowly influencing real relation.

Relations must be considered while doing diplomatic decisions. Making war against country, which is generally liked by people might be dangerous and can lead to revolts. Alliances between hostile countries, though not impossible and dependent on international situation and threats from outside, will be rather fragile and would not last very long.

3.3.1 International situation and history

While making negotiations with chosen country, there are history of relations with this country and various related informations about international situation shown.

From history we focus on things, which might influence diplomatic actions and probability of their success:

- lately declared wars,
- exchanges of territory,
- signed trade agreements, etc.

There are always some regional or global issues important for foreign politics of many countries. It allows them to build cooperation to solve common problems or sometimes trigger conflicts, when one country wants to do it with too much loss for others. Such situations might be the following:

- possible existence of powerful and aggressive country in neighborhood,
- economical problems (lack of some supplies),
- unstable situation in some important or nearby region,
- part of country's dominating nation is living on territory of other country
- some country is very economically expansive

Meaning of all these facts for particular diplomatic movements should be always mentioned - possibilities of cooperation, proposals for solving problems (negotiating trade agreements).

3.3.2 Diplomatic actions

Diplomacy consists of giving good arguments for your proposals. Sometimes, even between hostile countries, alliance is possible, when they stand in face of big threat to all of them. Also declaring war on country, which has bad name and has shocked international opinion with cruel actions, might be seen as good decision and increase popularity.

Also using properly chosen words can change the overtone of diplomatic proposition. For example recalling past hostilities or, on the other hand, talking about reconciliation and building new future.

In diplomatic negotiations player can choose guideline and elements of his diplomatic missions. Basically negotiations are form of "trade", where player must find balance between demands and combination of offers and arguments. He is always informed, what "power" and overtone currently chosen elements have.

It's possible to have negotiations between more than two countries. It can be used to make agreements between alliances and their enemies.

We allow rich set of actions, offers, proposals, demands, threats. Each of them has some particular cost and profit for countries. All elements can be enriched by arguments mentioned in 3.3.1, which might change diplomatic overtone and costs or profits.

propose peace treaty - It has positive overtone, but its cost depends mainly on current military situation of countries, war tiredness and international situation or pressure,

declare war - It makes great impact on international relations with country. It can be used as threat, when used with some demands. In such a case opposite side can avoid war by satisfying demands.

sign trade agreement - It can concern strategic resources, which one of countries lack or just making better overall connections, lowering duties, etc. Latter option has rather low diplomatic costs and high profits, but it needs relatively good relations.

increase trade isolation and set embargoes - Used mainly to protect local markets, make pressure on some country (can be used as threat, just like declaring war), limit somebody's expansion

create alliance - Alliances has many sorts. Strongest, but most diplomatic expensive (depends much on international situation) are defensive alliances. They implies military and technological cooperation and common fight against aggressions on one of allied countries. Also short term alliance against one or more countries is possible and it's easier to negotiate.

demand tribute or dependency - Obviously it has great cost and is mainly used in big power disproportion between countries

offer tribute - Used in weak position to obtain something.

try to improve relations - Set of diplomatic actions used to convince interlocutor about our good will and friendship. It doesn't cost neither diplomatically, nor financially. Its effects depend on money spent on diplomacy from budget and skills of ruler.

worsen relations - Just like previous point, but with opposite effect.

3.3.3 Espionage, intelligence and counter-intelligence

Diplomacy always has its secret side. Work of spies is almost only automatic process. Player chooses what countries are subject to most intensive observation (percentage distribution among all encountered countries) and assign money from budget.

Counter-intelligence can't be controlled at all, only amount of money spent from budget can be set.

3.4 Government

Structures created to rule country are crucial in keeping powerful, prospering and stable kingdom. Although player has only limited influence on changing its properties, it might be very useful to watch them and make important decisions dependent on them.

There is one general parameter describing state of government, its position and meaning - *control*. Allowing it to get too low (as result of long wars, discontent in society, etc.) might lead to dangerous revolts.

3.4.1 Ruler

Head of reign is represented by set of skills and features.

power - we consider ruler's variable control over country. It corresponds to his individual personality, strictness, and popularity with (or being the terror of) aristocracy and

army. High value allows to make more critical reforms without discontent in society and slowly increases government *control*.

diplomatic skills - ability to make alliances, trade treaties and keeping good relationship with other countries

From time to time country goes under control of new ruler. It can be caused by natural death or conspiracy against previous leader. Latter case is often result of war tiredness, weak political skills of ruler or accompanies large revolts. In worst case this leads to division of country into parts.

3.4.2 Political system

Country always has some organized system for governing people. It consists of set of laws and traditions giving power to some group of people. Entire administration structures are also part of it. Changing current state is often very hard, because any reformer must fight resistance of most powerful elites and effort costs of rebuilding entire system, which people are often used to. It's much easier when ruler has great prestige and power or when acceptance for changes in society is high (e.g. approval for current political system is low).

We distinguish few parameters, which can be watched and more or less influenced. All except the last one have three marks - current state, expected state among entire society (not always the same like this of people holding power), state toward which ruler try to change current.

democracy - describes, how the group holding power is chosen. Low level means some sort of monarchy or oligarchy.

strictness - is system liberal and freedom giving or tyrannizing. High level decreases costs of workforce and army.

centralization - corresponds to structure of administration in country. It can be concentrated in capital city or distributed among entire country, giving more control to local authorities.

advance level - complexity and development level of political system. It cannot be directly changed by player and changes with time and technological (social) progress. High level decreases negative effects of current system and increases positive.

3.5 Interior policies

Our goal is to make player somehow connected to nation, which he rules. In order to do this, we give him ability to change laws and treatment of people as a whole or as unique groups.

3.5.1 Fight of classes

Entire population is divided into classes. We distinguish two town and two village classes. Natural names are *high* (or middle) and *low-classes*.

Most visible difference between them is amount of owned property. In modern times this is the only thing, which allows to distinguish them, but for many ages that was not a case. High classes were closed groups with distinct rights and privileges. In earliest societies full division into our four classes was also not valid. Anyway, such distinction arises naturally with increasing complexity and size of society.

Related screens: **classes screen** (7 in 4.2.2 on page 23).

Player's observations consist of informations: how many classes currently exists, their names and distribution of population among them.

Ruler usually knows what are the levels of:

- wealth
- satisfaction
- education

of classes in country.

Player's interactions: Country policies can impose different duties and give different rights to some people. Currently distinguished classes can have distinct status (scale from none to high) in:

- taxation
- rights to own some properties (usually land)
- personal freedom, civil right (right to leave place of living)
- voting right
- military service

Some of these parameters are directly connected to their counterparts from other sections (taxation to tax level in finances section 3.8.1, voting right to democracy and civil right to strictness in political system section 3.4.2). Difference is that here detailed distribution among classes is possible.

3.5.2 Treatment of nations

Country can have different policies for particular nations inhabiting it or coming from outside. Foreigners can be grouped by their country. Setting these options corresponds to making laws regulating treatment and freedom of minorities in country. For each nation only one of following policies can be chosen.

1. Assimilation

In early societies this method is not much efficient. Only with common education and existing institutions looking after structure of society or foreigners, government can strongly influence people's national feelings.

Nevertheless, setting this variant has always some meaning. For nations with weak culture, it makes their attitude to country more positive. It is second best option (after indifference) for strongly developed nations with unique culture.

2. Slavery (only when country allows slavery)

If nation is not warlike, it can greatly increase workforce and production in country by working as slaves. It allows also better integration of this nation's land into player's (increased inner migrations into lands deserted by those taken into slavery).

3. Extermination

Try of destroying particular nation. This option may be used rather only for domestic nations, because outside of borders it's ineffective and spoils relations with other countries very much.

4. Indifference (Obojętność) - No money is spent. Nation can assimilate, revolt or just do nothing depending on its national consciousness.

Country always have its dominating nation. Commonly this means nation, which is the largest fraction in country. Sometimes some smaller group can conquer or dominate (by cultural influence) country, then it's treated as dominating. Of course mentioned earlier types of politics don't apply to this one nation.

3.5.3 Religion

One of vital properties of nation are their beliefs. They are important in cultural development, diplomacy, controlling country and others.

Religions often have structure and administration independent from country, which can be even international. On the other hand, many religions divide into factions and small sects, which still have similarities.

Clergy can become quite powerful group in country. Allowing them to grow too high might lead to creation of fanatic religion. On the other hand, for most ages they assembled intellectuals and were main motor of philosophical development.

Related screens: **religion screen** (9)

Player's observations consist of: what are the religions in country, their names and distribution of population among them. With names comes also short description of type (polytheistic, monotheistic), advance level and nature (peaceful, fanatic, etc.) of religion.

Exact distribution of each religion's believers is shown on map in culture mode. Here also level of difference between them can be seen (similar or distinct colors).

Player's interactions: Country always has its official, dominating religion. Changing it, is rather drastic move, but it might be good when some new beliefs are gaining more power. Available options are of course chosen from existing religions in country.

Main tool for influencing religious affairs is setting tolerance level. It can be changed independently for all religions. It can vary from persecution (believers are treated very bad) to favor (a little bit more than neutral), because ruler commonly has no way to perform positive actions, but has great choice of negative actions.

3.6 Trade and economy

Building economy power is basis for any other actions performed by ruler. Only country with stable supply of resources, strong monetary system and good general organization can develop properly.

In the game we use several terms from scientific economy and allow various interactions with them. Obvious weakness of our approach is caused by applying modern parameters (created for post-industrial economy) to historical times. We won't obtain such power of expressiveness, like in modeling only modern economy. Nevertheless, we will try to focus on those processes, which are enough general and universal to make some consistent system.

From professional point of view our model is very simple, but it still has considerable connection to real world parameters and processes.

3.6.1 Production

Potential productivity (e.g. obtained in state of full employment and resources allocation) of country depends on its population, existing infrastructure and current technology level. Current production level is most of the time lower due to unemployment. It's more or less represented by Gross National Product (GNP), which is formally sum of the value of all national production (usually in period of one year), calculated in market prices. From now on we will use term *production* for GNP.

GNP is sometimes written as product of *prices* times *quantity of production* ($P \times Q$), giving us equation

$$production = prices \times quantity,$$

which is very useful for our purposes. Amount of produced goods is sometimes more important for us, than their market values.

Real GNP is a little different parameter than GNP. It is value of production calculated in constant prices (i.e. it's divided by factor of inflation), thus it's more comparative across years. We will use it for some statistics.

3.6.2 Supply of materials and goods

Prices of commodities are mainly influenced by their availability. For raw materials it simply corresponds to wealth of deposits, used technology of extracting and possessed tools. Almost the same holds for any other goods, but instead of considering deposits, we take prices of materials needed for production.

In economy, *supply* is defined as relation of prices to amount of goods, which are produced by industry at those prices. Higher the prices are, more attractive it is to produce large quantities of goods.

Player's observations: There is a list of all resources considered in game. Their prices and production level is given here. Usually it's not obvious which prices are relatively high, so resources, whose supply is greatly lowered by lack of their deposits in country, are marked by red color. It notifies, that getting more of them (by exploration, conquest or trade agreements) can greatly improve economy.

Protecting production centers placed in country is crucial for keeping high supply of goods manufactured there and thus maintaining powerful economy.

3.6.3 Demand for goods

Industry produces only things, which are needed in country. There is no point in making goods, which cannot be sold and used. Of course people want to have infinite amount of them, but they buy only what they can effort.

Demand is relation of prices to amount of goods, which people are buying. Lower the prices are, more is possible to be bought.

After taking *supply* and *demand* together, one can see, that there's always some point of balance between them. At some price, amount of commodity which will be produced is equal to that, which will be bought. One of basic observations of economy says, that on free market, price will stabilize on such level and always adapt to changes of supply and demand to obtain this balance.

As we assumed presence of free market, we must consider factors, which might interrupt it. Some of them just increase prices (lower supply):

low trade level - when trade routes between production points and end market are insecure, trade taxes are too high, trade traditions and technology level are low

poor infrastructure - low quality and quantity of roads, markets and transportation devices

constant prices - artificially limited level of prices

Taxation is controlled by player from trade screen and from public finances (redundantly). Quality of trade routes can be increased by changing funds or direct actions concerning infrastructure and security.

There are also more specific influences on market. Ruler can limit prices to some constant value, preserving supply and demand from obtaining balance. This leads to shortage (in case of upper limit) or excess of production level. Such actions are mainly performed to obtain some social goals.

3.6.4 Workforce

In Nations we can understand workforce just as another resource, which has its availability (population) and price (laws of workers, etc.). But still we have to consider essentially different processes involved.

Population is source of workforce. Its demographic structure and law acts currently in force influence supply of workmen:

people in working age - only some fraction of population can work and only they are considered in most of game's processes,

slavery, peasants' serfdom - greatly increases supply, introducing some amount of free workforce (there is some supply at zero price)

women rights

pressure from labor unions - increases costs of work beyond balance point by forcing minimal wages, limiting working hours.

Demand for workforce is created every time, when something is produced in country. This is the place, where technology and infrastructure make great difference. Automation of many industrial processes reduced demand for workforce. In composition with increasing supply (large population) it created *unemployment* in modern times.

3.6.5 Money supply

There were many currencies across ages. Each of them had some influence on ease of doing transactions. Also amount of this currency in economy changed prices and development. Here we can use another equation from economics:

$$Money \times Velocity = Prices \times Quantity \quad (1)$$

Here, *money* (or *money supply*) denotes amount of money existing within country's economy. For example with currency consisting of gold, it's weight of all gold being in

used in transactions. *Velocity* of circulation denotes how many times is monetary unit usually spent during one year. It depends mainly on kind of currency being used and communication level (infrastructure, technology used in communication and transport).

As mentioned before, we want to use real not nominal prices in our calculations. Equality 1 takes nominal prices and gives some insight into relation of prices to amount of money in economy. Velocity and quantity of production are considered as much more constant than prices, so increasing money supply cause mainly increase of prices (inflation). As we will keep prices constant, we have to consider *inflation* parameter. Its high values are negative for economy.

Currency. We distinguish main three kinds of currency:

- based on commodities,
- valuable ores (gold, silver, etc.)
- paper money.

They have different velocities of circulation and allow different influence on their amount in economy. Paper money have both of these parameters very high - player can for example print some of them.

Although prices can easily adapt to changing money supply, really low level of latter causes decrease of production. Also chronic hyper-inflation can have additional effects. Such inefficiency of monetary system can cause switch to more primitive currency and decrease velocity of circulation, again lowering the production.

3.6.6 Roads and railways

Transport infrastructure is being built automatically from public funds. Order of works is defined by needs of trade.

Player can also make initiative to create road or railway on some selected route. He just point on map, choose appropriate option and fix start and end points (or direct route with more details).

3.7 Science

Full meaning of this section appears very late, when gaining of technological advantage over other nations would become one of clear objectives for nation.

Technologies are meant to be developed without much interaction with player. He will be able to force inventors to focus on some branch of science or support some of their spontaneous initiatives, but he can't tell them exactly what to do and in which order invent technologies. Much funds will be lost in meaningless efforts like trying to change iron into gold.

Player will be notified about new technologies by set of names of last developed advances, short description of current level in particular branch. When level of some technology will approach close to some advance, then there appears information, that inventors are about to formulate new idea or invention. In opposite case there will be only very general note about research direction (because researchers don't know themselves what they would invent in future).

3.8 Public finance

One of most important ways to influence on country is managing its public finance.

Public finance is understood as processes connected with the accumulation and allocation of public funds, particularly: the collection and accumulation of revenue, spending public funds, deficit financing.

Appearance of funds distribution in game's GUI depends on country's development level. In primitive societies there will be only few parameters, how goods are distributed among people and institutions. Names of particular parameters will also vary. For example there will be no option to support universities when they don't exist. Entire structure of funds distribution will change depending on form of government in country and its ruling structures.

3.8.1 Revenue

Money are collected from taxes and national properties. All incomes are indicated on *revenue screen*.

Player can set tax rates in percents. They relate to trade taxes (see also 3.6.3) and personal taxes (3.5.1). Both of them have some collect level, which is shown together with tax rate. It's decreased by inflation, corruption, illegal employment and weak tax collecting abilities of government. Higher taxes generally means lower collect level.

Another part of income comes from industry and land owned by government. Its size depends on nationalization level of country.

3.8.2 Treasury

This covers the national monetary reserves. Some money from the budget can be spent to make such reserves, to cover future urgent needs. From those money player can fund initiatives in country, like building new city or castle, fast hiring and arming troops, supporting people in case of disasters.

Some kind of wealth which ruler can give for achieving his objectives are privileges and guarantees of constant income for some groups of society. These are not part of treasury, but will appear sometimes as equivalence for money, especially while creating armies.

We consider such tricks as printing money, which influence many aspects of economy, but can be some kind of very short term help for government. Such money goes directly to treasury and can be spent for anything (see 3.6.5).

3.8.3 Spending

Player defines percentage distribution of all income for following sections on *spending screen*.

1. Scientific research

Science as sink of funds was not always present. In early societies, discoveries were made by craftsmen, sages, priests or merchants. They were obviously not payed to make studies and inventions. Moreover, in many ages making discoveries was limited by some institutions like church and no one could even imagine getting money for doing this.

So, for most time of the game the amount of money spent for science will be limited to some degree and will appear only at some stage of country development, when consciousness of need for technological development will be strongly present in society.

Many possibilities for funding science will arise when some thinkers and inventors would request support from ruler for their work. Later on, there would appear many constant costs like building and supporting universities, laboratories or payment for scholars and scientists.

2. Education

Education will also be limited as non existent in early societies. This section is separate from science, because role of institutions in education is slightly different. It is mainly focused on bringing common knowledge to all people, while science is rather considered as work of elite and the intellectuals. Of course high education level will result after some time in higher science development, but it is not direct relation.

Spending on education contain building libraries, schools, universities, payments for teachers.

Higher education level means more people will move to cities, overall science level will increase, but this also means that education will become more expansive.

3. Culture

This section contains all kinds of culture. Beginning from entertainment for masses (building and supporting arenas), through museums, concert halls for intellectuals and finishing on funding great paintings, sculptures or other art.

4. Health care

This section will appear and gain meaning at some level of development.

It contains building and supporting water supply, hospitals, education of medics, paying for free health care.

This will greatly influence people satisfaction, their growth rates, capacity of cities. Health care financing and elements it contain are strongly connected with some branches of science development.

5. Social welfare

Money can be spent to help poor people, beggars, unemployed.

Great way to make your country socialistic. Has really big influence on people satisfaction and make them less willing to work :)

6. Public administration

In early country development level this means money for king's court, later for building administration and structures to rule the country.

Increased funding implies better reputation of ruler among other nations, better collection level of taxes, less corruption.

7. National defense

Denotes amount of money spent for army, supporting weaponry production, military schools.

This section contains minimal amount of money needed for maintenance of existing army. If received money exceed needed, then army is being upgraded:

- better armament is bought and army is more efficient
- leaders and generals are trained, military academies are built and military theories are developed (connected with science and education);
- fortifications and military infrastructure are created

Lack of money for supporting army causes degradation of battle value and desertions.

8. Public safety

Influences stability, security, crime level in country and level of government power.

- (a) Administration of justice - Will cause lower corruption, crime level and increase people satisfaction (except anarchists ;)).

It contains police support.

- (b) Political police - Its importance depends on personal liberty of citizens and form of government. It can be used to force order in country.

In totalitarian governments and when liberty/democratic development is low, there is danger of government weakening and raise of magnates power, when spending are low in this area.

- (c) Counter-intelligence - Decreases level of knowledge of other countries about ours and level of technology stealing.
 - (d) Office of propaganda - Convincing people about rightness of government actions.
9. International affairs - Supporting diplomatic actions, country's reputation, espionage and intelligence.
- (a) Embassies - Increase efficiency of all diplomatic actions
 - (b) Espionage - Technology stealing, it decreases good relationship with other countries
 - (c) Influence - Contains all sort of actions increasing our country meaning and power in other countries. Economy influence, cultural influence...
10. Transport and infrastructure
- (a) Roads - Overall increase of trade and mobility in country.
 - (b) Fortifications - Castles, city walls.
11. Territorial expansion

Sea oriented

- (a) Exploration - Building exploration ships and automatic expeditions.
- (b) Placements on not civilized areas - Automatic building of trade placements and colonies.
- (c) Security of sea routes, piracy fighting, convoys - Decreases negative influence of enemy piracy on our trade ships.
- (d) Supporting own piracy

Land oriented

- (a) Exploration - Support exploration journeys.
- (b) Colonization of not civilized terrains - Rather cheap way to increase territory. Colonists are sent to areas, where no other country has made colonies yet.

4 Graphical representation

Main game screen will be divided into few parts:

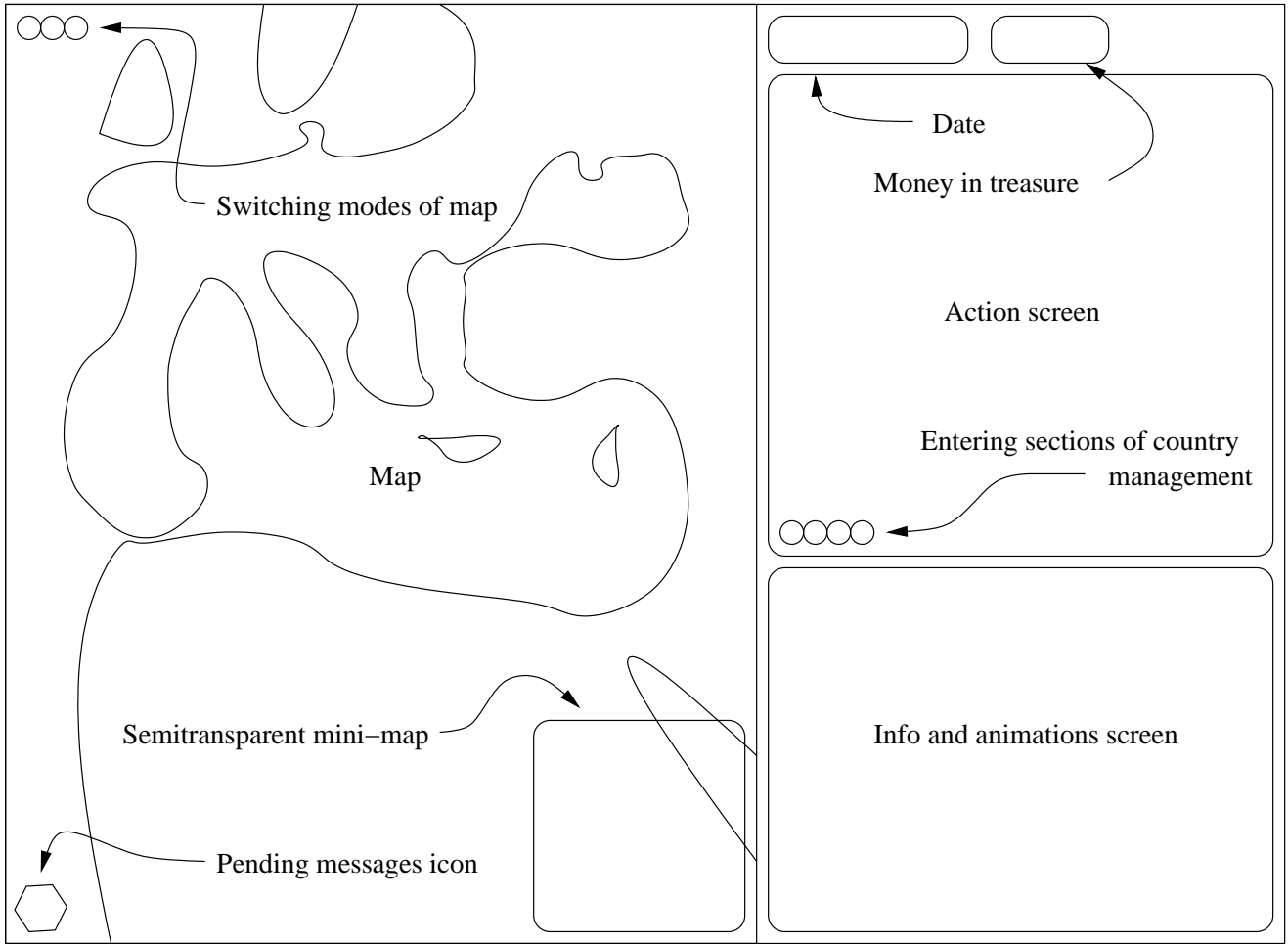


Figure 1: Main game play screen

4.1 Map

Largest part ($\frac{2}{3}$ of the screen). It shows currently viewed part of world map, where unexplored territories are hidden. Each country consists of one or more provinces, each grouping some amount of fields (5-20).

Map has few modes which allows to view various data about country (standard with military units, cities, fortifications, other with religions, nations, richest provinces, etc.). In every mode borders of the countries should be visible and borders of provinces should be semi-transparent. Most important elements of view should always be clearer and more distinct than others (which might be semi-transparent or a little bit blurred) - for example units and fortifications in standard mode or cities, roads and supply points in trade mode.

We imagine map screen as some kind of isometric view on the land (similar to Settlers and Civ 2-3). Terrain, though generated from grid of hexagons, shouldn't appear as grid with distinguishable borders between fields.

4.1.1 Information

Every element on the map can be pointed or selected to get detailed informations about it. They appear in *info screen* (4.3). When selection doesn't apply to any particular object, then the whole province is chosen and its data is presented. What exactly is displayed depends on currently active map mode.

4.1.2 Actions on map

After pointing some place on map player can choose one of actions to perform. They are closely related to various sections of country management and where their detailed description is. Here we just list them and give appropriate references.

- build single fortification object (3.1.3)
- build line of fortifications (3.1.3)
- build road or railway (3.6)
- found city, colony or trade placement (3.2)
- create mobilization point for army (3.1.1)
- begin negotiations with chosen country (3.3.2)

4.1.3 Standard mode

Mode for managing units (military and explorers), watching natural properties of land (type of terrain, rivers, mountains), infrastructure (roads, fortifications, agriculture improvements), size and amount of cities.

Existing units are indicated as groups of little figures. Their amount and type must depend on number and armament of soldiers - exact representation of given size of army will change according to country's population and military possibilities.

4.1.4 Trade mode

Production points of various materials are indicated on the map (as symbols of those materials, sized according to production level). Trade routes between them and cities are also drawn here - lines with thickness depending on size of their turnover. Segments of those lines have colors, which tell what is the quality of given part of route (roads, security). Player can use this information to make strategic decisions about building fortifications (which improve security of trade routes) or conquering most important places.

Many trade routes go through seas, but instead of drawing them here, we end them in harbors. Most important among such points are distinctly shown as trade centers. Information about sea routes would appear after pointing and selecting such a center - as tabular data in action screen and as values of turnover shown near other centers, with which the chosen one has some exchange.

Trade mode also provides information about how rich provinces of country are. It's indicated by color of given part of land.

4.1.5 Culture mode

Shows distribution of nations on the world. Each nation (or culture, which we understand as part of nation) have different color. Dominating nation on every field is shown.

Some of the automatic processes are also indicated on map in this mode:

- migrations of settlers to new lands (as walking nomad, wagon or truck, depending on technology level)

4.2 Action screen

This is the place, where detailed informations about entities or events in game are shown. It allows to perform interactive actions like making diplomacy, altering laws and parameters of country, viewing statistics.

Action screen has many modes, which we all mention here. Some of them can be accessed by selecting one of the *switches* (see figure 1). They relate to main sections of country management and allows to turn on other subscreens, describing more detailed issues.

4.2.1 Diplomacy

1. **relations screen** - list of all encountered countries with basic information about them and current relation level (3.3). It's top screen for diplomacy (turned on after

choosing related switch) and after choosing some country, it directs user to **relations to country screen**.

2. **relations to country screen** - detailed information about chosen country including its alliances, wars and our relations - treatment of its inhabitants in our nation, trade turnovers, history and related international situation (3.3.1). It allows to open **negotiations screen**.
3. **negotiations screen** - relates to all actions from 3.3.2. Lists currently chosen and available proposals, overtone and power of current position.

4.2.2 Interior affairs

Top screen is **government screen**.

4. **government screen** - general information about interior affairs and control over country. It shows control level (3.4 and general description of ruler, political system, classes, nationalities and religion with links to related, more detailed screens. It's top screen of interior affairs.
5. **ruler screen** - name, skills and features of ruler (3.4.1).
6. **political system screen** - current and desired policies of political system (3.4.2): democracy level, strictness, centralization, advance level.
7. **classes screen** - detailed distribution of population in classes with their names, current and desired policies in taxation, rights, freedoms and duties (3.5.1)
8. **nationalities screen** - distribution of nations in country and policies toward them (3.5.2). All nations, with which country has contact, are listed.
9. **religion screen** - information about dominating religion in country, list of religions encountered by country and policies toward them (3.5.3).

4.2.3 Economy

Top screen is **economy screen**.

10. **economy screen** - general parameters of economy, like GNP, inflation, unemployment (3.6). It's top screen of economy.
11. **production screen** - lists quantity of production of goods and materials in country, their prices on market (3.6.1, 3.6.2). Main production points are listed.
12. **trade screen** - lists trade routes and their turnover and security (3.6.3). Allows to define trade taxes for some or all routes.

4.2.4 Science

Top screen is **science screen**.

13. **science screen** - lately discovered technologies, current research topics and discoveries, which would probably appear in near future (3.7).
14. **research branches screen** - detailed information about current technology level in existing branches of science.

4.2.5 Public finances

Top screen is **public finances screen**.

15. **public finances screen** - general balance of public finances, main income and outcome streams (3.8).
16. **revenue screen** - detailed list of income sources with tax rates (3.8.1).
17. **spending screen** - branches funded from budget (3.8.3).

4.2.6 Statistics

Viewing comparison of countries' performance in time.

4.2.7 Unrelated

There is also a set of screens, which aren't directly related to any of mentioned sections. They are mostly used for operations performed on map and are switched by them.

18. **mobilization screen** - gathering and recruiting army in point selected on map. Available soldiers from nearby provinces are listed, with division on veterans and common recruits.

4.3 Info and animation screen

4.4 Help system

Each part of GUI, when being pointed by mouse, should be described by short message (in window appearing near pointer). When player keeps holding pointer over something for a longer time, then bigger window with detailed description should appear.

Part III

World model

We will now give entire model of world - all processes will operate on it and every visualization in game will be based on this data.

5 Earth

Map of the world is given as grid of hexagons (*fields*). In most scenarios they will have 30 km side length. Entire map is divided into groups of fields, called *provinces*. Their size will vary depending on how habitant friendly given terrains are (deserts will be in large provinces and densely inhabited lands in small).

5.1 Field

Smallest part of world's map, which has unique description and stored data.

It holds geographical data describing the land:

movement cost - how terrain affects movement - plain value not modified by roads, forests and infrastructure

roughness - shape, irregularity and slope of terrain (plains, hills, mountains)

type - terrain type is connected with other attributes, but here it's directly named. It contains values like desert, sea, grassland, etc.

stone resources - wealth of stone available for usage

water coverage - amount of field's space covered by water (lakes, rivers)

forest coverage - amount of field 's space covered by forests

5.1.1 Inhabitable field

When *terrain type* is appropriate, then field can be inhabited by humans. In such a case, following additional parameters are stored:

soil fertility for crops - usefulness of terrain's soil for crops; varies from none to very high

soil fertility for breed - usefulness for animal breeding

agriculture - level of accommodation of this land for agriculture, which people have done

urbanization - level city infrastructure on this field

population - amount of people living on this field

nationalities - percentage distribution of nationalities within population

5.1.2 Uninhabitable field

Terrain cannot be colonized and provides no food supplies.

5.2 Province

Provinces are simply groups of adjacent *fields*. They are used to summarize some data stored in contained fields, easily manage territory exchanges between countries, set policies for corresponding parts of land.

They are smallest entities, for which different policies can be set:

- tax level
- religious tolerance
- nationalities treatment

5.3 Resource

On some *fields* there are minerals, which can be extracted as *resources*. They are important in production of any goods in economy. They are the places where trade routes would lead most likely.

5.4 City

Cities represents largest urban areas in the *province*. They are placed on some *fields* (maximum one per field) and are often important nodes of trade net, points of people migrations and centers of industry, culture or science.

5.5 Colony

Colonies are placements of some *country*, but they are not actual part of its territory. They are destination of people migrations and bridgehead of expansion into foreign lands.

Colony has few levels of development:

1. basic placement controlling single *field*
2. organized territory controlling entire *province*
3. confederation of few *provinces* with regular government

5.6 Improvements

After some time of human habitation on land, it is being adapted for purposes of agriculture, communication, military actions. Some of those improvements are evenly distributed among entire land (like agriculture, local roads, buildings) and they are stored in *fields*, but others goes between distant points and don't spread on whole field (international roads, border fortifications. They are stored in *province*.

5.6.1 Road

Long-distance roads, king tracks, highways greatly enchances communication between *provinces*. They are used for *trade routes* and speed up transportation of *military units*.

There can be few roads in province, each has

end points - two *fields* where the road begins and ends

quality

railway quality

5.6.2 Fortification

Long belts of fortifications are used to protect large ares, like *province* and *country* border. They consist of bunkers, forts, lines of trenches, watchtowers, radar stations, anti-air defences or even satellite support.

They are described by following parameters:

end points - begin and end of fortifications line

power against infantry

anti-armor power - efficiency of defense against armored units

anti-air power

6 Country

Country is main entity, which goes into interaction with player. Each player or AI controls one country.

It holds:

- set of *provinces* laying in the borders of country
- entire model of *society*

- controlled military *units* and explorers
- model of *economy* containing *trade routes*, market prices and amount of available *resources*
- *political system*
- model of *science*, which country has achieved
- set of *cities*, *colonies* and *trade placements* controlled by country

6.1 Military unit

Units are controlled by player, they move and fight with other units.

Every unit consists of soldiers, which are divided into groups with different experience. It has also exact list of armament possessed by this unit. Weapons and equipment vary upon their technological advancement, type (short or long range, way of moving, etc.), quality and quantity.

6.2 Society

Society represents all people inhabiting given country or land. It is complex structure describing dependencies between various groups, their laws and properties. Our representation is attached to country, but some description of differences between people goes down to the level of fields.

6.2.1 Nation

We introduce the term of *nation*. It should be understood as entity representing culture, national consciousness and uniqueness of some group of people. It will be our main tool for describing how societies differ from each other (often even within one country).

Internally this entity consists of following parameters:

culture - most important part in describing uniqueness of nation, it can be viewed as union of traditions, language and national consciousness; it is represented by two subparameters - direction (uniqueness, which can have many extreme points allowed to become closer to each other or merge into one) and intensity (level of development, linearly raising from 0.0)

religion - type and advance level of beliefs; represented by direction and intensity

personal freedom - consciousness of personal laws and determination in defending them; represented by intensity

race - physical differences between human races; represented by direction

way of living - migrative or settled life; it's always somewhere between those two points

6.2.2 Class

Most societies are divided into hierarchical *classes*, with variable degree of distinction between them. In game we consider:

1. lower land class
2. higher land class
3. lower city class
4. higher city class

All of them can have different laws, wealth and their distribution among society.

6.3 Political system

All information about government is stored in political system of country.

6.3.1 Ruler

6.4 Economy

6.4.1 Trade placement

6.4.2 Trade route

6.5 Science

Technological development is modeled as many continuous parameters and branches of research. Advancement of science depends on following factors:

- level of research needed to develop given branch
- how much particular technology is needed in country (nobody would invent sails in country without water), which can be stimulated by player and additional money for some branch. Basic needs of people will always trigger research in most important directions for them (food production, water supply, construction, clothes production), but also any events happening in country would force inventors to seek new solutions for problems (wars would speed up weaponry creation, high level of trade would help development of economic sciences and better transportation).
- contact with more advanced civilizations; new ideas and inventions would spread very fast unless particular country isolates itself. This mainly influences theoretical research, because practical experience is much harder to be copied.

- availability of important resources; for example in terrains reach with woods and stones, construction would develop much faster than in grasslands. Sometimes lack of particular resource will greatly slow down development in some branches.
- general education level, money spent on science, amount of people in cities, cultural level

All science is divided into two groups:

Theoretical research It contain those branches of science, which represents various ideas, theories, philosophies, purely abstract sciences and theoretical basis for inventions. Many theoretical branches will start to being developed as the result of high advance in practical usage of some older technologies.

Practical implementation of technologies This part of science development depends on level of craft and practical usage of invented technologies in real live and production. Many technologies have important implementations in live, but making them really work in useful way is as hard as researching the basis tech.

For example, there is a big difference between inventing theory behind electric engine and building working engines in industrial scale, and similar between inventing gunpowder and building good muskets.

Process of achieving this state consists of developing detailed procedures, tools, training workers and preparing infrastructure for production. It will highly depend on level of economy and industry in country. Every technology will have to be first mastered, before it can be really used, for example in military.

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