

Global Simulator 0.01

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Chapter 1

Introduction

1.1 Authorship Note

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1.2 Version Note

Version of this document: 0.01

1.3 Licence Note

1. The authors of this document do not provide any guarantee of using the presented model or any part of this model.
2. All authors of this document should be efficiently informed about any use (especially commercial and public) of the presented model or any part of this model.
3. Scientific and other publications, which provide results obtained by using the presented model or any part of this model, should have an appropriate note (including all authors names and surnames) about this fact at least in bibliography.

1.4 Terms Definition

1. **model** – a set of configurations, a specific instance of world/map
2. **node** – limited area, territorial administration unit
3. **nation** – an ethnically homogeneous group of people
4. **stock** – a type of good which can be controlled, transported and processed
5. **stream** – a pipe between 2 adjacent nodes for stock transport
6. **population** – sum of all people (over nations) in a node
7. **process** – a defined way to process an combination of stocks to:
 - another combination of stocks (stock process)
 - any selected force (force process)
8. **action** – a type of acting, it gives possibility to imact on a model
9. **controller** – an object giving access for human player or controled by AI
10. **force** – a type of power (both civilian and military) which represets quantitative impact on a node
11. **attitude** – quantitative representation of sympathies or dislikes from a nation to a controller
12. **noospher** – sphere of human thought, it represents control of population using media
13. **current** – this quantity characterizes strength (steepness) and direction of:
 - surface slope
 - sea currents
 - rivers

Chapter 2

Data: Tables and Maps

All data, including maps, shall be organized in tables. Each table has to contain at least a single key (column of the table). Division between keys and values are defined by "role" column in a corresponding table header definition. Each key has to be unique in a table.

2.1 Frozen Tables (FT)

Frozen Tables are tables which are defined for a specific simulator version. They have fixed size and constant keys defined by this document. The column configuration is also constant or depends on other constant or static tables. Selected values can be set only before simulating. During the simulation, they are always read only.

2.1.1 Config Frozen Table

- table name: config_ft
- table type: frozen table
- brief: a list of predefined global parameters

Tab. 2.1.1 Header

| column title | column type | column role | column brief |
|--------------|-------------|-------------|-----------------|
| name | string | key | parameter name |
| value | float | value | parameter value |

Tab. 2.1.1 Content

| name | parameter brief |
|----------------|--|
| map_scale | map scale |
| map_width | map width (rounded to int) |
| map_height | map height (rounded to int) |
| map_project | code of map projection (rounded to int, only 0) |
| toll_transship | cost metric for land-see/see-land transport |
| toll_transport | cost metric for civillian transport |
| toll_fortress | cost metric for units moving during a battle |
| toll_current | cost metric for currents |
| transship_gain | building gain for land-see/see-land transport |
| transport_gain | building gain for civillian transport |
| product_gain | building gain for production |
| depot_gain | depot capacity (mean amount of stock per depot) |
| house_gain | house capacity (mean number of people per house) |
| build_staff | mean number of people needed to building maintenance |
| build_cost | amount of building stock needed to building |
| offensive_cost | cost of offensive as factor |

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| name | parameter brief |
|--------------------|--|
| defensive_cost | cost of defensive as factor |
| barrack_cost | cost of barrack as factor |
| media_attitude | impact on noosphere from infrastructure |
| capitol_attitude | impact on noosphere from capitol |
| leader_attitude | impact on nation from leadership |
| nation_attitude | impact on noosphere from nation |
| human_consumption | amount of stock needed for people for life |
| employ_impact | employ impact on birth rate |
| attitude_impact | attitude impact on birth rate |
| birth_rate | base birth rate |
| swap_tollerance | swap tollerance |
| swap_dynamic | swap dynamic |
| employ_dynamic | employ dynamic |
| attitude_dynamic | attitude dynamic |
| emigration_dynamic | emigration dynamic |
| land_range | land trade/civil range |
| see_range | see trade/civil range |
| air_range | air force range |
| navy_range | navy warfare range |
| light_range | land light range |
| heavy_range | land heavy range |

2.1.2 Force Frozen Table

- table name: force_ft
- table type: frozen table
- brief: a list of predefined military processes

Tab. 2.1.2 Header

| column title | column type | column role | column brief |
|-------------------------------|-------------|-------------|-------------------------------|
| name | string | key | force name |
| code | char | key | force code |
| offensive | float | value | offensive power $(0, \infty)$ |
| defensive | float | value | defensive power $(0, \infty)$ |
| civil | float | value | civil power $(0, \infty)$ |
| \forall name \in stock_ft | float | value | stocks needed to work |
| \forall name \in stock_ct | float | value | stocks needed to work |

Each unit needs stocks to work.

Tab. 2.1.2 Content

| name | code | force brief |
|-------|------|---|
| civil | C | civil service (diplomats, intelligence, corporations) |
| light | L | land light army (mainly infantry) |
| heavy | H | land heavy army (mechanized, artillery) |
| navy | N | naval warfare (selected actions on adjacent land allowed) |
| air | A | air force (selected remote actions allowed) |

2.1.3 Action Frozen Table

- table name: action_ft
- table type: frozen table
- brief: a list of predefined action types

Tab. 2.1.3 Header

| column title | column type | column role | column brief |
|--------------|-------------|-------------|--|
| name | string | key | action name |
| type | string | value | types are defined by Tab. 2.1.3 Coding |
| factor | float | value | factor $(0, \infty)$ expresses efficient of the action |
| target | string | value | target type (controller, nation, process, ...) |
| attitude | float | value | attitude $(-\infty, \infty)$ on population |

Tab. 2.1.3 Coding

| type code | code brief |
|-----------|---|
| C | can be realized by civil service |
| L | can be realized by light forces |
| H | can be realized by heavy forces |
| N | can be realized by naval forces |
| A | can be realized by air forces |
| 1 | can be realized if defence of population will be overcome |
| 2 | can be realized if defence of action target (including population support) will be overcome |
| 3 | can be realized if defence of all enemies and population will be overcome |
| X | civil power using |
| D | defensive power using |
| O | offensive power using |

Tab. 2.1.3 Content

| action | type | target | brief |
|--------|-----------|------------|--|
| A0 | CLHN-3-X | stock | apply input duty |
| A1 | CLHN-3-X | stock | apply output duty |
| A2 | CLHN-3-X | stock | apply transit duty |
| A3 | CLH-1-X | stock | get taxes |
| B0 | CLHA-1-O | process | block stock process |
| B1 | CLHA-2-O | controller | block force processes |
| B2 | CLHA-1-X | – | control force processes |
| B3 | C-1-X | – | realize stock processes |
| C0 | C-1-X | – | get economy info |
| C1 | C-2-X | controller | get military info |
| C2 | C-2-X | controller | get service info |
| D0 | CLHNA-1-D | – | block X2 and X3 actions (default) |
| D1 | CLHNA-2-O | controller | remove service |
| E0 | C-1-X | nation | spreading positive propaganda |
| E1 | C-2-X | controller | spreading negative propaganda |
| F0 | CVMNA-1-X | stock | create stream |
| F1 | CVMNA-2-O | controller | block/destroy stream |
| F2 | CVMNA-2-O | controller | confiscate/destroy stock (remote only A) |
| G0 | C-1-X | node | move civil force |
| G0 | LHNA-3-O | node | move non civil force |
| G1 | CLHNA-2-O | controller | strike militarily (remote only A) |
| H0 | CL-1-X | building | develope selected building |
| H1 | CLH-1-O | building | destroy selected non-critical building |
| H2 | CLHAN-3-O | – | destroy critical building (remote only AN) |
| H3 | CLHAN-3-O | – | destroy all building (remote only AN) |
| I0 | CLH-3-O | nation | persecute selected nation |
| I1 | CLH-3-O | – | persecute all nations |
| J0 | CLHAN-1-X | nation | change leader nation (only in capitol) |
| J1 | CLHAN-1-X | node | change capital node (only in capitol) |
| J2 | CLHAN-1-X | controller | peace declare (only in capitol) |
| J3 | CLHAN-1-X | controller | war declare (only in capitol) |

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| action | type | target | brief |
|--------|----------|--------|----------------------------|
| K0 | CLHN-1-X | stock | declare stock buy |
| K1 | CLHN-1-X | stock | declare stock sell |
| K2 | CLHN-1-X | stock | declare stock distribution |

2.1.4 Building Frozen Table

- table name: building_ft
- table type: frozen table
- brief: a set of predefined buildings

Tab. 2.1.4 Header

| column title | column type | column role | column brief |
|--------------|-------------|-------------|------------------|
| name | string | key | name of building |

Tab. 2.1.4 Content

| name | building brief |
|-----------|--|
| transship | transship infrastructure (critical) |
| transport | transport infrastructure (critical) |
| fortress | fortress used for defence during battle (critical) |
| media | information infrastructure (impact) |
| house | housing infrastructure (capacity) |
| depot | depot infrastructure (capacity) |

2.1.5 Stock Frozen Table

- table name: stock_ft
- table type: frozen table
- brief: a list of predefined stocks

Tab. 2.1.5 Header

| column title | column type | column role | column brief |
|--------------|----------------------|-------------|-----------------------------------|
| name | string | key | stock name |
| decay | float (0, 1] | value | decay of the stock per each round |
| toll | float (0, ∞) | value | toll for stock transport |

Tab. 2.1.5 Content

| name | decay range | toll range | stock brief |
|-------------|-------------|----------------|---|
| energy | 1 | (0, ∞) | energy which can be consumed in the current round |
| building | 1 | ∞ | building possible to develop in the current round |
| consumption | 1 | ∞ | it represents consumption in the current round |

2.2 Constant Tables

Constant Tables are tables which are defined for a specific model. Their sizes, column configuration, and content (keys and values) have to be set before simulating. During the simulation, they are always read only.

2.2.1 Terrain Constant Table

- table name: terrain_ct
- table type: constant table
- brief: a list of terrains

Tab. 2.2.1 Header

| column title | column type | role | brief |
|--------------|---------------------|-------|-------------------------------|
| name | string | key | terrain name |
| color | string | key | RGB in HEX |
| drag | float $(0, \infty)$ | value | drag / resistance |
| charge | float $(0, \infty)$ | value | building maintenance charge |
| capacity | float $[0, \infty)$ | value | capacity for stock and people |

2.2.2 Stock Constant Table

- table name: stock_ct
- table type: constant table
- brief: a list of stocks

Tab. 2.2.2 Header

| column title | column type | column role | column brief |
|--------------|---------------------|-------------|---------------------|
| name | string | key | stock name |
| decay | float $(0, 1]$ | value | decay in each round |
| toll | float $(0, \infty)$ | value | toll for transport |

2.2.3 Process Constant Table

- table name: process_ct
- table type: constant table
- brief: a list of processes

Tab. 2.2.3 Header

| column title | column type | column role | column brief |
|--|---------------------------|-------------|--------------------|
| name | string | key | process name |
| energy | float $(-\infty, \infty)$ | value | energy amount |
| building | float $[0, \infty)$ | value | building amount |
| consumption | float $[0, \infty)$ | value | consumption amount |
| $\forall \text{ name} \in \text{stock_ct}$ | float $(-\infty, \infty)$ | value | stock amount |
| <i>Each process can have any combinations of stocks.</i> | | | |

2.3 Static Tables (ST)

Static Tables are tables which are defined for a specific model. Their sizes and column configuration have to be set before simulating and are read only. However, during the simulation, their content (values only) can freely be modified.

2.3.1 Control Static Table

- table name: control_st
- table type: static table
- brief: a list of controllers

Tab. 2.3.1 Header

| column title | column type | column role | column brief |
|--|----------------|-------------|----------------------------------|
| name | string | key | controller name |
| nation | string | value | nation of leader |
| capitol | string | value | base node name of the controller |
| employment | float $(0, 1]$ | value | model of employment |
| $\forall \text{ name} \in \text{control_st}$ | bool | value | war declaration |
| <i>Each controller can declare war for any other controller.</i> | | | |

2.3.2 Nation Static Table

- table name: nation_st
- table type: static table
- brief: a list of nations with their attitude to controllers

Tab. 2.3.2 Header

| column title | column type | column role | column brief |
|---|---------------|-------------|------------------------|
| name | string | key | nation name |
| employment | float (0, 1] | value | fraction of employment |
| \forall name \in control_st | float [-1, 1] | value | attitude |
| <i>Each nation has specified attitude to all controllers.</i> | | | |

2.3.3 Swap Static Table

- table name: swap_st
- table type: static table
- brief: a list of stocks with their mean prices expressed in amount of different stocks

Tab. 2.3.3 Header

| column title | column type | column role | column brief |
|---|----------------------|-------------|------------------------|
| name | string | key | stock name |
| volume | float | value | stock volume exchanged |
| offer | float | value | total stock offer |
| need | float | value | total stock need |
| \forall name \in stock_ft | float (0, ∞) | value | mean ratio/price |
| \forall name \in stock_ct | float (0, ∞) | value | mean ratio/price |
| <i>Each stock has specified prices expressed by all stocks.</i> | | | |

2.4 Dynamic Tables (DT)

Dynamic Tables are used as buffers for data which can be modified during simulating. Their sizes can be freely changed (even to 0 rows). Only the column configuration has to be set before the simulation but later it is read only.

2.4.1 Action Dynamic Table

- table name: action_dt
- table type: dynamic table
- brief: a list of actions to process

Tab. 2.4.1 Header

| column title | column type | column role | column brief |
|--------------|-------------|-------------|------------------------------------|
| owner | string | value | controller name |
| action | string | value | action name |
| force | char | value | force code – defined by Tab. 2.1.2 |
| share | float | value | share/fraction of available impact |
| start | string | value | starting node name |
| stop | string | value | destination node name |
| target | string | value | controller/nation/stock/process |

2.4.2 Force Dynamic Table

- table name: force_dt
- table type: dynamic table
- brief: a list of forces over controllers

Tab. 2.4.2 Header

| column title | column type | column role | column brief |
|--------------|---------------------|-------------|------------------------------------|
| owner | string | value | controller name |
| node | string | value | node name |
| force | char | value | force code – defined by Tab. 2.1.2 |
| amount | float $(0, \infty)$ | value | force amount |

2.4.3 Stream Dynamic Table

- table name: stream_dt
- table type: dynamic table
- brief: a list of streams over nodes

Tab. 2.4.3 Header

| column title | column type | column role | column brief |
|--------------|-------------------|-------------|-----------------------|
| id | int $[0, \infty)$ | key | stream identifier |
| owner | string | value | controller name |
| stock | string | value | stock name |
| start | string | value | starting node name |
| stop | string | value | destination node name |
| amount | float | value | stock amount |

2.4.4 Flow Dynamic Table

- table name: flow_dt
- table type: dynamic table
- brief: a list of components of streams

Tab. 2.4.4 Header

| column title | column type | column role | column brief |
|--------------|-------------------|-------------|-----------------------|
| id | int $[0, \infty)$ | value | stream identifier |
| start | string | value | starting node name |
| stop | string | value | destination node name |

2.4.5 Market Dynamic Table

- table name: market_dt
- table type: dynamic table
- brief: a list of offered stock transactions over nodes

Tab. 2.4.5 Header

| column title | column type | column role | column brief |
|--------------|-------------|-------------|-----------------|
| owner | string | value | controller name |
| node | string | value | node name |
| stock | string | value | stock name |
| amount | float | value | stock amount |

2.5 Constant Maps (CM)

Constant Maps are tables which are defined for a specific model with the geographical context. Their sizes, column configuration, and content have to be set before simulating. During the simulation, their are always read only.

2.5.1 Diagram Constant Map

- table name: diagram_cm
- table type: constant map
- brief: a list of atoms with terrain and node characterization over the geographical context

Tab. 2.5.1 Header

| column title | column type | column role | column brief |
|--------------|---------------------------|-------------|--------------------|
| x | int $[0, \infty)$ | part of key | x coordinate |
| y | int $[0, \infty)$ | part of key | y coordinate |
| color | string | value | terrain color / id |
| node | string | value | node name |
| dx | float $(-\infty, \infty)$ | value | vector x component |
| dy | float $(-\infty, \infty)$ | value | vector y component |

2.5.2 Source Constant Map

- table name: source_cm
- table type: constant map
- brief: a list of natural stock source over the geographical context

Tab. 2.5.2 Header

| column title | column type | column role | column brief |
|--|---------------------|-------------|----------------|
| node | string | key | node name |
| $\forall \text{ name} \in \text{stock_ct}$ | float $[0, \infty)$ | value | yield of stock |
| <i>Each node can be a source of any stock from stock_ct.</i> | | | |

2.6 Static Maps (SM)

Static Maps are tables which are defined for a specific model with the geographical context. Their sizes and column configuration have to be set before simulating and are read only. However, during the simulation, their content (values) can freely be modified.

2.6.1 Nation Static Map

- table name: nation_sm
- table type: static map
- brief: a list of nation over the geographical context

Tab. 2.6.1 Header

| column title | column type | column role | column brief |
|--|-------------------|-------------|------------------|
| node | string | key | node name |
| $\forall \text{ name} \in \text{nation_st}$ | int $[0, \infty)$ | value | number of people |
| <i>Each nation has a specific distribution over nodes.</i> | | | |

2.6.2 Building Static Map

- table name: building_sm
- table type: static map
- brief: a list of building over the geographical context

Tab. 2.6.2 Header

| column title | column type | column role | column brief |
|--|---------------------------|-------------|---------------------|
| node | string | key | node name |
| $\forall \text{ name} \in \text{building_ft}$ | $\text{int } [0, \infty)$ | value | number of buildings |
| $\forall \text{ name} \in \text{process_ct}$ | $\text{int } [0, \infty)$ | value | number of buildings |
| $\forall \text{ name} \in \text{force_ft}$ | $\text{int } [0, \infty)$ | value | number of buildings |
| $\forall \text{ name} \in \text{stock_ct}$ | $\text{int } [0, \infty)$ | value | number of buildings |
| <i>Each building has a specific distribution over nodes.</i> | | | |

2.6.3 Noosphere Static Map

- table name: noosphere_sm
- table type: static map
- brief: a list of controller share of information media over the geographical context

Tab. 2.6.3 Header

| column title | column type | column role | column brief |
|---|------------------------|-------------|--------------|
| node | string | key | node name |
| $\forall \text{ name} \in \text{control_st}$ | $\text{float } [0, 1]$ | value | share |
| <i>Each controller can have a specific distribution of impact over nodes.</i> | | | |

2.6.4 Stock Static Map

- table name: stock_sm
- table type: static map
- brief: a list of gathered stock over the geographical context

Tab. 2.6.4 Header

| column title | column type | column role | column brief |
|--|-----------------------------|-------------|--------------|
| node | string | key | node name |
| $\forall \text{ name} \in \text{stock_ft}$ | $\text{float } [0, \infty)$ | value | amount |
| $\forall \text{ name} \in \text{stock_ct}$ | $\text{float } [0, \infty)$ | value | amount |
| <i>Each stock can have a specific distribution over nodes.</i> | | | |

Chapter 3

Mechanisms

3.1 Event Order

3.2 Node Control

3.3 Actions

3.4 Map Projection

3.4.1 Cylinder Projection

3.5 Transport

$$R_{\text{next}} = R_{\text{curr}} + R_{\text{atom}}X^{-S_{\text{stream}}}$$

3.5.1 Stock Transport

3.5.2 Force Transport

3.6 Population

3.6.1 Employment

3.6.2 Birth Rate

3.6.3 Migration

3.7 Production

3.7.1 Stock Production

3.7.2 Force Production

3.7.3 Development

3.8 Maintenance

3.8.1 Force Maintenance

3.8.2 Building Maintenance

3.8.3 Stream Maintenance

3.9 Stock Exchange

3.9.1 Swap Ratio

3.9.2 Local Exchange

3.9.3 Inter-Controller Trade