

AMiCUS: An Agent-based Model for CommUNITY driven Supply in rural areas

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1 Introduction: Social challenges

- Social challenges like **growing urbanization** and **demographic change** result in **new issues** like declining numbers of stores for convenience goods in **rural areas**.
- On the other hand, growing **digitalization** might be a solution: without adapting the infrastructures an app-driven **community-based delivery system** can empower the people to help each other.

2 Motivation: A community-based service (cbs)

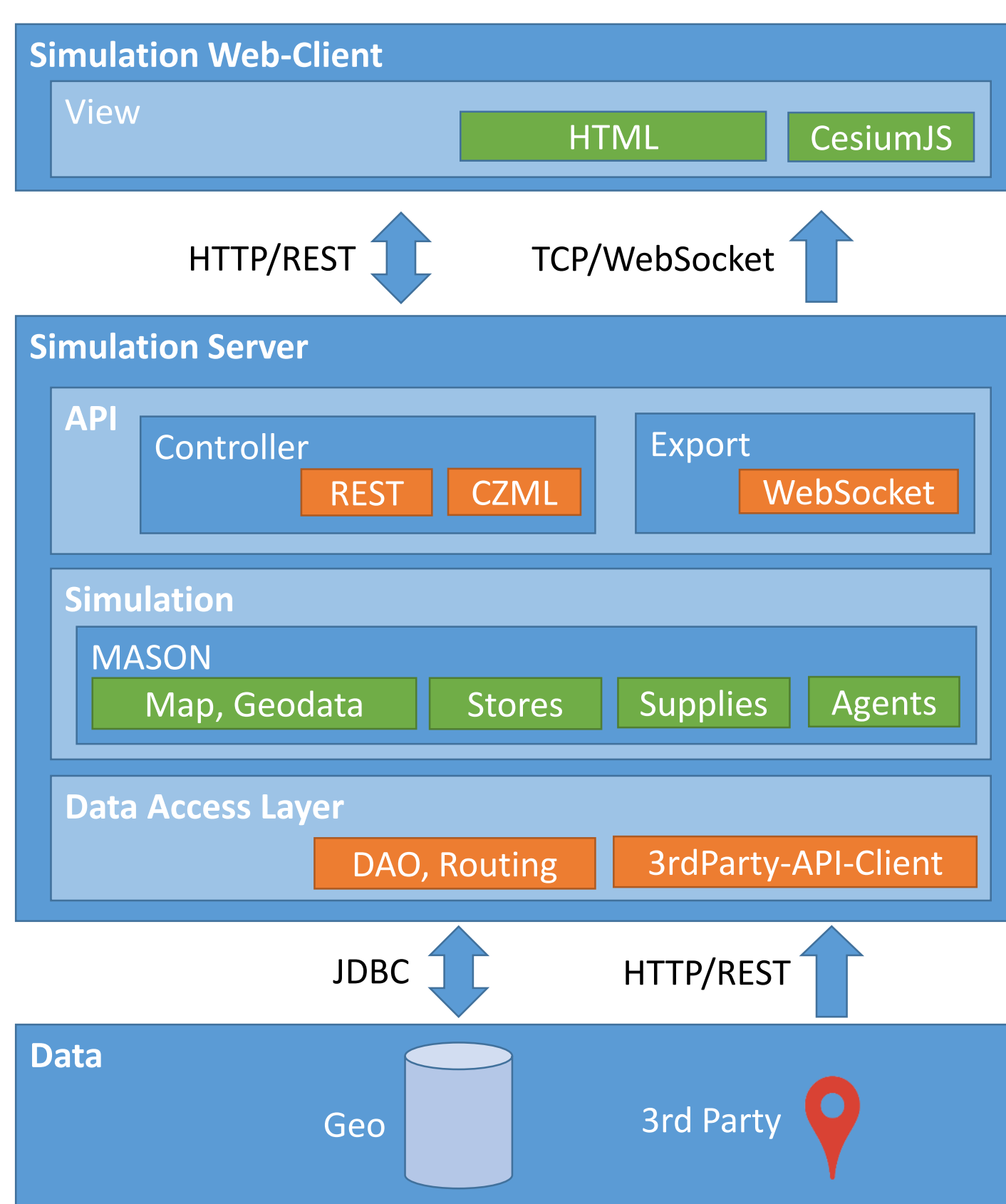


3 Hypothesis: logistic cbs lead to new issues

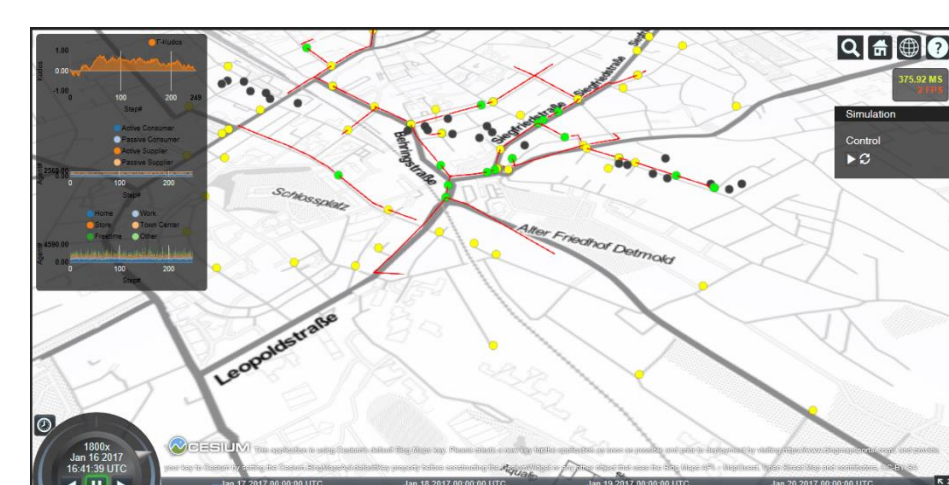
- Quality and performance of community-based services (cbs) depend on quantity and quality (role) of **active users**.
- For logistic cbs in particular, also depending on **space** and **time**.
- Analyzing those interconnections could lead to later improvements.

4 Method: GIS and ABM

- To investigate spatial-geographic, socio-spatial and infrastructural relationships within a community-driven delivery service we combine **GIS** and **ABM**.
- ABM are commonly used for the recognition of social-scientific problems. In this case the behaviour of users in a digital community-based service.
- Therefore we built a **simulation environment** and developed an ABM based on ODD.



- Simulation environment is a client/server web application.
- Java-based enhancement of MASON multi agent toolkit.
- Usage of open source software like CesiumJS, PostGIS, Spring.IO.
- Geodata provided by ESRI shapefiles and 3rd-party API like Google Places.

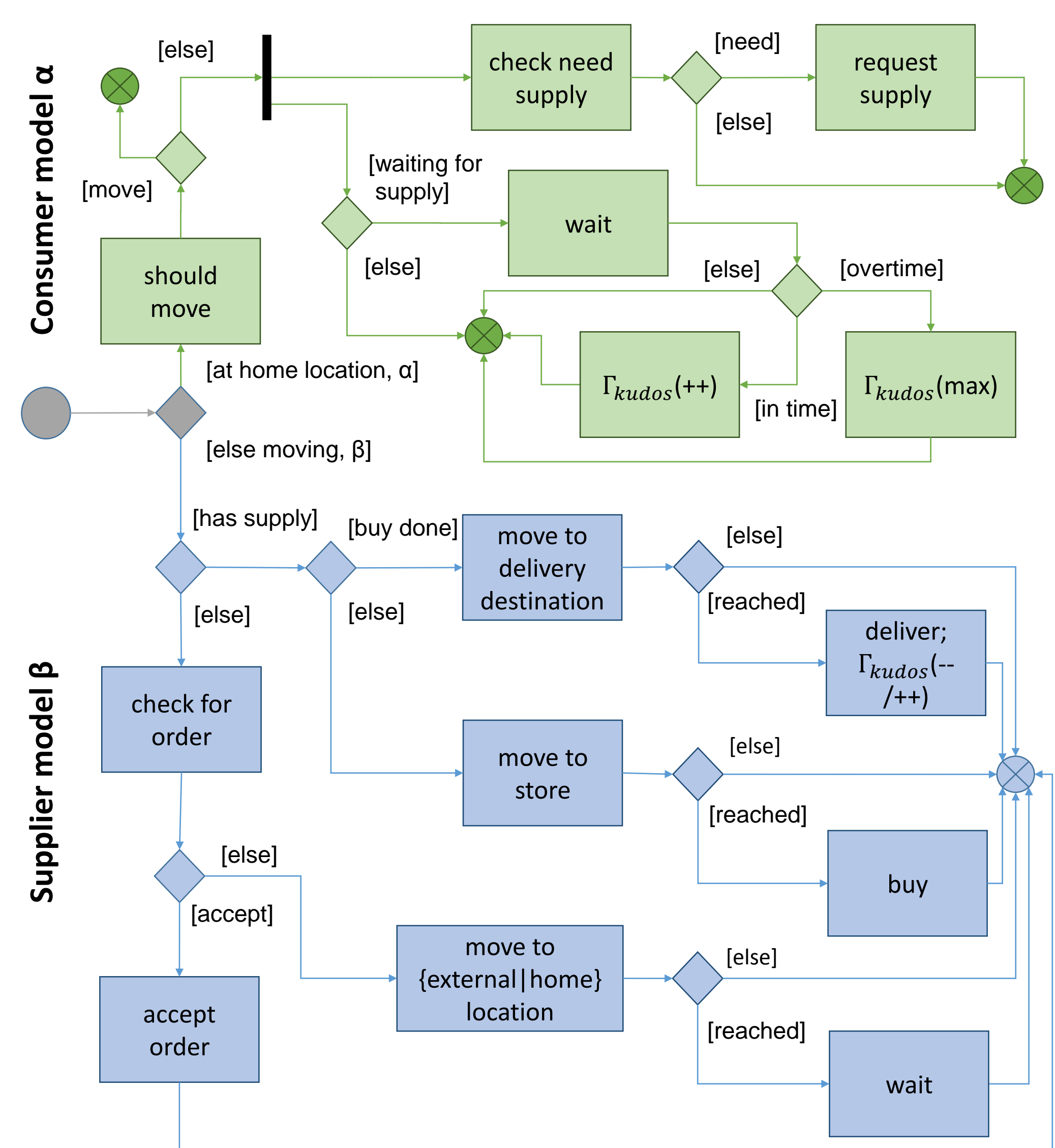


5 Proposed model

- **Purpose:** Estimation of the success of the app-driven community-based delivery service through a simulation.
- **Simulation parameters:** User agents as consumers (α), user agents as suppliers (β) and the community-based service itself (Γ).

Parameter	Value range	Description
$\Gamma_{storeLocation}$	$P(x, y), x, y \in \mathbb{R}$	A location where supplies can be bought
$\Gamma_{serviceKudos}$	$[-1, 1] \in \mathbb{R}$	The overall reputation of the service
$\alpha_{homeLocation}$	$P(x, y), x, y \in \mathbb{R}$	The location where supply should be delivered to
α_{demand}	$[0, 1] \in \mathbb{R}$	The time-dependent demand for supplies
$\alpha, \beta_{serviceKudos}$	$[-1, 1] \in \mathbb{R}$	The personal reputation of the service
$\beta_{externalLocations}$	$\{P(x, y) \mid x, y \in \mathbb{R}\}$	A set of locations where to move repeatedly
$\beta_{\Delta maxCost}$	$\in \mathbb{N}$	The maximum amount of extra cost (e.g. distance, time) for a detour

- **Process overview and scheduling:** Consumers demand for supply (α_{demand}) and will request goods. Whether the users satisfy their needs using this service is determined by their own ($\alpha_{serviceKudos}$) and overall ($\Gamma_{serviceKudos}$) experience. Moving users outside their home location can check for available requests for supply and accept them as supplier. The acceptance is based on three factors: additional cost ($\beta_{\Delta cost}$) for the detour to fetch and deliver the order as well as global ($\Gamma_{serviceKudos}$) and personal ($\beta_{serviceKudos}$) reputation of the system. The diagram shows one simulation step of an agent's activities.



6 Future work

- The model will be implemented and several simulations will be run to collect relevant data.
- Using a virtual gaming approach, the simulation environment will be extended by a smartphone app for usage by real life users. Within a pilot phase this **mash-up** of **real** and **simulation** data will be another step forward to validate the model and to get conclusions about the success of such a service.