Testing Markov Nature of the City Developers' Behavior: 'In Vitro' Experiment and the Simulation Model

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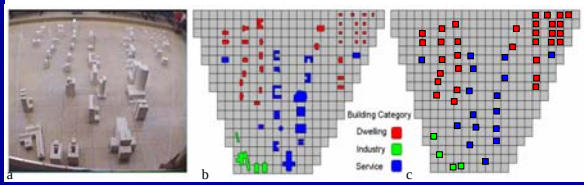
Experiment

- We asked 30 undergraduate students of geography (Developers, below) to 'built a city' using a set of mock-ups models.
- The mock-ups represent real buildings and resemble different urban functions.
- Developers assigned an urban function to each building (Dwelling, Industry or Service.
- Each developer below, 'built the city' once, locating one mock-up at a time.

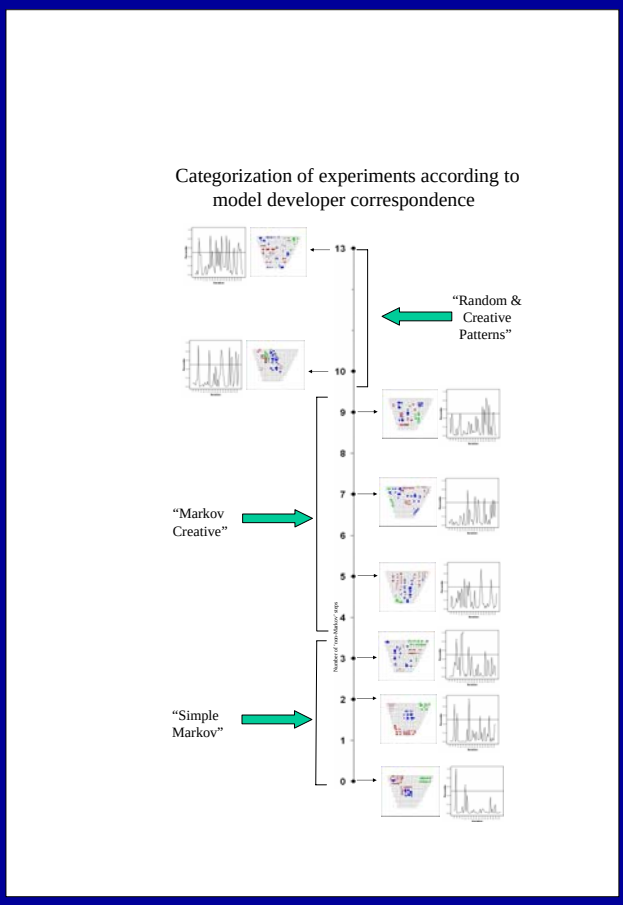
7 of the 52 mock-ups used in the experiments (The floor tiles are of 20x20cm size)

A snap-shot of a game outcome (a), and its GIS presentation by means of mock-up foundation polygons (b) and polygon centroids (c).



Individual developers versus average model

- The number of low potential locations chosen by the developer



Experimental Results

Developers behavior is two-step:

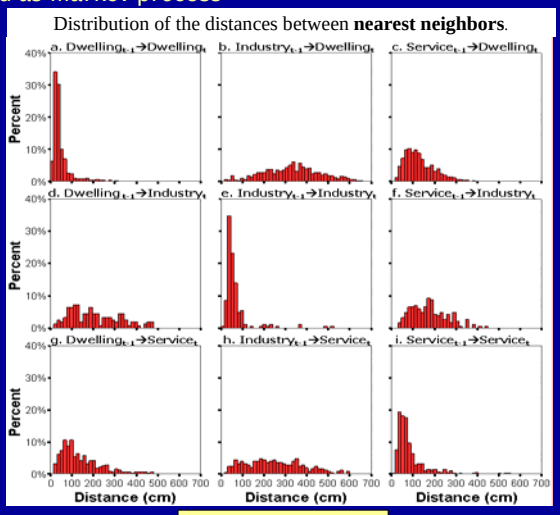
1. Assign urban function of the building: Verified as Markov Process

B_t \ B_{t+1}	$Dwelling_{t+1}$	$Industry_{t+1}$	$Service_{t+1}$
$Dwelling_t$	0.797	0.058	0.145
$Industry_t$	0.277	0.496	0.229
$Service_t$	0.346	0.102	0.551

Transition probabilities of a building type choice if seen as a Markov process

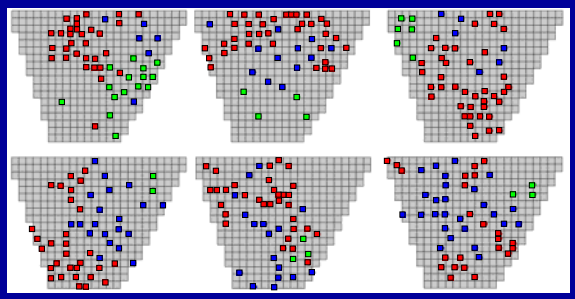
2. Locate the building on the floor according to potential functions: Verified as Markov process

Distribution of the distances between **nearest neighbors**.



Model

- Developers agent builds city according to experimentally established Markov model of behavior.



Model fit

Means and standard deviations of nearest neighbor distributions for the simulated and experimental city patterns.

Pair	Mean	STD	Mean	STD
Dwelling → Dwelling	30	6	35	5
Industry → Industry	58	32	29	20
Service → Service	61	14	64	13
Industry → Dwelling	280	97	260	65
Dwelling → Industry	184	97	170	65
Service → Dwelling	104	41	105	23
Dwelling → Service	112	56	96	25
Service → Industry	131	63	120	48
Industry → Service	212	63	197	61

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