Downtown Dynamics Model by Artificial Society Approach

Toshiyuki Kaneda and Shuang Chang

Abstract

Downtown revitalization has become an important policy issue, especially in advanced countries. In more than 50 years since Jane Jacobs's discourse, the mechanism of the formation and decline of downtowns has been the subject of much controversy. It has been argued that the agglomeration and attractiveness of downtown are supported by its internal diversity. However, very little research including model analysis with an awareness of quantification has been presented.In order to examine the generation and sustainability of "downtown," the paper outlines the Downtown Dynamics Model DDy using an artificial society approach. The paper mainly reported the formalization of externalities as the basic concept of the integration and specialization of shops, and oligo-centric market system and additional implementation applied to both the customer and shop agents in order to give a dynamic to the existing simulator ASSA. A prototype DDyn has been created on an experimental basis.

T. Kaneda (Corresponding author)
Graduation School of Engineering, Nagoya Institute of Technology,
Gokiso-cho Showa Nagoya Aichi, Japan
Email: kaneda@nitech.ac.jp

S. Chang
Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology, 2-12-1 Ookayama Meguro Tokyo, Japan
Email: chang11@dis.titech.ac.jp

1. Considering "Downtown" from Model Analysis: Background and Objectives of the Paper

Regeneration of 'downtown' in Central Business District has become a important policy, especially common in advanced countries. Even in the online shopping era of the 21st century, downtown should work as the 'place' where citizen visit and examine their preferred goods really in touch, try to experience novel services or look for discover something new beyond their daily life. Thus, downtown is needed in each metropolitan area.

The mechanism controlling the prosperity and decline of downtown has been discussed for more than half a century since Jane Jacobs presented her initial work; however, very little research including model analysis with an aware-ness of quantification has been presented.

It has long been known the origin of the prosperity and decline of downtown lies in maintaining diversity, as mentioned in the 1950s by Jane Jacobs in her hypotheses for city diversity generation. From among her works, the author focuses on the numerous positive and negative external effects (externalities) that are found or could be found among diversified economic entities (e.g. shops, customers) that are active in urban spaces.

The Osu district in Nagoya City has maintained itself as a busy and thriving downtown area by the ever-changing and constant accumulation and integration of many small-scale shops (Oiwa, Yamada, Misaka, Kaneda, 2005, Takeuchi, Yoshida, Kaneda, 2011, Kobayashi, Harazaki, Kaneda, 2015); based on in-depth knowledge of the actual conditions of both the district's customers and shops over 15 years, and by taking a bottom-up approach where diverse deci-sion-making entities dynamically interact, the author de-signed an artificial so-ciety system for "downtown" and through simulations, examines its implica-tions. Although this artificial society approach deviates from the KISS principle, it is the core of this challenging research project.

With an aim at creating "downtown" and exploring knowledge concerning its sustainability, the research newly proposes a Downtown Dynamics Model (hereinafter, DDy) that represents interaction between a wide variety of cus-tomer agents and shop agents as an artificial society system. Among these agents, positive and negative externalities are generated in response to market transactions (purchases). The artificial society approach creates a model to han-dle agent models designed with a focus on the compounding of the above-men-tioned externalities, and to study their interaction system. Moreover, by a con-structive approach with simulations, this approach explores the implications of the formation, sustainability, and decline of downtown.

2. Research Questions: The Objectives of the Downtown Dynamics Research Program

In the research the "externality" mentioned in the context of commercial activity is limited as follows: the secondary effects arising from any market transactions reach to third parties other than the transaction parties, but not by way of the market. So long as an externality is a consequence of market transactions, it would be sufficient to establish the foundation from the scale of meso micro or higher, where an aggregate is possible.

In DDy, particular attention is given to externalities between shop types within a district. The research also discusses not only static externalities that are not stipulated by a temporal axis, but also dynamic externalities taking into account temporal development.

The four conditions for city diversity presented by Jacobs, their sources, and how they are handled by the research model are classified and shown in Table 1.

The commercial district on which the research places a focus is characterized as a complex district consisting of small-size shops, in which (1) all shops of the same type have the same size (small-scale identity); and (2) each shop type deals with only one type of errand (non-complexity). These parameters characterize the downtown conditions under Jane Jacobs' hypotheses (Jacobs, 1961).

By describing the research questions more operatively, is it possible to reasonably demonstrate in a downtown model the four conditions for city diversity presented by Jacobs? In addition, within such a system, with what characteristics is this possible? If possible, the paper would like to present a research program to explore key elements and factors.

Table 1. Texts on City Diversity Hypotheses (Jacobs, 1961) and Their Tentative Interpretation on Modeling

Requirements of the City Diversity	Citations in the Text	Tentative Expression in Downtown Dynamics Model
(1) Mixed (Two or more) Primary Use	- On successful city streets, people must appear at different times(p.172). - NO neighbourhood or district, NO matter how well established, prestigious, or well heeled, and NO matter how intensely populated for spreading people through time of day without frustrating its potential for generating diversity.(p.172) - If it is combined with another primary use that brings people in and out and puts them On the street at the same time, noting has been accomplished.(p.174)	• The types of shops with many planned visits are treated as the primary types. • Different cases of numbers of the primary types and other types are to be set initially.
(2) (Not too large) Small Blocks	– Long blocks, in their nature, thwart the potential advantages that cities offer to incubation, experimentation, and many small or special enterprises. Long blocks also thwart the principle that if city mixtures of use are to be more than a fiction on maps. (p.196) – On certain streets, any disproportionately large occupant of street frontage is visually a treat disintegrator and desolators, although exactly the same kind of uses, at small scale, do no harm and are indeed an asset.(p.247) – Frequent streets are necessary to city districts in any case, if diversity is to be generated. (p.230)	• In SOS (Shop On the Street) expression, maps of different block sizes with same set of shop nodes are to be set initially.
(3) Mix of Old and New (Aging buildings)	– If a city area has only new buildings, the enterprises that can exist there are automatically limited to those that can support the high costs of new construction.(p.200) – Among the most admiral and enjoyable sights to be found along the sidewalks of big cities are the ingenious adaptions of old quarters to new uses.(p.207) – In particular, they need old buildings to incubate new primary diversity.(p.208)	• For Shop agent, the rent for each shop node varies.
(4) Density; Diversity generates concentration	– To be sure, the dwellings of a district need to be supplemented by other primary uses(p.214) – In the case of enough people in enough dwellings, the diversity can be generated.(p.220) – Frequent streets are necessary to city districts in any case, if diversity is to be generated. (p.230) – The very process of increasing densities gradually but continually can result in increasing variety too, and thus can permit high ultimate densities without standardization. (p.229)	• The Number of customers is to be given, that determined by a threshold value to guarantee the diversity.

3. Formalization of Externalities: Establishing the Foundation for a Commercial District Integration and Specialization from Agent Interaction

3.1 Formalization of Externalities in a Commercial District

A commercial district model mentioned in the research assumes a complex district consisting of small-size shops as described above, and two hypotheses are set: (Hypothesis 1) All shops of the same type are equal in size and the size remains constant; and (Hypothesis 2) A shop (shop type) only deals with single errands and therefore, does not comprise any other different shop type (complexity is not handled).

In general, Agt is the Agent set. When Agent s and t do transactions, the resulted externality to Agent r, $r(s, t, r \in Agt)$ is represented as the following utility value:

$$u_{ext} : Agt \times (Agt \times Agt) \to \mathfrak{R} \ldots (1)$$

$u_{ext}(r; s, t)$: Utility function of externality factor

For example, regarding the externality among different types of shops,

$$Agt = Cus \cup Ten \ s.t. \ Cus \cup Ten = \phi$$

Cus: Customer agent set in Metropolitan
Ten: Shop agent set in Metropoilitan
X and Y are the set of Shop agents x and y of type X and Y, i.e. $x \in X, y \in Y$ while X and Y are the partition of Ten.

When Customer a purchases at Shop x of type X, the externality for Shop y of type Y is expressed by the utility value as follows, which can be accumulated by assumption.

$$u_{ext}(X, Y) = \Sigma_{y \in Y} \Sigma_{x \in X} \Sigma_{a \in Cus} u_{ext}(y; x, a) \ldots (2)$$

When a customer a has made a purchase at shop x of shop type X in a district i at a point of time t, if an external effect to shop y of shop type Y is given by a real-valued utility function shown below, an externality element utility function is defined as described within the box at the upper right of this page. Here, if this utility can be added up, the externalities between shop X and Y at a point of time t in district i can be totalized. If variable values comprising the intermediate formula change in terms of time, it is possible to represent dynamic externalities.

3.2 Commercial Integration and Specialization Resulting from Externalities between Shop Types: Classification According to Case Scenarios

On the assumption that externalities between shop types are fixed for a short time, and based on a thought experiment, the integration of a shop type

composition in a commercial district was classified according to case scenarios, as shown in Table 2. Firstly, the following three cases are considered: (a) the externalities between shop types in the district are all positive; (b) positive and negative externalities between shop types coexist; and (c) the externalities between shop types are all negative. Moreover, scenarios are considered where each of the three cases is superior to a rival district in terms of attracting customers. In this regard, it could be thought that the capability to attract customers depends on the integration of the same shop type and diversity. When the district is inferior to a rival district, it tends to decline.

Table 2. Typical Agglomerations Affected by Externalities between Shop Types inside a District

Externalities among Each Shop-Type within District	In Case that the District has Advantage in Other Districts in Retail Fascination (i.e. Size and Diversity)	In Case that the District has Disadvantage in Other Districts in Retail Fascination
(a) Case of All Positive	Agglomeration with Diversity and No Specialization within District	Decline
(b) Case of Mixture of Positive and Negative	Agglomeration with Diversity but Specialization within District	
(c) Case of All Negative	Agglomeration of Specialized Shop-Type but with No Diversity	

In Case (a), on the whole, diverse integration could be formed with no internal differentiation of shop types. In Case (b), on the whole, diverse integration is formed with internal differentiation of shop types. In Case (c), the whole integration specialized in any one of the shop types is formed; in this case, no diversity is found.

In Case (b), positive and negative externalities coexist, it is not difficult to imagine that the case takes on a complicated aspect in a so-called ecosystem of its components. In addition, the capability to attract customers, which determines a district's ranking, is not just simply a matter of size, but could include diversity as a primary factor; therefore, to pursue such characteristics in detail, a modeling is required that captures the characteristics of the target district.

Thus, from the formalization of externalities, to some extent the formalization of integration and diversification of a commercial district can be classified according to the case scenario. However, to discuss actual "downtown" regeneration, a new operative model is required.

3.3 Condition Setting for Externalities and Indirect Externalities

As described above, to introduce externalities, a market as an aggregate concept is essential. In an agent approach, however, the foundation for externalities can be established through economic (monetary) transactions between individuals, which should be called micro decomposition of the market.

Here, to design a DDy basic model, it is assumed that this system consists of a great number of customer agents and shop agents, and in the district, monetary transactions between each customer and shop is carried out.

Hereby followings 6 items of the third group in externalities which to relate to "downtown", will be explained.

(a) group is the direct eternality to have effect on each agent. The first is the drop-in induction effect to another shops in the same district (a-1). "Drop-in induction effect" gives eternality to both customers and shops.

For the shop side, "bandwagon effect" (a-2) is considered, namely to gain more customers to the popular shops. As described above, (a-1) is mostly referred as the first factor of the micro factors about the integration of many shops in central business district.

(a-2) has been studied as an object in the field of the socio-psychology, the marketing science and recently the complex system science, too.

(b) group is not monetary transactions between agent itself, but the indirect externality from the transactions of communication.

For the customer side, "word and mouth effect"(b-1) has been studied as an object since long ago. And for the shop side, the imitation of stores each other and innovation (b-2) can be pointed out. Especially the effect of innovation is regarded as a subtype of eternality by Jane Jacobs.(This commercial model is consisted of only 2 types agents, small shops and customers. Therefore it is thought that manufacturers and wholesalers should be omitted.) In the DDY's current version it will be not taken, but the interaction system can be planned to enable a simulation experiment.

(c) group is the actualized externality by the count in the district of the delicate externality and the count for a long term. For the customer side, the attractive improvement effect of central business district (c-1)will be considered. It can be

thought that the count depends on "stop-by-incidentally' effect" and "mouth word's effect". The attractive improvement effect of the district by "stop –by- incidentally" effect has been implemented as the update- algorithm of the prior district effect in the DDy.

For the shop side, The observation of the district-visitor's layer has effect to enable that the slump store should be changed into the other shop type(c-2). In the DDY the shop agent will convert the shop type by calculating of the maximum expected profit based on the number of customers, who pass a street of the front. It can be called as a shortsighted rationality model.

The above-mentioned form expression will be also presented

(a) Direct Externality to Individual
    (a-1) 'Stop-by-Incidentally' Effect (Customer and Shop-Sides):
        $(\exists\ c,s,s^{\wedge'}\in T)(cVs \Rightarrow cVs')$.
        Micro-origin of retail agglomeration
        Already considered (from ASSA project)
    (a-2) 'Bandwagon' Effect (Shop-Side):
        $(\exists\ c,c^{\wedge'},s\in T)(cVs \Rightarrow c^{\wedge'}Vs)$.
        Well-known in existing sciences
        To be planned
(b) Indirect Externality by Communication
    (b-1) 'Mouth Words' Effect (Customer-Side):
        $(\exists\ c^{\wedge'}\in C)(\exists\ c,s\in T)(((cVs)\wedge(⟦cIc⟧\ ^{\wedge'}))\Rightarrow c'Vs)$.
        Well-known in existing sciences
        To be planned
    (b-2) Imitation/Innovation Effect (Shop-Side):
        $(\exists\ c,s,s'\in T)(((cVs)\wedge(sIs'))\Rightarrow(s'\mapsto s''))$.
        A special (retail) case of Jane Jacobs Externality
        To be planned
(c) Meso-Aggregation of Fine Externalities
    (c-1) Town-Wide Attractiveness Effect (Customer-Side):
        $(\exists\ c,s,s^{\wedge'}\in T)(((cVs)\wedge(cVs^{\wedge'}))\Rightarrow cVT)$.
        $(\exists\ c^{\wedge'}\in C)(\exists\ c,s\in T)(((cVs)\wedge(⟦cIc⟧\ ^{\wedge'}))\Rightarrow c'VT)$.
        The former is implemented as 'Updating of Ex-Ante Utility of Downtown Visit in DDy.
    (c-2) Shop-Type Change Effect (Shop-Side):
        $(\exists\ s^{\wedge'}\in T)(\exists\ \{c\},\{s\}\subseteq T)((\{c\}V\{s\})\Rightarrow(s'\mapsto s''))$
        Implemented as 'Myopic rationality principle' of shop agents in DDy $s'\mapsto s''$
(notation)
    $c,c^{\wedge'}$:customer,$s,s^{\wedge'},s^{\wedge''}$:shop,C:Set of customers in Metropolis,
    S:Set of shops in Metropolis, T:Set of agents in Downtown($T\subseteq C\cup S$).
    $V, I, \mapsto$: binary relation.
    cVs means "c has visited s".
    cIs means "c has communicated with s".
    $s^{\wedge'}\mapsto s^{\wedge''}$ means "s has changed to s".

4. Artificial Society System Model for Selection of Commercial Districts

4.1 Features of the Artificial Society System in DDy

The Downtown Dynamics Model (hereinafter, DDy) handled in the research has been developed from an ASSA model focusing on a downtown district as a relatively superior commercial district in an urban area (Yoshida, Kaneda, 2007, 2009, 2011, 2013a,2013b, Kaneda, Yoshida, 2012). The ASSA is characterized by (1) garbage can model, and (2) customer behavior model with intelligent agents, and the details are described in a previous report. The following sections explain an "oligo-centric market system," which form the entire structure of DDy; a district prior utility function, which was introduced as a commercial district selection model; and customer behavior in the downtown district.

4.2 Oligo-Centric Market System

An oligo-centric market system is different from the mono-centric market system of the downtown district in the previously-presented ASSA. A variety of errands arrive every hour, and from among them, each customer agent finds errands corresponding to or exceeding the preset number (threshold) of types; they then make a decision on whether to visit a commercial district. When decision-making, as candidate districts in the initial stages, a downtown district with its large number of shop types is the most attractive; however, there are multiple commercial districts with sole or multiple shop types (Fig. 1).
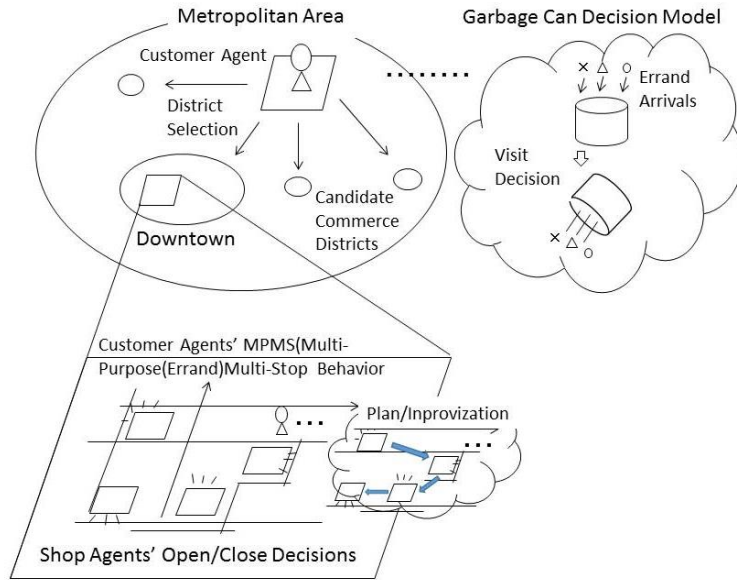
Fig. 1. Oligo-Centric Structure of Commerce Distributions in Downtown Dynamics Model
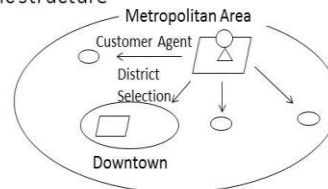

Errand-based District Selection Model under Oligocentric structure

$$V_i = \alpha \ln A_i - \beta T_i \quad (1)$$

$$U_i = V_i + \varepsilon \quad (2)$$

$$\varepsilon \sim Gumbel(0,\ \eta) \quad (3)$$

$$q_i = \exp(V_i) / \sum_{j \in \{D_j\}} \exp(V_j) \quad (4)$$

In case of downtown($i = 0$), Expected district utility value considering errand completion, impulse purchase, and time cost within the district

Replace A_i in equation (1) $\quad \tau_i \sum_{k \in \{X \cap D_0\}} u_k$

with Divide β into β_S and β_C to fit $T_i = S_i + C_i$

But, a penalty will be posed if the errand is failed when visiting the district

Especially, when $u_k = 1$ for all k, $\tau_i \#\{X \cap D_0\}$

$$V_0 = \alpha \ln \tau_0 \#\{X \cap D_0\} - (\beta_S S_0 + \beta_C C_0) - (Penalty) \quad (1)'$$

In case of other districts ($i \neq 0$), Assume there is only one shop for each type, use expected utility value considering only the probability of errand completion $\quad \sum_{k \in \{X \cap D_i\}} p_k u_k$

Replace A_i in equation (1)

with
Especially, when $u_k = 1$, $p_k = p$ for all k, $p \#\{X \cap D_0\}$

$$V_i = \alpha \ln p \#\{X \cap D_i\} - \beta_S C_i \quad (1)''$$

When selecting a district, for the downtown district, a utility value V_0 is calculated using a district prior utility function, and for other districts, to simplify, a logit model that can be interpreted as a rational model in an approximate sense is used to select in a probabilistic manner. The logit model has a utility value calculated from the number of shop types $\#\{X \cap D_i\}$ (positive factor) and the distance from the agent residence to the relevant district C_i (negative factor).

In the downtown district prior utility function, as a positive factor, the number of shop types (including unplanned purchase) $\tau \cdot \#\{X \cap D_0\}$ is used, and as negative factors the distance from the agent residence to the relevant district C_0 and a prior predicted value for the walking distance S_0 in the downtown district are used to calculate a utility value (refer to the upper part of this page). In addition, in the downtown district, when a planned errand fails, a negative value Penalty is added to the utility value of the next time.

4.3 Customer Agent Behavior in the Downtown District

The essential parts of Customer Agent has been designed and implemented as a simplified ASSAver2 version. Table.3 shows the difference of the decision mechanisms between DDy and ASSA such as Selection of planned shops, Plan/re-plan, Errand success or not, Trigger to re-plan, Select alternative shops, Impulse visit of shops and Impulse detour.

Table 3. Difference of Decision Mechanisms between Downtown Dynamics and ASSA

Stage	Decision Item	ASSA	DDy
Selection and decision of agent in downtown	Selection of planned shop	Choose shop with the largest utility value (arg max shop utility)	Choose shop with the largest utility value
	Plan/re-plan	Genetic algorithm considering time constraints	Always connect a pair of the nearest distance between shops (Clustering algorithm)
	Errand successful or not	Probability (depend on shop type)	Probability (depend on shop type)
	Trigger to Re-plan in case of errand failure	(1) When alternative shop selection (2) When impulse visit	(1) When alternative shop selection
	(a) Select alternative shops	With probability 1-ε, choose shop with the largest value regarding remained time and distance. With probability ε, choose shop randomly (ε-greedy)	Step 1: Explore planned route and choose the nearest same-type shop. Step 2: Choose shop with the largest utility value
	(b) Impulse visit of shops	[When decide] regarding the remained time, utility value of street (average value of shops' utility). [Shop selection in the street] ε-greedy	[In SOS (Shop-On-the-Street) Expression], choose it with certain probability in every shops along the route
	(c) Impulse detour	Logit Model (Soft max as Boltzmann, T=1)	–

5. Implementation of Dynamics Mechanism in the Downtown Dynamics Model

5.1 Reinforcement Learning Model of Shop Utility in Customer Agents

In ASSA as well, when each customer visited a shop, depending on the success or failure of an errand, the shop utility value was simply added or subtracted. The increased or decreased portion was calculated and used according to a normal distribution where the majority would be a positive value. This method, however, is dependent on an errand success probability p, which made it difficult to adjust reinforce learning; this is a weak point. To improve this, the following p‐neutral reinforcement learning rule has been developed and used for DDy.

Some Dynamics Mechanisms for Customer Agent

- **p-neutral Reinforcer (Stroke)**
- $u_i = \mathrm{p} \cdot \lambda_i \cdot \mathrm{u}$
- In the case of the errand success,
    - $\lambda_i \leftarrow f(vt) + \lambda_i \cdot (1 + \delta)^{\alpha(1-\mathrm{p})}, (\delta > 0)$
- In the case of the errand failure,
    - $\lambda_i \leftarrow f(vt) + \lambda_i \cdot (1 + \delta)^{-\alpha\mathrm{p}}, (\delta > 0)$
  f(.) : Derivative of Variety Seeking Function
- **Tau(Shop Visit Multiplier)-Smoother**
- $\tau \leftarrow r \cdot (\#(\text{Bought})/\#(\text{PlannedVisit})) + (1 - r) \cdot \tau, (1 > r > 0)$
    - Considering Impulse Visit Effects

In addition, f(·) is a derived function of a variety seeking function mentioned in marketing science, and vt is the number of successive errand successes. Bowa, who introduced a variety seeking function, treated this just as a quadratic function and represented inertia tendency (example, positive linear function), variety seeking (boredom) (example, negative quadratic function), and neutral (constant), which is a function constructing a baseline locus.

5.2 Update of the Downtown District Prior Utility Function

When an agent has finished their visit to the downtown district, the following formula is used to add a change to the τ value. This rule enables the asymptotic representation of a district utility value in the downtown district, where the structure changes.

5.3 Entry and Leaving of Shop Agents

Fig. 2 shows the algorithm of a shop agent. Each shop agent assesses monthly profit and loss based on the parameters (gross sales profit, fixed costs, and rent for the shop) given for each shop type at the end of every month. If a shop has a deficit for 2 consecutive months, the shop is closed. In the month following the two-month deficit, the number of customers who passed through the node of the closed shop is recorded, and an expected sales figure is calculated for each shop type. When the shop type with the highest figure is in the black, that shop type will open a new shop at the beginning of the following month. If no shop is in the black, the shop node will be empty and registered as a vacant shop.

  Since an expected sales figure is calculated from the customer stratum passing the front of a shop, this can be interpreted as a myopic rational model.
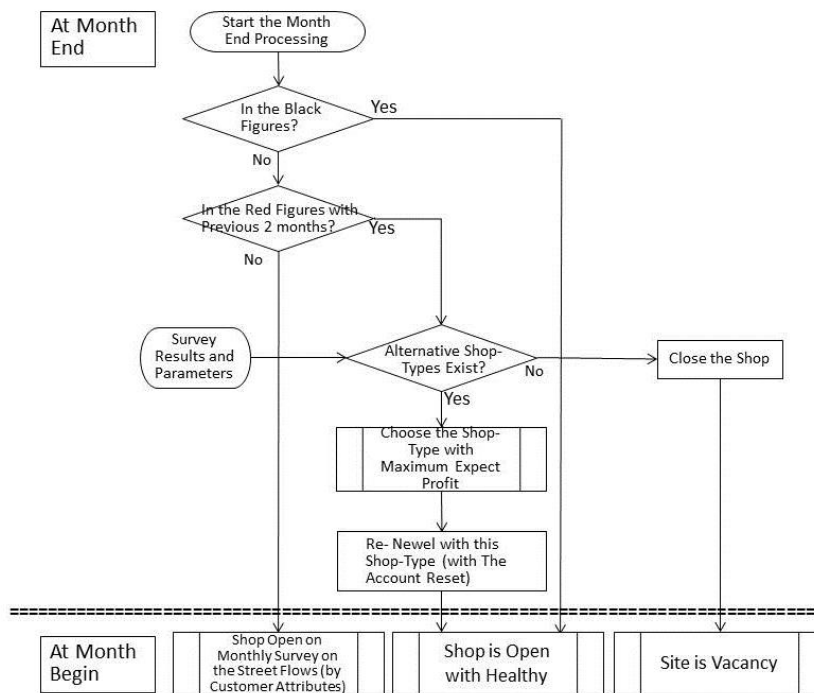

Fig. 2. Entry/Withdraw of Shop Agents

6. Concluding Remarks: The goals of the Artificial Society Approach

As described above, to examine the generation and sustainability of "downtown," the paper outlined the Downtown Dynamics Model DDy using an artificial society approach. The paper mainly reported the formalization of externalities as the basic concept of the integration and specialization of shops, and oligo-centric market system and additional implementation applied to both the customer and shop agents in order to give a dynamic to the existing simulator ASSA. A prototype DDyn has been created on an experimental basis (Shohmitsu, Chang, Kaneda, Jin, 2015).

DDy is, so called, an Artificial Society Type Retail Model in geographical information science. DDy does not deal with diversity as the whole city's functions, for example, including housing and a wide variety of industries mentioned in the original text, but deals with diversity of shop-type in downtown. Therefore, note that we newly introduce a variety of errands that correspond to the variety of shop-type.

The artificial society approach includes a constructive approach. In the author's view, through comparative examination of the simulation results under different structures, it is possible to clarify characteristics unique to a system. For example, the interaction between customers shown in the lower part of Fig. 3 might suggest the need to introduce the word of mouth effect, which is a relaxation of Condition 3 mentioned in this paper; and the effect of "power of place" on different shops might suggest the need to reinterpret "old buildings," the third city diversity condition presented by Jane Jacobs.
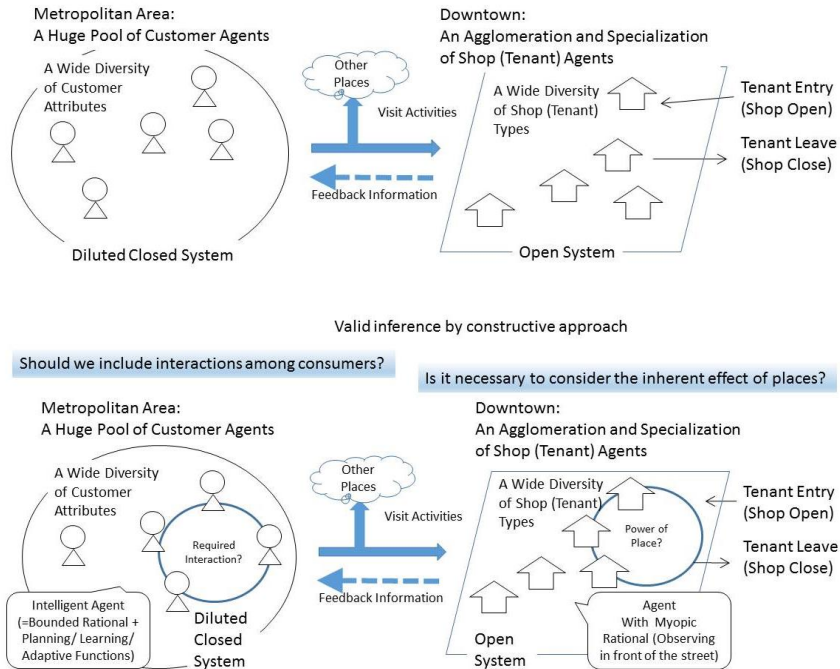
Fig. 3. Constructions of DDy as Artificial Societies

Acknowledgments

References

Jacobs, J. (1961). The Death and Life of Great American Cities. New York: Random House

Kaneda, T., Yoshida, T. (2012). Simulating Shop-Around Behavior. International Journal of Agent Technologies and Systems

Kobayashi, T., Harazaki, M., Kaneda, T. (2015). Analyses on Transition Factors of Tenants inside Shopping District by Using Shop-Around Behavior Survey Data. AIJ Journal of Technology and Design (in Japanese, in printing)

Oiwa, Y., Yamada, T., Misaka, T., Kaneda, T. (2005). A Transition Analysis of Shop-ping District from the View Point of Visitors' Shopping Around Behaviors －A Case of Ohsu District, Nagoya－. AIJ Journal of Technology and Design (in Japa-nese)

Shohmitsu, M., Chang, S., Kaneda, T., Jin, R., (2015). Simulation Analyses on Jane Jacobs' City Diversity Requirements by Using Downtown Dynamics Model. 14th International Conference on Computers in Urban Planning and Urban Manage-ment (in submitting)

Takeuchi, M., Yoshida, T., Kaneda, T. (2011). A Transition Analysis of Shopping Street Complex District from the Viewpoint of Shop-Around Behaviors －A Survey of Osu District, Nagoya in 2008－. Journal of Architecture and Planning Transac-tion of AIJ (in Japanese)

Yoshida, T., Kaneda, T. (2007). An Architecture and Development Framework for Pe-destrians' Shop-Aronud Behavior Model Inside Commercial District by Using Agent-Based Approach. 14th International Conference on Computers in Urban Planning and Urban Management

Yoshida, T., Kaneda, T. (2009). A Simulation Analysis of Shop-around Behavior in a Commercial District as an Intelligent Agent Approach －A Case Study of Osu Dis-trict of Nagoya City－. Agent-Based Approaches in Economic and Social Complex System V, Post-Proceedings of The AESCS International Workshop 2007

Yoshida, T., Kaneda, T. (2011). ASSA: An Intelligent Agent-Simulation for Shop-Around Behavior, Focusing on Its Performance Evaluation. 12th International Conference on Computers in Urban Planning and Urban Management

Yoshida, T., Kaneda, T. (2013a). ASSA: Project: An Intelligent Agent-Simulation for Shop-Around Behavior Evaluation. Agent-Based Approaches in Economic and So-cial Complex Systems VII, Post-Proceedings of The AESCS International Work-shop 2012

Yoshida, T., Kaneda, T. (2013b). Policy Simulation Trials of Intelligent Shop-Around Agent Model. 13th International Conference on Computers in Urban Planning and Urban Management