Organizational Diversity Effect on Dynamic Business Environment: A Simulation Approach

Geonsik Yu, Yerim Chung and Sunju Park.

YONSEI UNIVERSITY
SCHOOL OF BUSINESS

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1. Organizational Diversity

Definition) Organizational Diversity:

"The distribution of personal attributes among *interdependent* members of a work unit."

In Organizational Behavior: "Source of Creativity & Innovation"

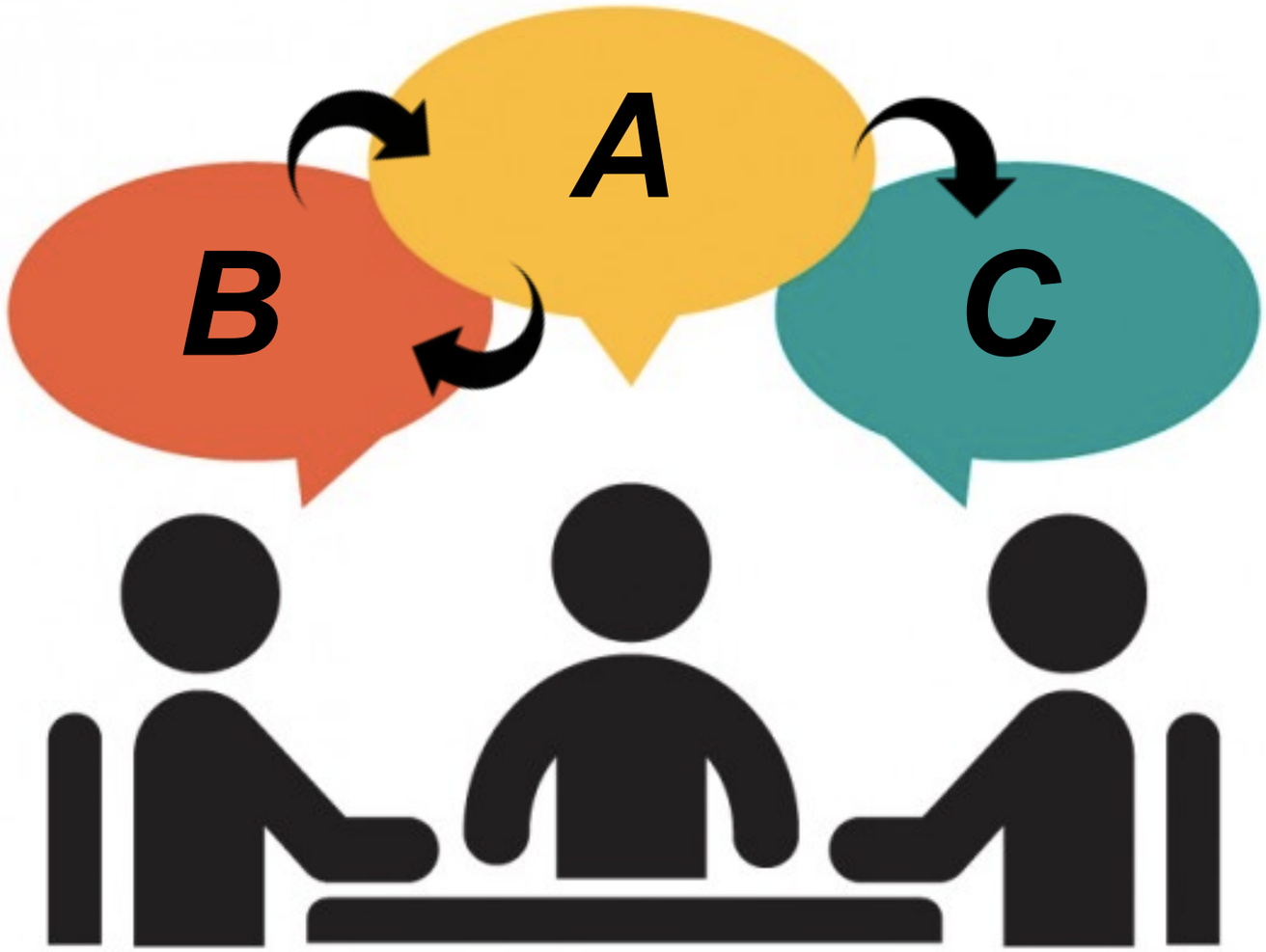
In Social Network Theory "Information Diffusion or Network Learning"

In Business Practice ***"Not always successful"***

1. Organizational Diversity

In Organizational Behavior:

"Source of Creativity & Innovation"



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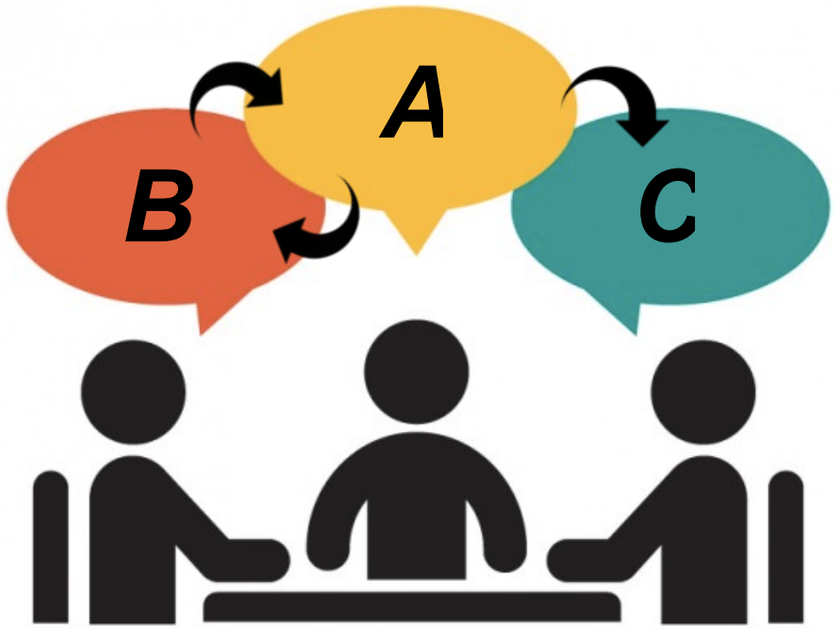
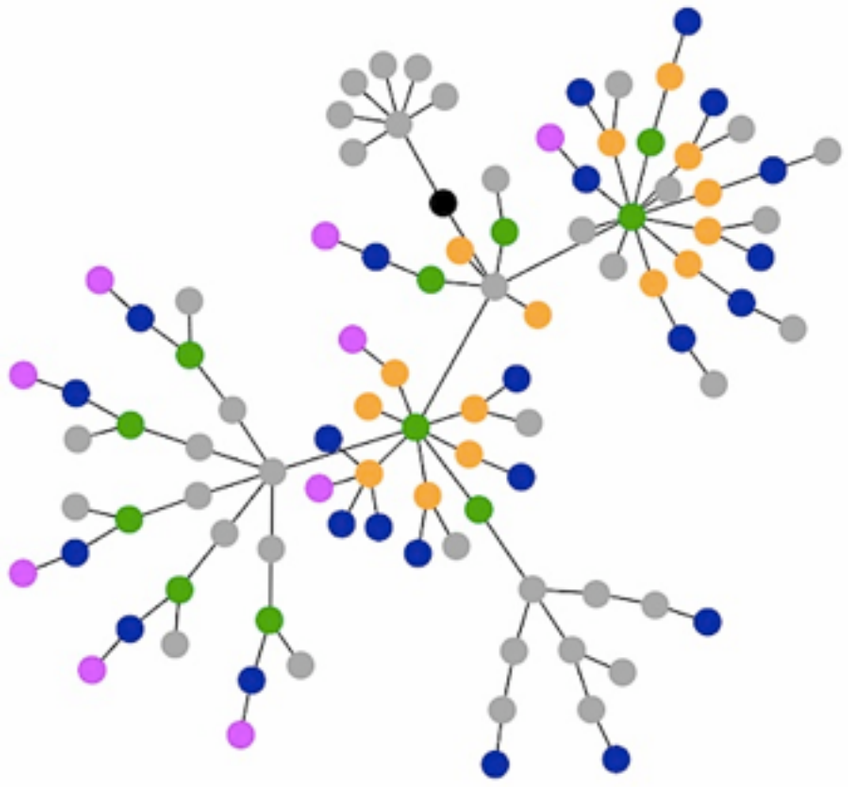
In Organizational Behavior: “Source of Creativity & Innovation”

In Social Network Theory “Information Diffusion or Network Learning”





1. Organizational Diversity

In Organizational Behavior: “Source of Creativity & Innovation”

In Social Network Theory “Information Diffusion or Network Learning”

In Business Practice ***“Not always successful”***

2. Research Questions

✓ Under what conditions, do efforts to build a diverse R&D team pay off?

: Market Environment

✓ What is the relationship between market variability and diversity effect?

2. Research Questions

Importance

Suggest theoretical basis, for the decision to take the diversification strategy or not.

Originality

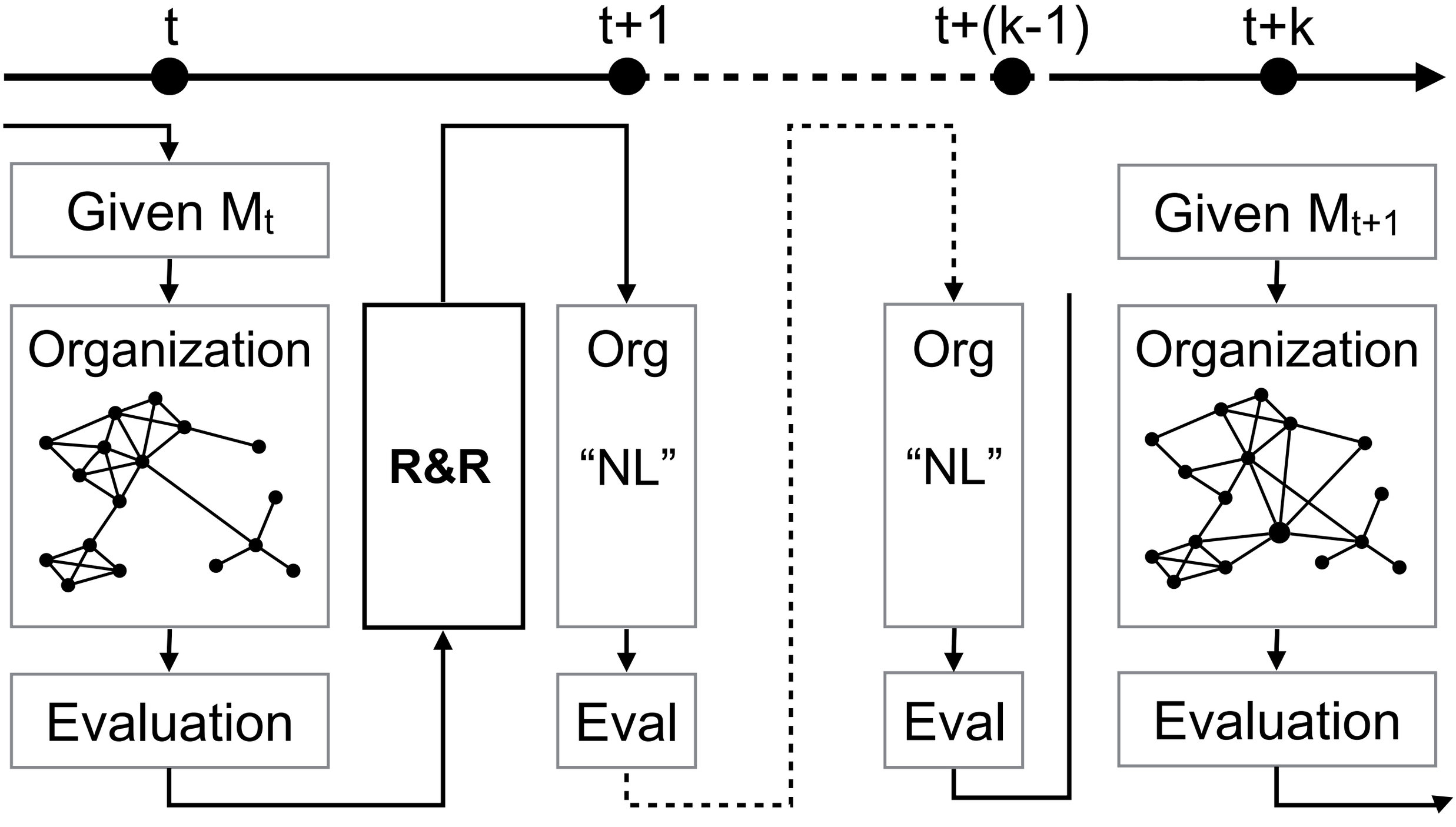
Try to explain the mechanism of the diversity effect including market variability using simulations.

Validity

Conduct experiments with simulation process under many different parameter settings.

3. Simulation: Overview

✓ **market variability - diversity effect**



3. Simulation: Overview

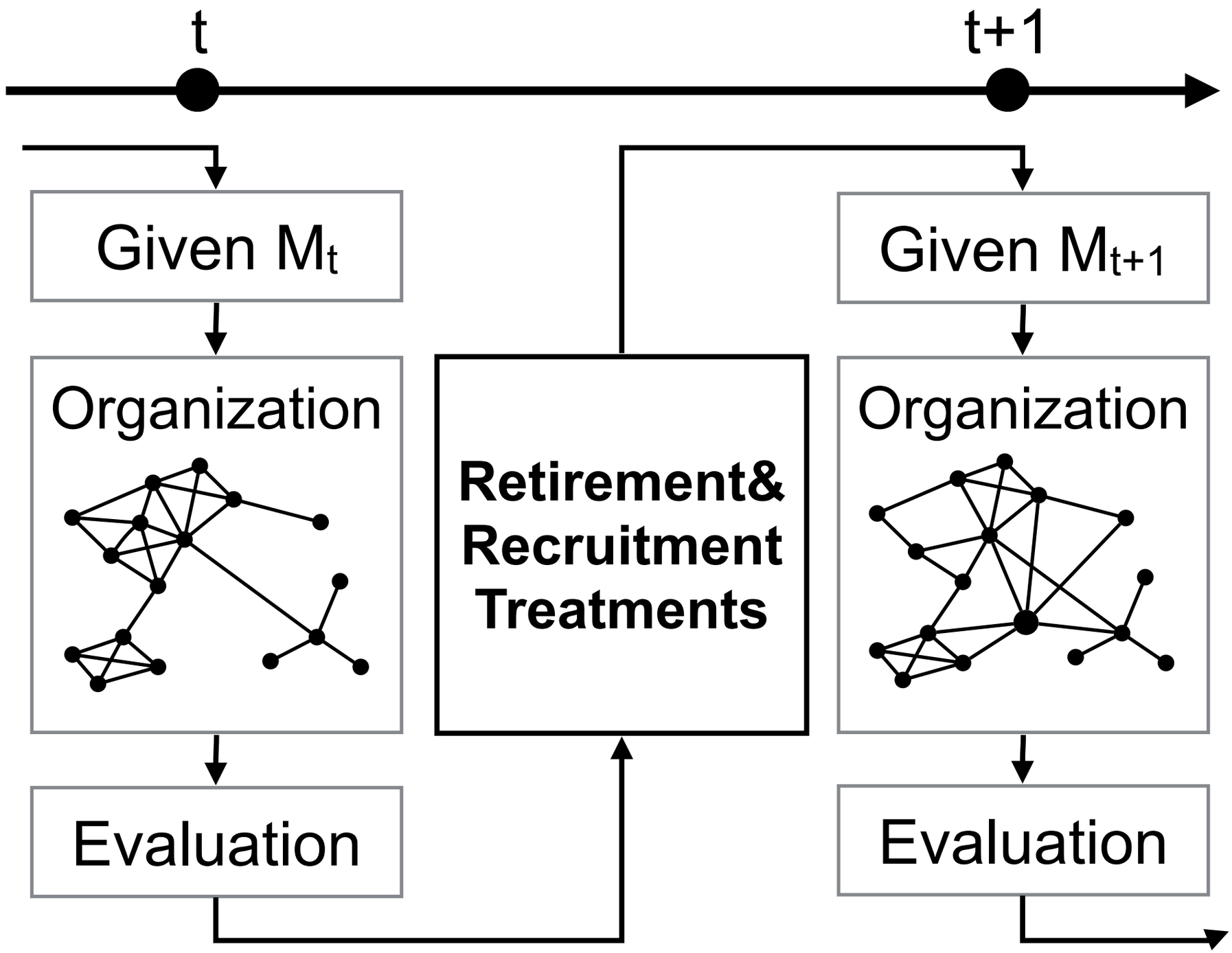
✓ **market variability - diversity effect**

1. Time

2. Market Vector

3. Organization
- Opinions

4. Evaluation
& Learning



3. Simulation: Overview

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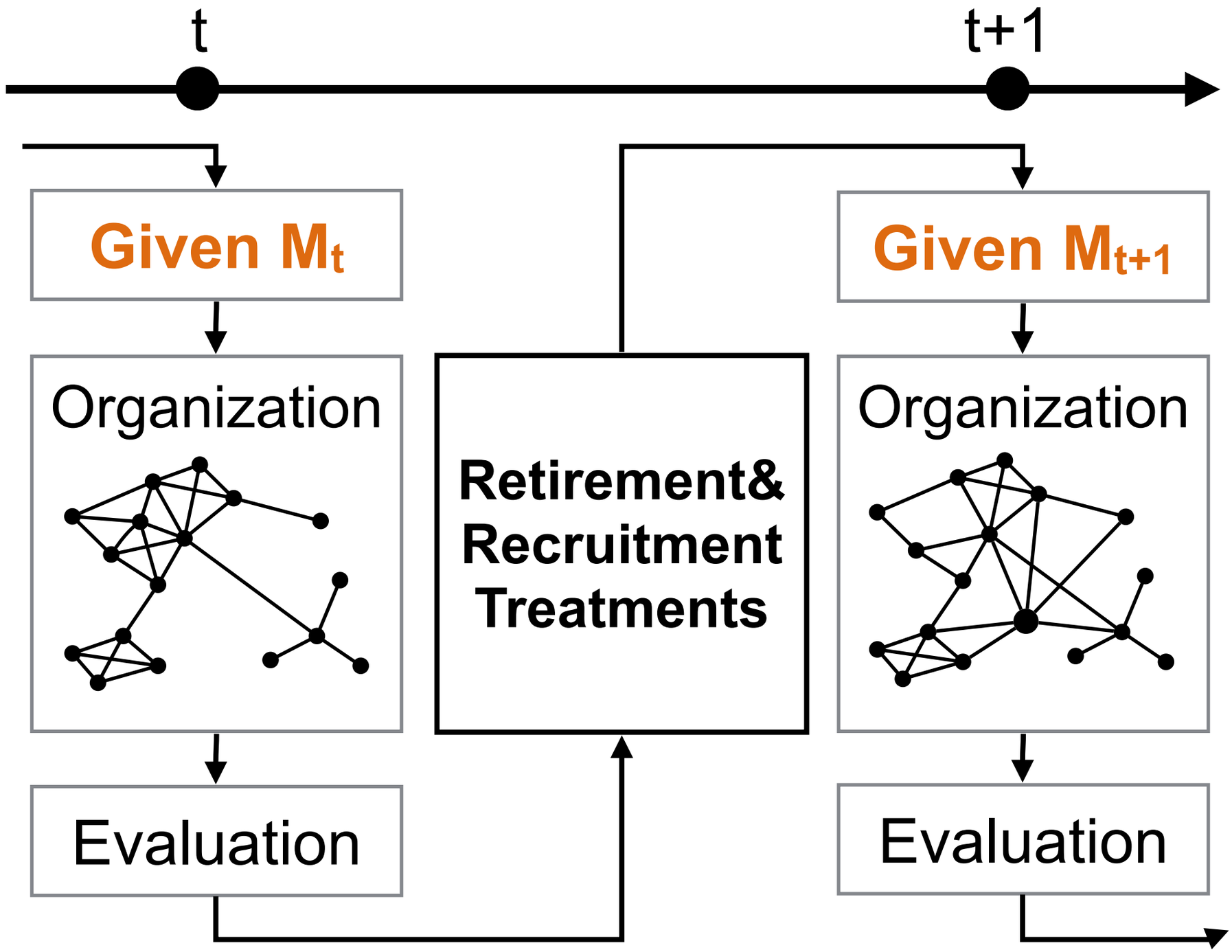
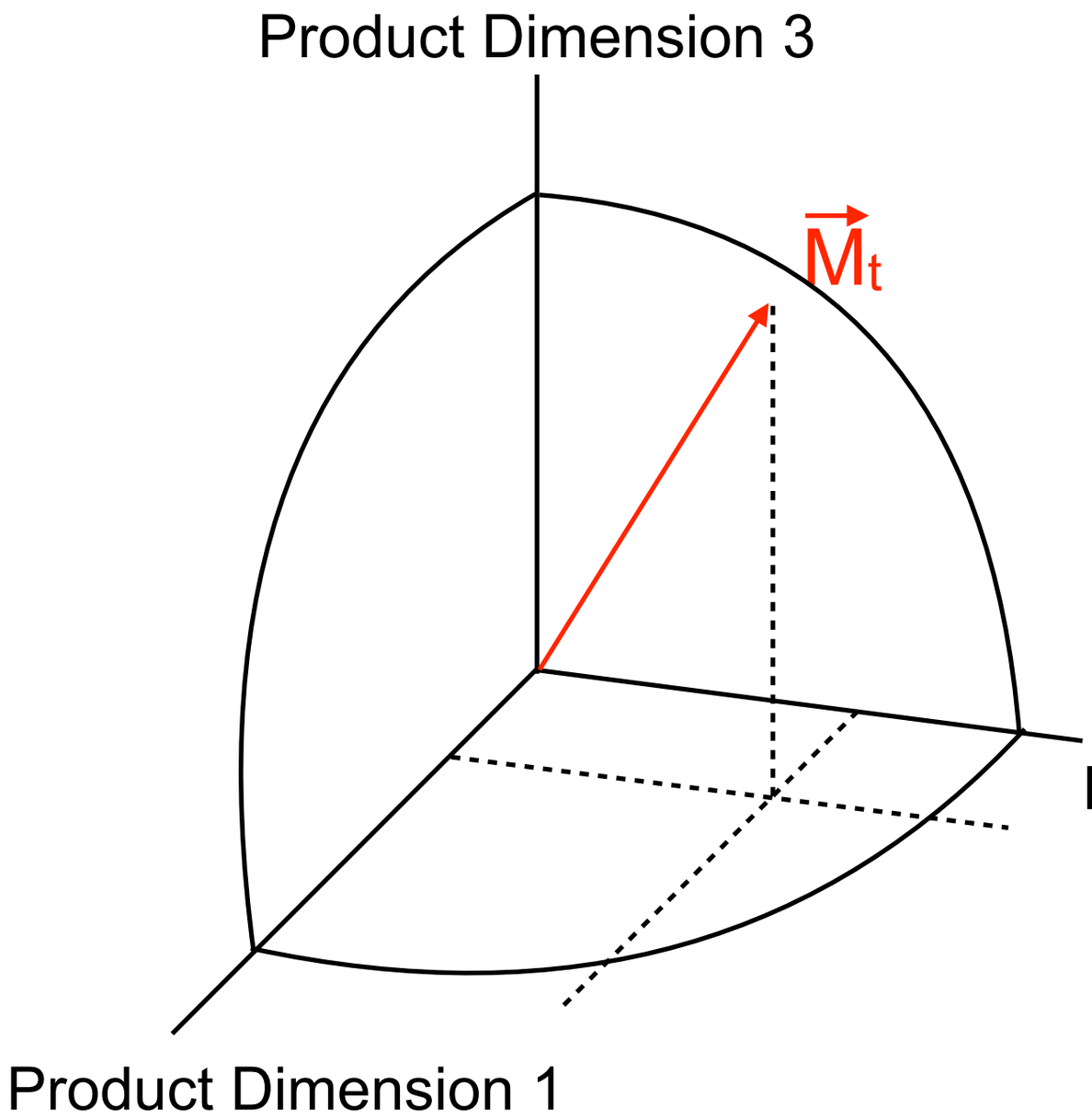
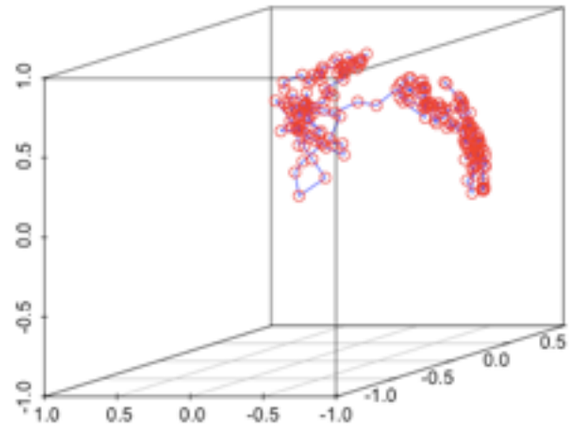


3. Simulation: Market Trend

< *d*-Dimensional Perceptual Map(*d*=3) >



μ = 0.0
σ = 1.0



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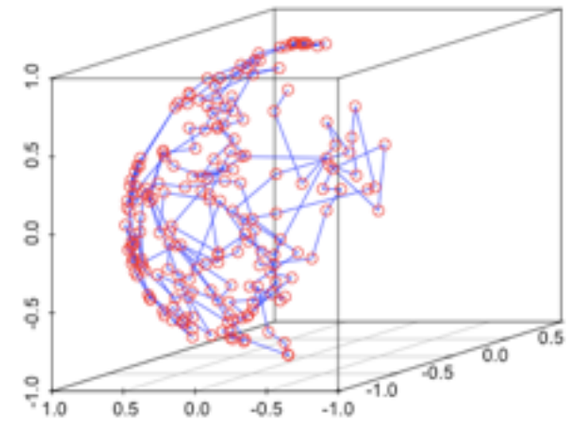
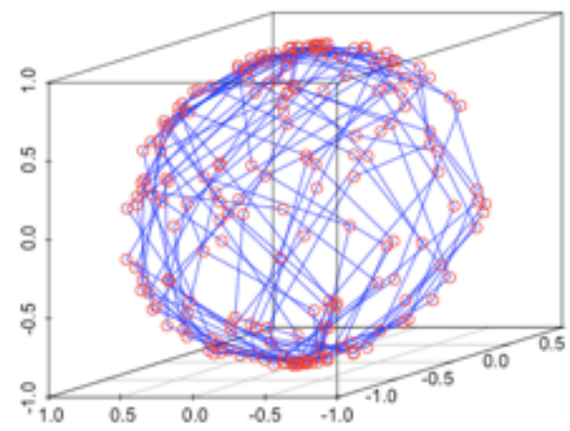


μ = 9.0
σ = 3.0



3. Simulation: Overview

✓ **market variability - diversity effect**

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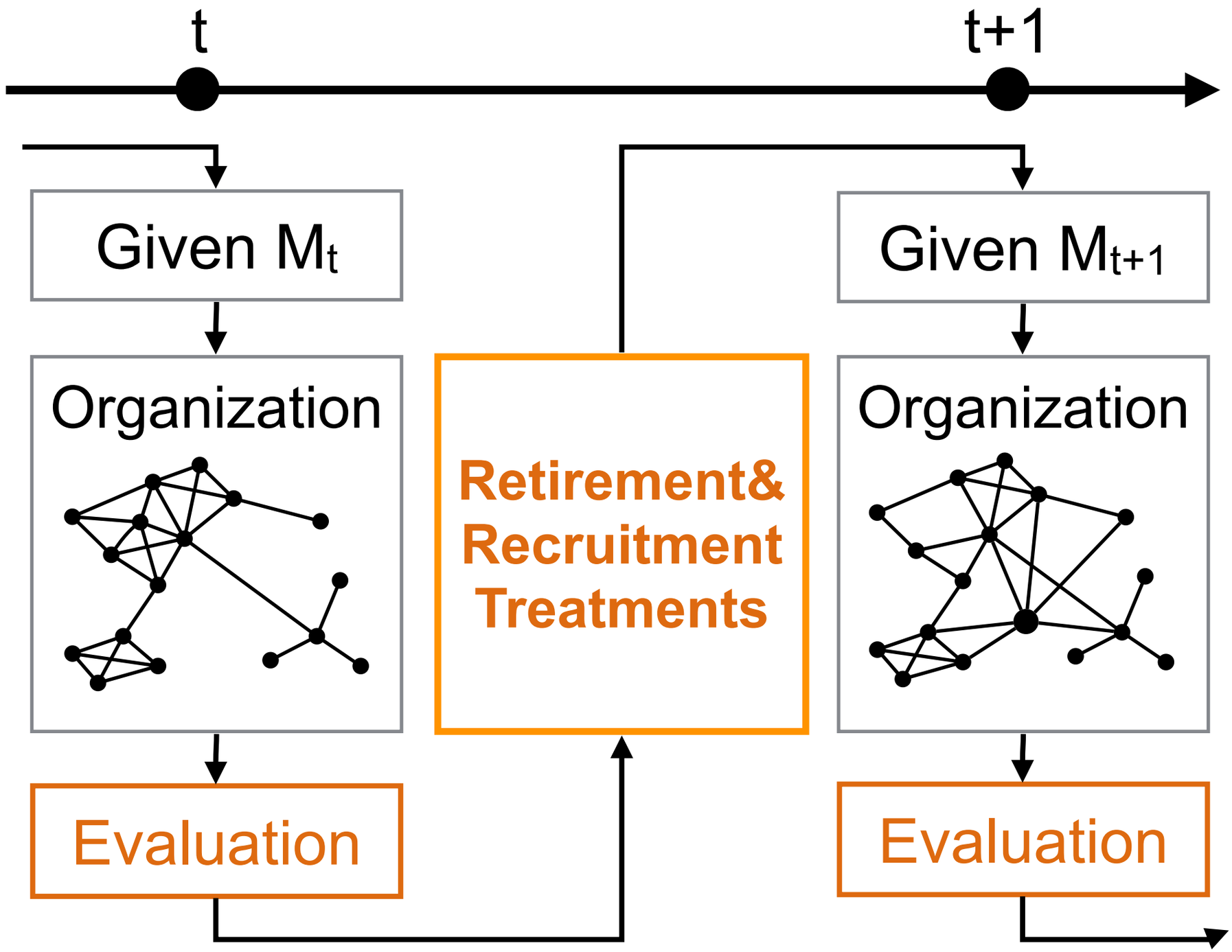
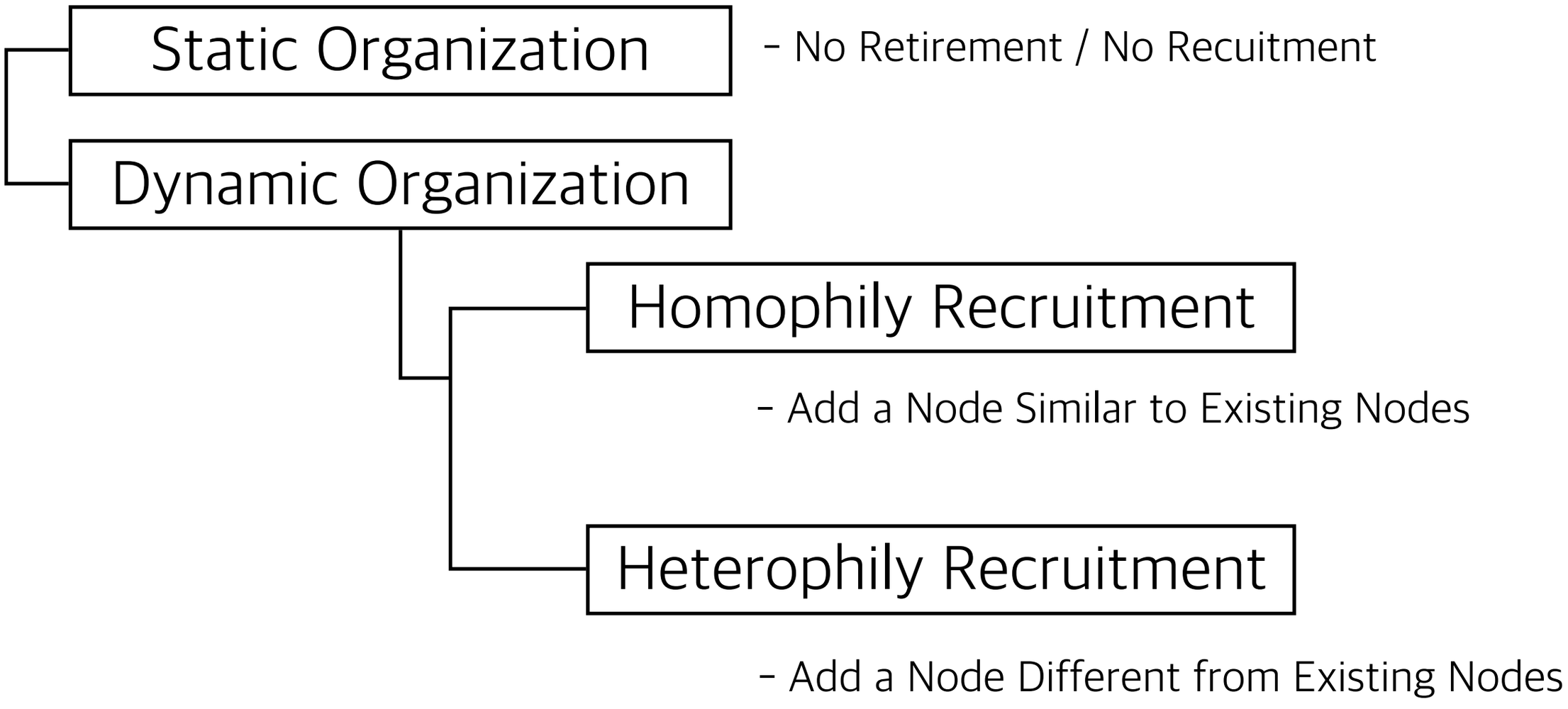


3. Simulation: Treatments

- **Identical Retirement Treatment (Random)**
- **Different Recruitment Treatment**



3. Simulation: Parameter Settings

Parameters	remarks	values
n	Number of members in the organization	*20, 40, 60, 80, 100*
d	Number of dimensions	*3, 4, 5*
$r_{learning}$	Learning rate	*0.3, 0.5, 0.7, 1.0*
$r_{retirement}$	Retirement rate	*0.05, 0.1, 0.15, 0.2*
μ	Market variability : Brownian motion mean	*1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 1.0, 3.0, 5.0, 7.0, 9.0*
σ	Market variability : Brownian motion sigma	*1.0, 3.0, 6.0*
T	Time interval	*200*

4. Result Analysis

$n = 40$

$d = 3$

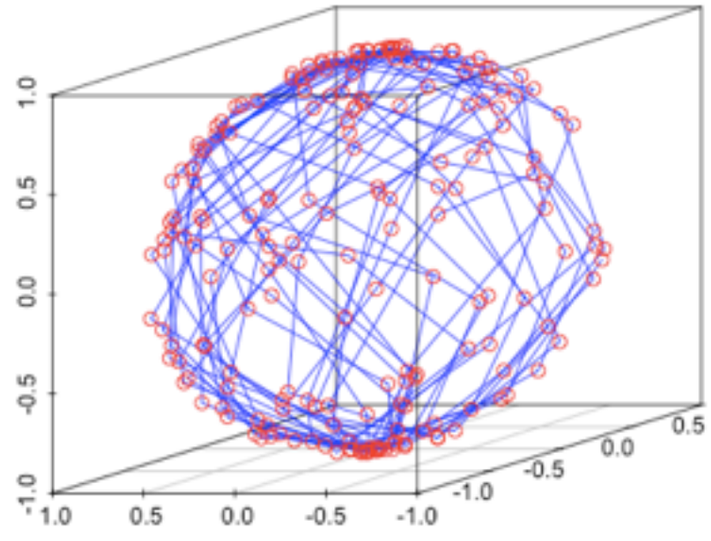
$T = 200$

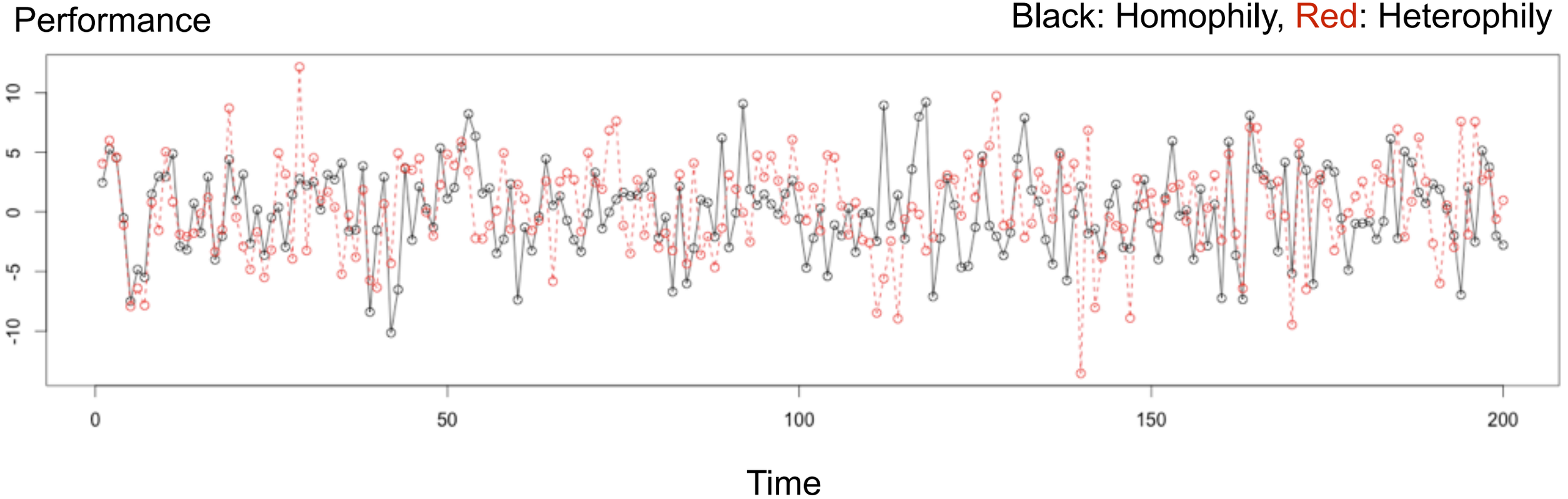
$r_{learning} = 0.5$

$r_{retirement} = 0.05$

$\mu = 3.0$

$\sigma = 9.0$





Thank You

* Related Works & Motivation

- Amabile, T. (1998). **How to Kill Creativity**. Harvard Business Review.

- Davidson, M. (2011). **The end of diversity as we know it.** San Francisco: Berrett-Koehler Publishers.

- Simons, S. and Rowland, K. (2011). **Diversity and its Impact on Organizational Performance: The Influence of Diversity Constructions on Expectations and Outcomes. Journal of Technology Management & Innovation**, 6(3), pp. 171-183.

- Fang, C., Lee, J. and Schilling, M. (2010). **Balancing Exploration and Exploitation Through Structural Design: The Isolation of Subgroups and Organizational Learning.** Organization Science, 21(3), pp.625-642.

- Organization at T
- Opinions at T
- Trend Given at T
- Evaluations at T – Record It

- Retirement / Recruitment
- Pear Learning(HOW : No Evaluation Result with new one)
- Pear Learning with Neighbor Average Point

- Organization at (T + 1)
- Opinions at (T + 1)
- Trend Given at (T + 1)
- Evaluations at (T + 1) – Record It

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Figure 5 Effect of Turnover in Changing Environment

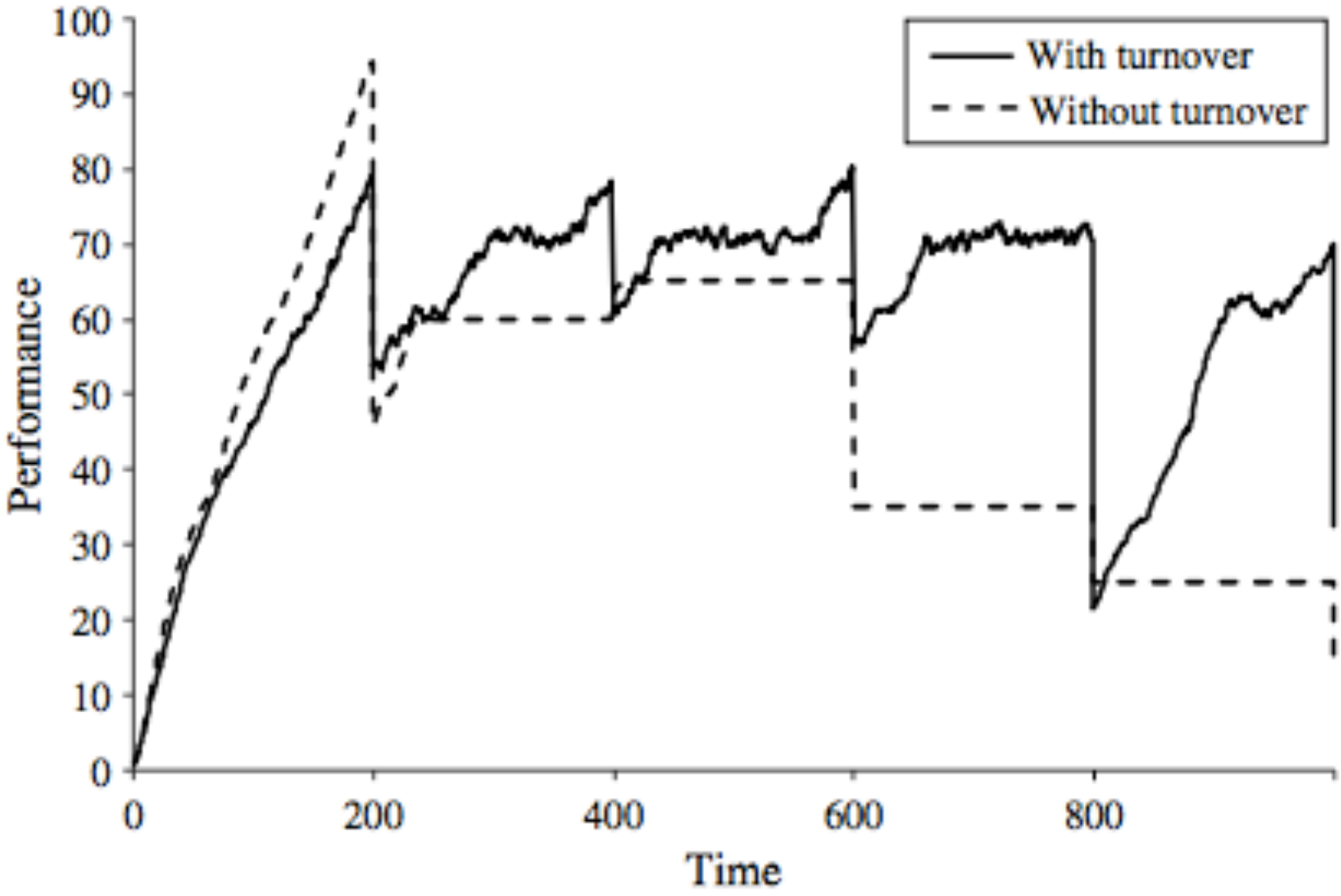


Table 1 Mean Performance of Organizations Under Different Rates of Turnover and Environmental Change

	Rates of turnover			Rates of environmental change		
	No ($p_{turnover} = 0$)	Low ($p_{turnover} = 0.01$)	High ($p_{turnover} = 0.1$)	Low ($p_{envir} = 0.1$)	Medium ($p_{envir} = 0.4$)	High ($p_{envir} = 0.7$)
Nearly isolated	31.17	44.45	23.32	44.45	26.05	23.41
Semi-isolated	36.42	61.49	41.71	61.49	38.13	34.22
Random	32.39	54.47	38.63	54.47	32.11	28.64
F-value	21.18	1,127.23	4,187.54	1,129.23	361.31	257.55
P-value	0.001	0.001	0.001	0.001	0.001	0.001

Notes. This table reports the levels of organizational performance across three levels of turnover and three different levels of environmental change. For the results where turnover is varied, the value for p_{envir} is fixed at 0.1. For the results where environmental change is varied, $p_{turnover}$ is fixed at 0.01. The results show that the semi-isolated subgroup structure is always the highest performer across different turnover and environmental change conditions, and the performance differences among different structures are statistically significant at $p < 0.01$.

Market 변동성 고정

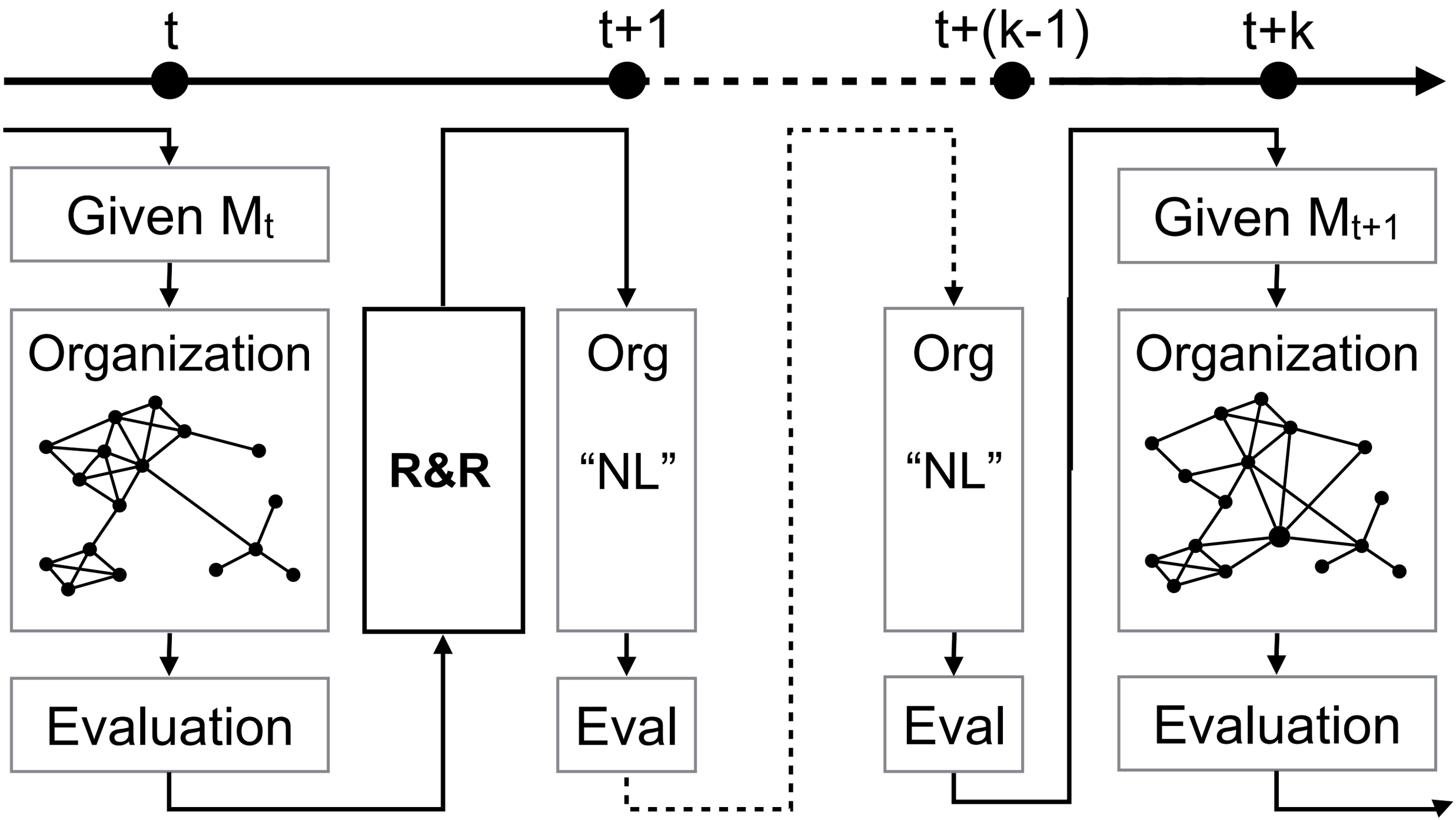
Retirement / Recruitment(%) 고정(임의 채용)

Appendix. Simulations

Simulation Process: Parameter Settings

Parameters	remarks	values
n	Number of members in the organization	*20, 40, 60, 80, 100*
d	Number of dimensions (Product Complexity ?)	*3, 4, 5*
$r_{learning}$	Learning rate	*0.1, 0.3, 0.5, 0.7, 1.0*
$r_{retirement}$	Retirement rate	*0.05, 0.1, 0.15, 0.2*
μ	Market variability : Brownian motion mean	*0.0*
σ	Market variability : Brownian motion sigma	*1.0, 3.0, 5.0, 7.0, 9.0*
T	Time interval	*1000*
period	Trend change interval	*20*

Simulation Process: Overview

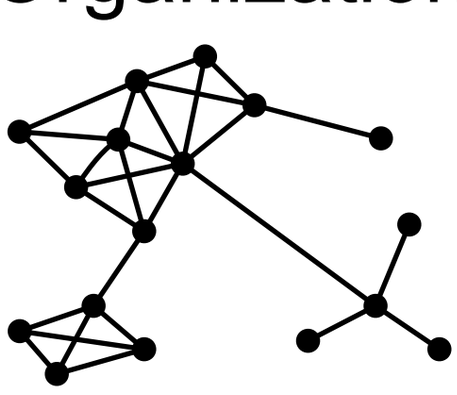


Simulation Process: Overview

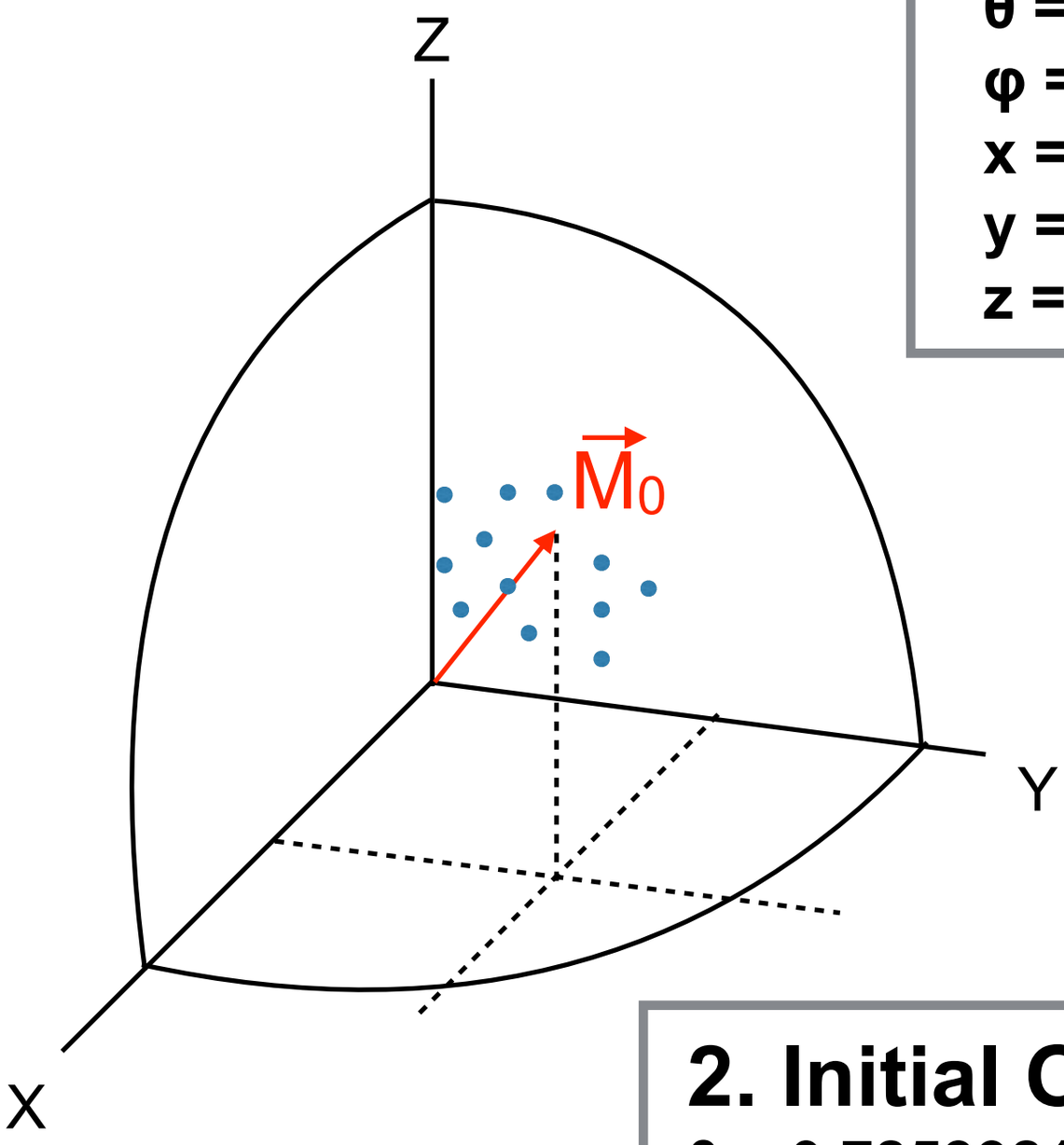
Initial: t = 0

Given M_t

Organization



Evaluation



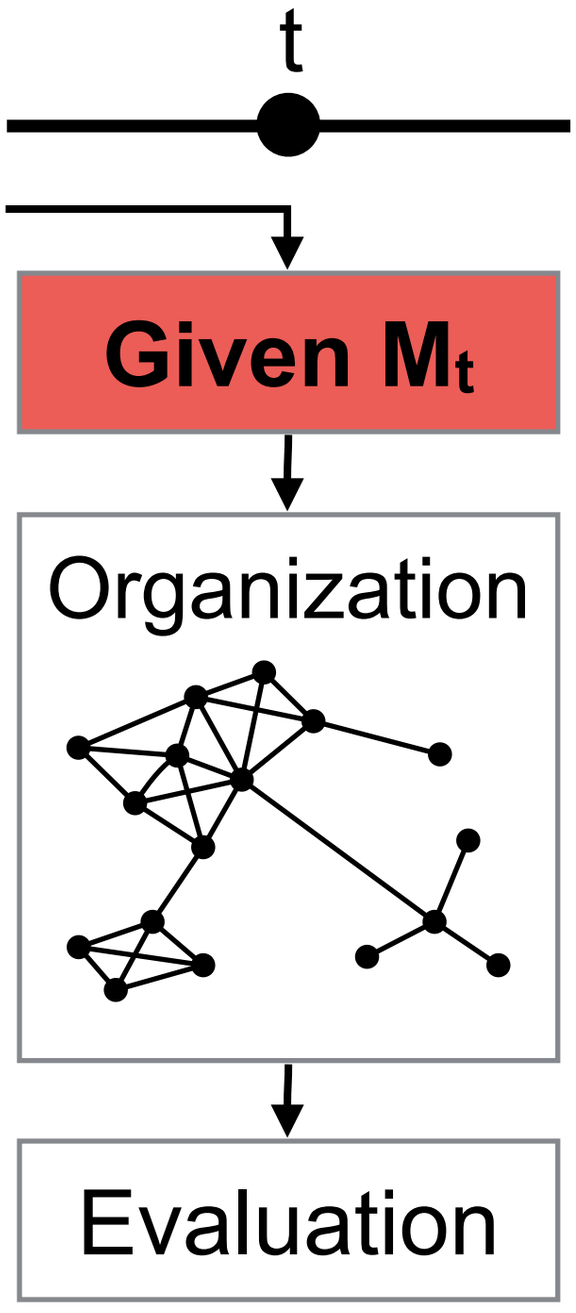
1. Initial Trend:

θ = 0.785398163397
φ = 0.955316618125
x = 0.57735026918
y = 0.57735026918
z = 0.57735026918

2. Initial Organization:

θ = 0.785398163397 + Random
φ = 0.955316618125 + Random
" Adapted to M_0 "

Simulation Process: Overview



3. Trend Change

- Weinner Process:

$$W_n(t) = \frac{1}{\sqrt{n}} \sum_{1 \le k \le \lfloor nt \rfloor} \xi_k$$

- Weinner Process Applied:

$$\theta_{t+1} = \theta_t + (1/\mathrm{sqrt}(n)) * X_1$$
$$\varphi_{t+1} = \varphi_t + (1/\mathrm{sqrt}(n)) * X_2$$

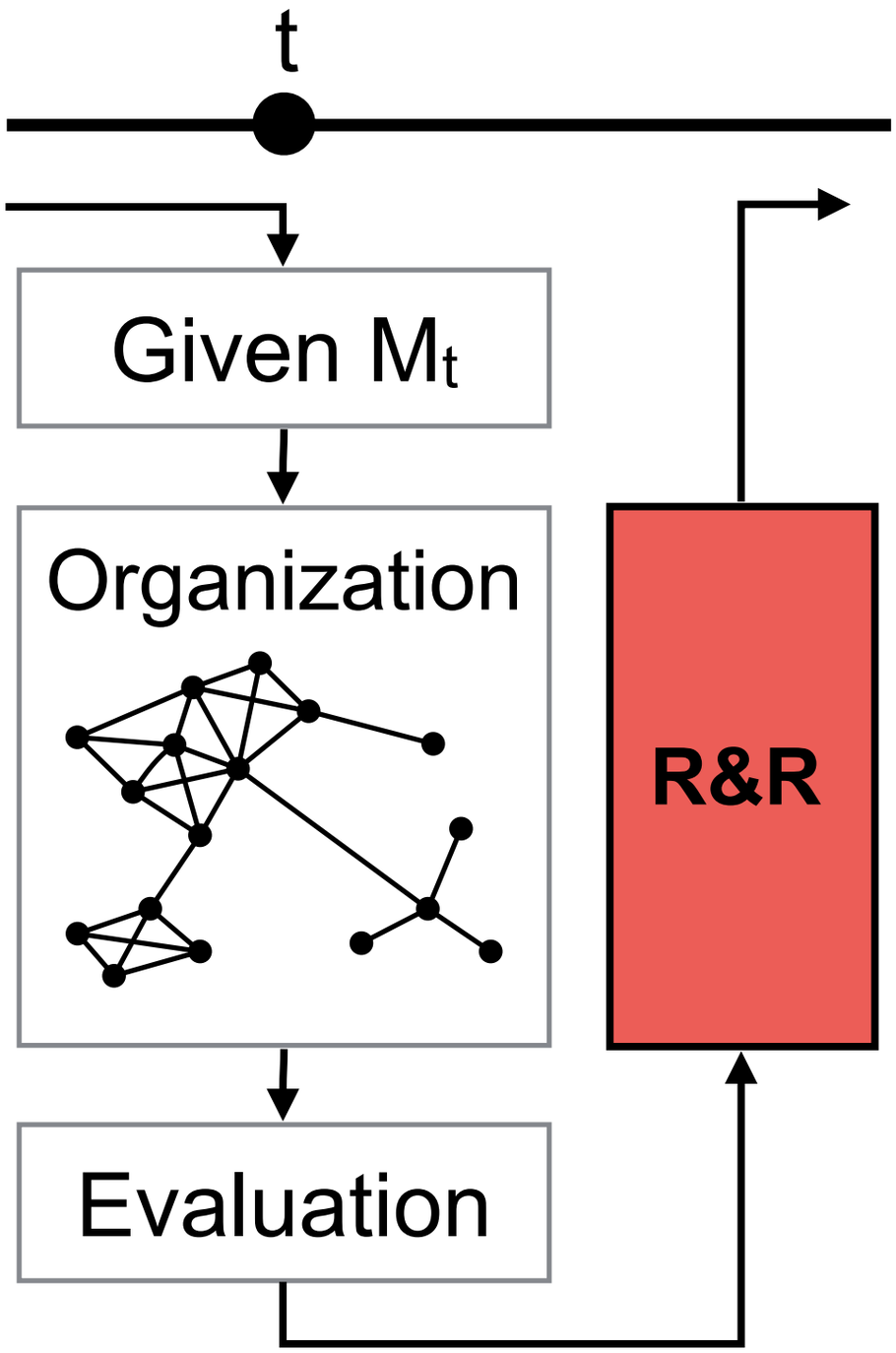
$X_1 \sim \mathrm{Normal}(0, \mathrm{Sigma})$
$X_2 \sim \mathrm{Normal}(0, \mathrm{Sigma})$

Simulation Process: Overview

mean = 0, dimension = 3

Sigma	Mean(Angle in Radian)	Mean(Angle in Degree)
1.0	0.077	4.4
2.0	0.15	8.6
3.0	0.22	12.6
4.0	0.30	17.2
5.0	0.37	21.2
6.0	0.44	25.2
7.0	0.51	29.2
8.0	0.58	33.2
9.0	0.65	37.2
10.0	0.72	41.3

Simulation Process: Overview



4. Treatment

Oracle Recruitment

$\theta_{new} = mean(\theta_{new\_trend})$

$\varphi_{new} = mean(\varphi_{new\_trend})$

Homophily Recruitment

$\theta_{new} = mean(\theta_i)$

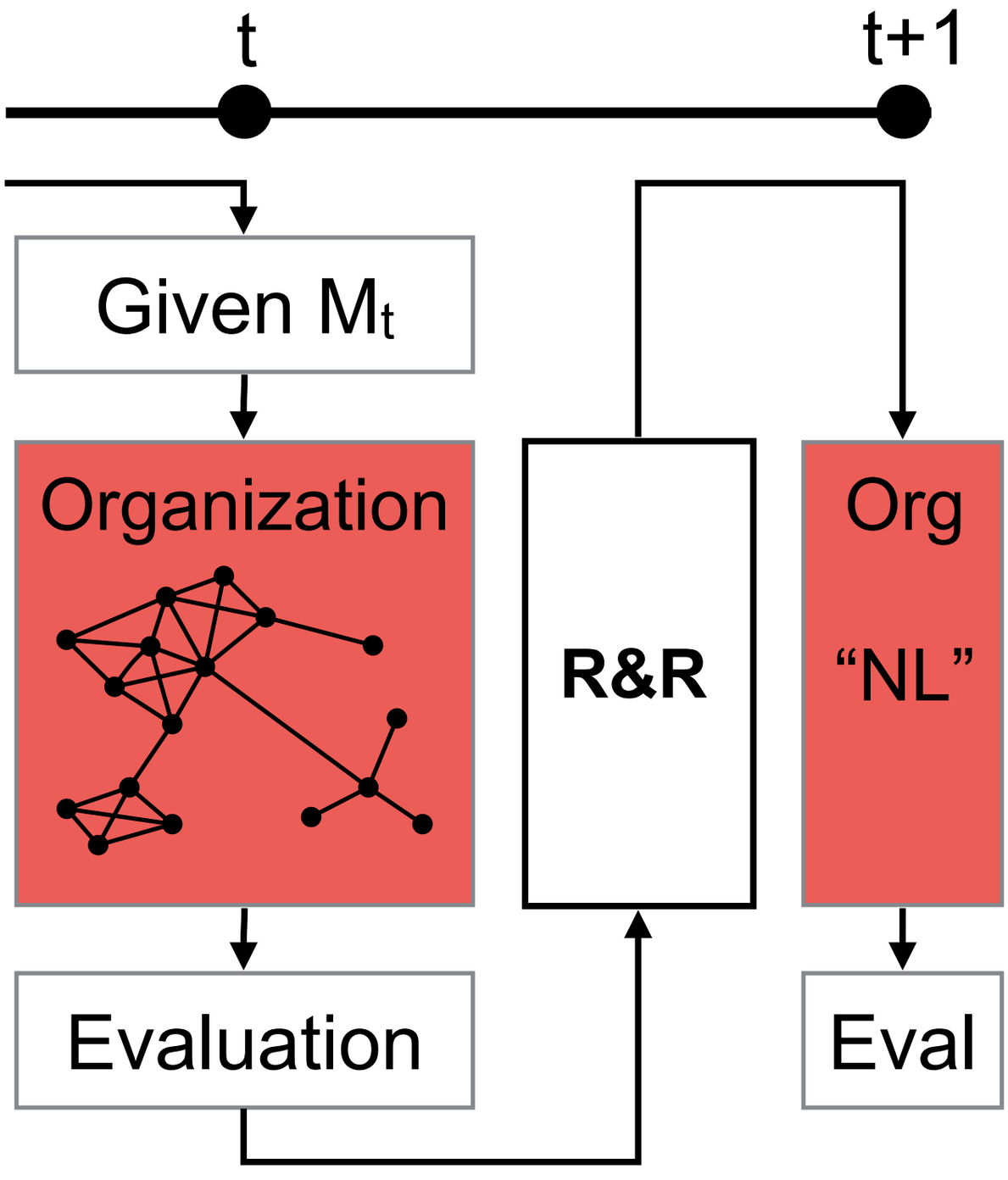
$\varphi_{new} = mean(\varphi_i)$

Heterophily Recruitment

$\theta_{new} = mean(\theta_i) + \pi$

$\varphi_{new} = mean(\varphi_i) + \pi$

Simulation Process: Overview



5. Network Learning

$$\theta_{i,\,t+1} = (1-\ell)*\theta_{i,t} + \ell* \theta_{best\_neighbor}$$

$$\varphi_{i,\,t+1} = (1-\ell)*\varphi_{i,t} + \ell* \varphi_{best\_neighbor}$$

*Unexpected Effect

Simulation Process: Example

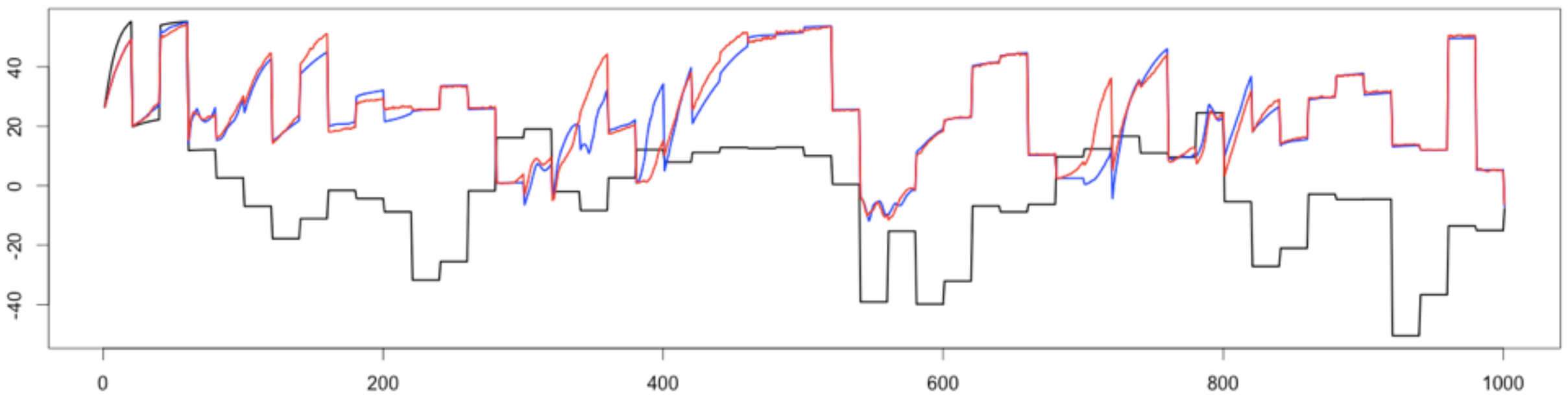
Parameter Setting

$n = 60$ $\mu = 0$

$d = 3$ $\sigma = 10.0$

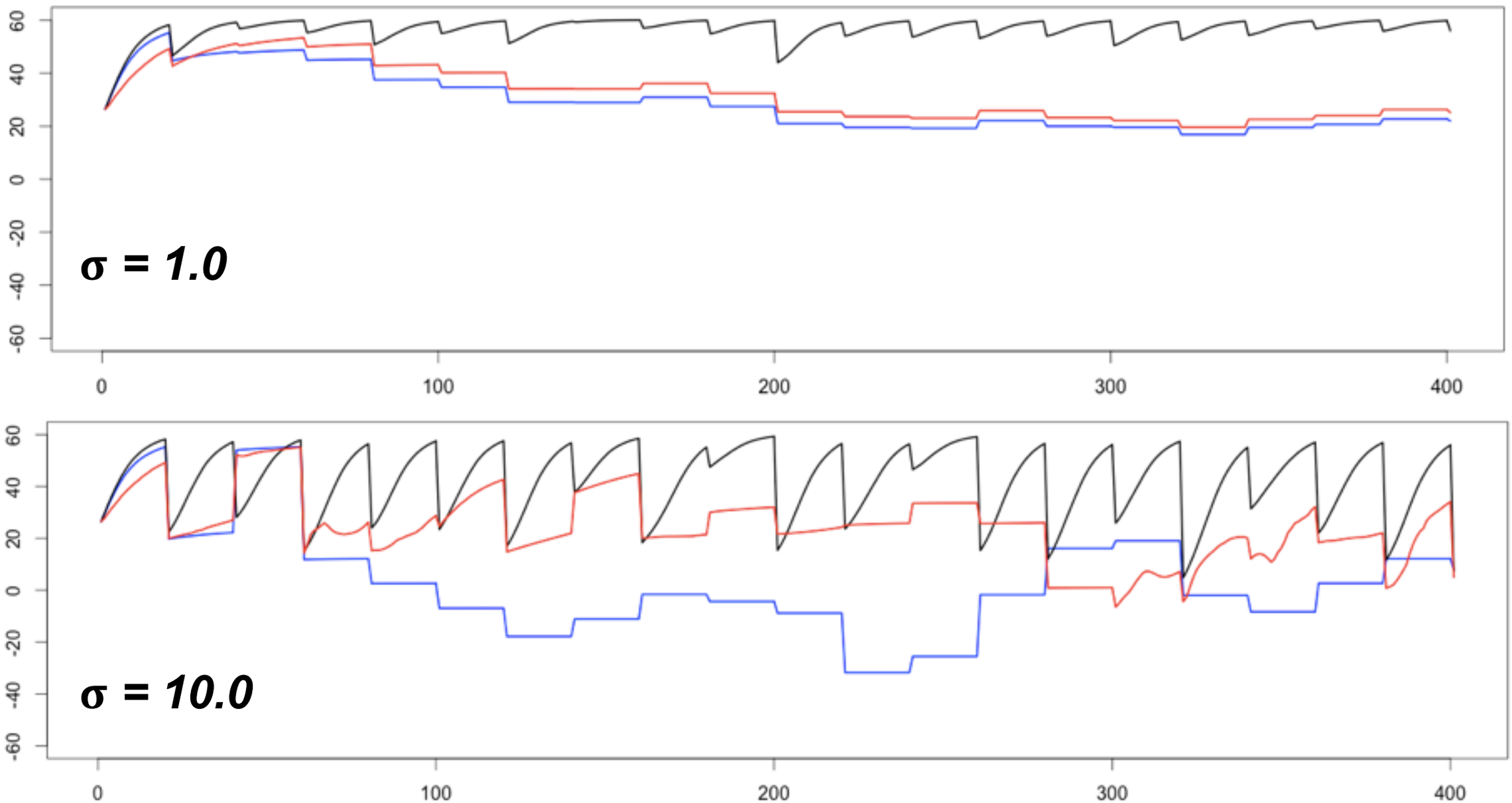
$r_{learning} = 0.1$ $T = 1000$

$r_{retirement} = 2/60$ $period = 20$



Simulation Process: Example

$n = 60$	$\mu = 0$
$d = 3$	$T = 400$
$r_{learning} = 0.1$	$period = 20$
$r_{retirement} = 2/60$	



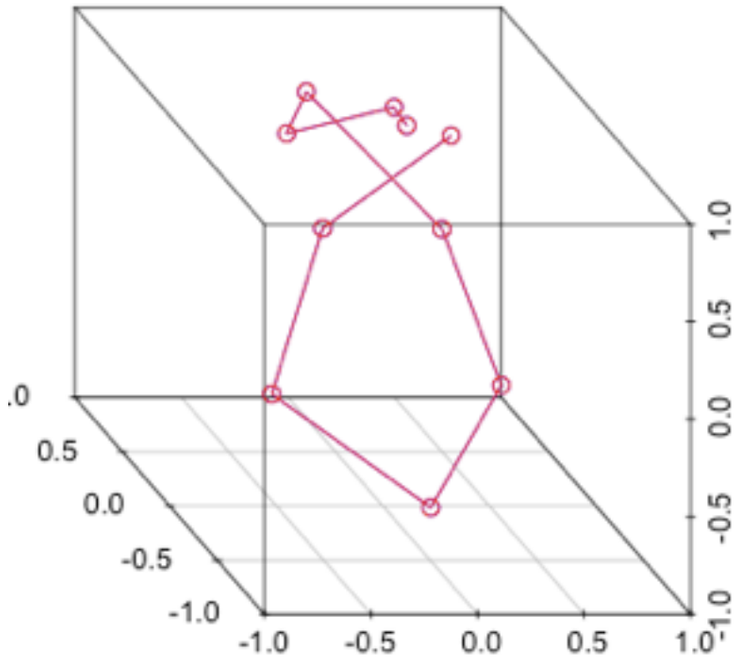
Simulation Process: Example

Trend #1, Network #1~100

	Sima = 0.1	Sigma = 10.0
Oracle	28.2315	22.2885
Homophily	18.8098(66%)	4.7032(21%)
Heterophily	20.2629(71%)	15.3298(68%)

Appendix. Trend Tendency

Trend Direction Tendency



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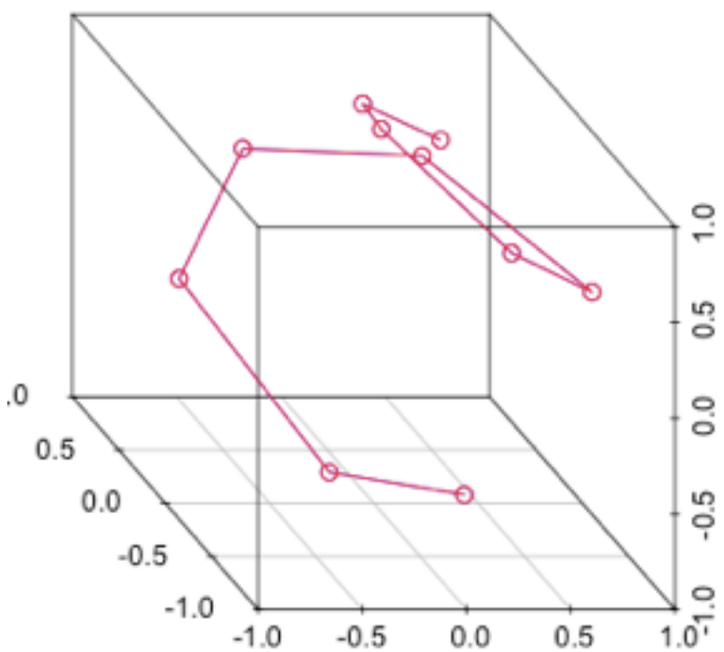
$$\varphi_{t+1} = \varphi_t + (1/\text{sqrt}(n)) * X_2$$

$$X_1 \sim \text{Normal}(8, \text{Sigma})$$
$$X_2 \sim \text{Normal}(8, \text{Sigma})$$

0.9553, 0.7853
1.6928, 1.4148
2.4332, 1.9734
3.3514, 2.8737
4.0854, 3.6153
4.6977, 4.0377
5.8189, 5.1154
5.8257, 6.2331
6.4184, 7.0647
7.2677, 7.3118



$$\theta_{t+1} = \theta_t + (1/\text{sqrt}(n)) * X_1$$
$$\varphi_{t+1} = \varphi_t + (1/\text{sqrt}(n)) * X_2$$

$$X_1 \sim \text{Normal}(8, \text{Sigma})$$
$$X_2 \sim \text{Normal}(-8, \text{Sigma})$$

0.9553, 0.7853
0.7533, 1.223
-0.0758, 1.600
-0.8422, 2.0968
-1.2829, 2.7962
-1.1444, 4.0588
-1.2148, 4.9531
-1.8252, 5.3716
-2.882, 5.1557
-3.5617, 6.0948