Diffusion

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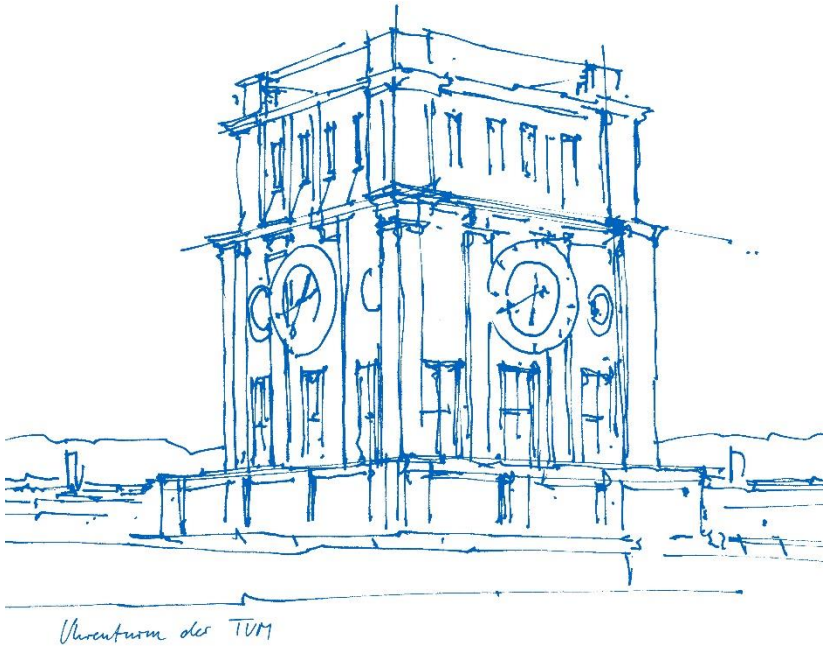
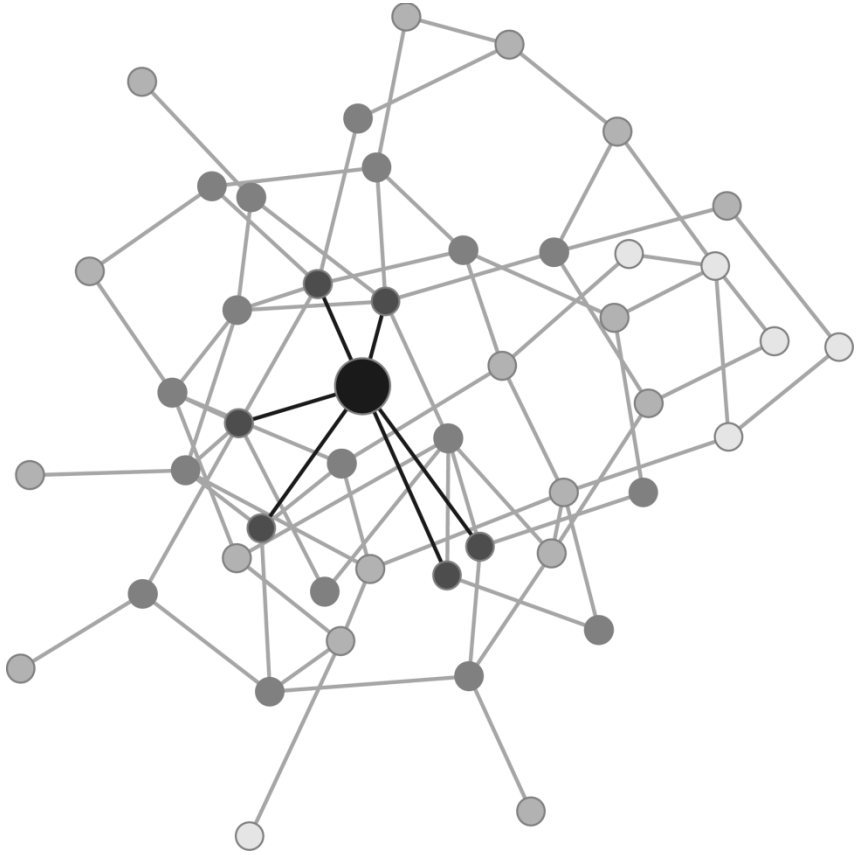


Networks and Diffusion



Diffusion of Innovation

Rogers, Everett M. (2003)

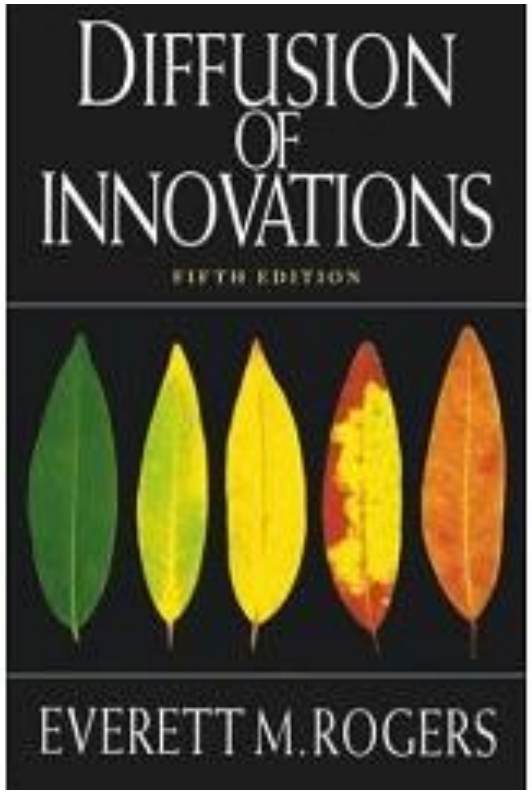
Diffusion of Innovations, Fifth Edition

Spread of new ideas in society

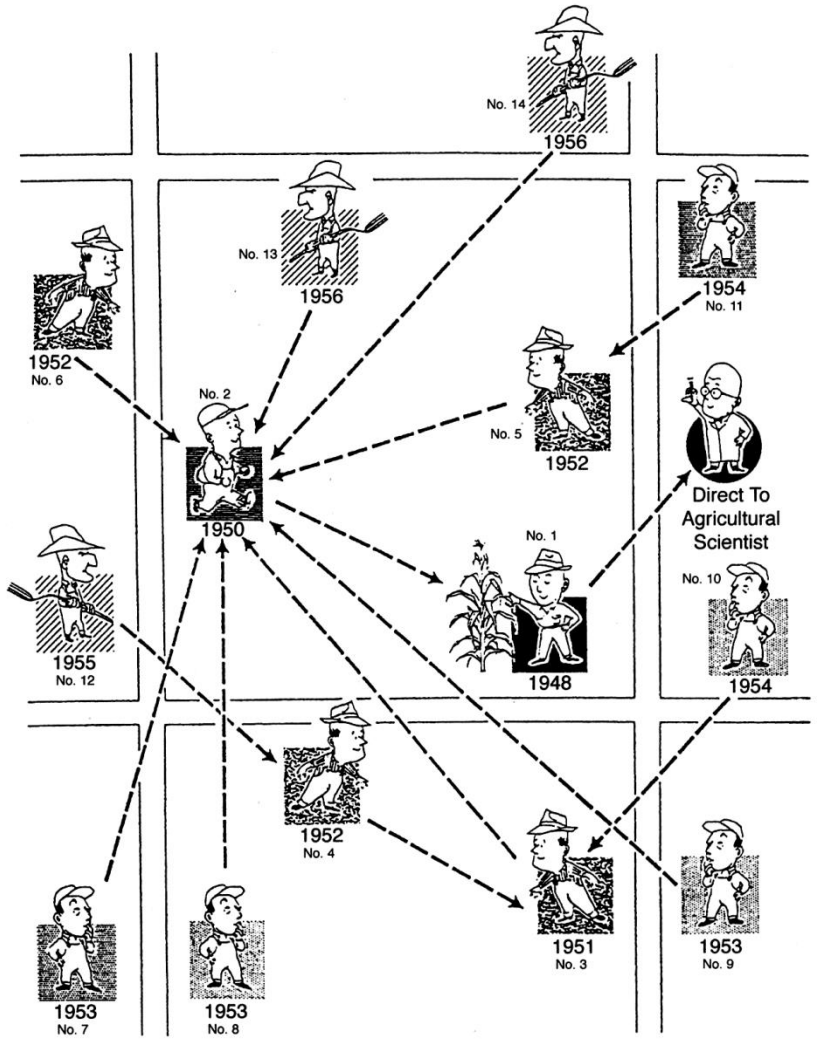
Results from 500+ diffusion studies

“Holistic” theory of diffusion

Great book (!)

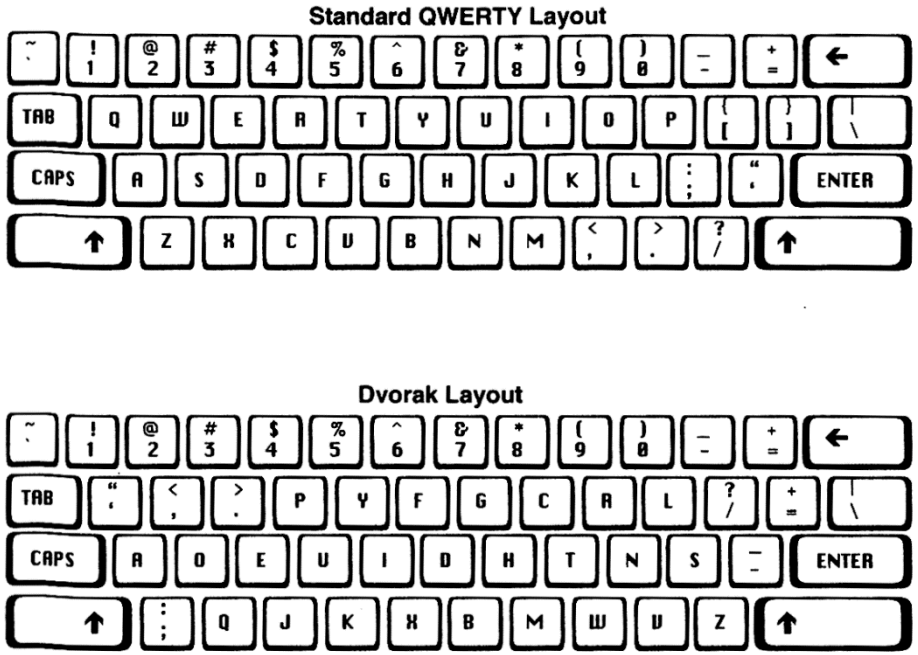


Successful Diffusion



Failed Innovations

Figure 1-1. Layout of the QWERTY and the Dvorak Keyboards.



The Dvorak keyboard is much more efficient for typists than the QWERTY keyboard, which was designed more than a century ago to slow down typists so as to prevent the jamming of keys on early typewriters. Yet almost no one has adopted the Dvorak keyboard. Superior technological innovations do not necessarily diffuse themselves.

Elements of Diffusion

Diffusion is the process

by which an **innovation**

is **communicated** through certain **channels**

over **time**

among the members of a **social system**.

The Innovation

Idea,

practice, or

object

that is perceived as new

Characteristics of Innovations

1. Relative advantage
   - Measured in economic terms, social prestige, convenience, …
2. Compatibility
   - Perceived as being consistent with existing values, norms, experience, needs, … (Water boiling)
3. Complexity
   - Perceived as difficult to understand and use?
4. Trialability
   - Experimented with on a limited basis? (Hybrid seed corn)
5. Observability
   - Results on innovations are visible to others? (Solar collector)

Communication Channel

Mass media

- Radio, television, newspaper
- to inform potential adopters (awareness)

Interpersonal communication

- Face-to-face, telephone, social media

Mass media, especially newspapers, were expected to shape the beliefs of the masses (Lippman, 1922)

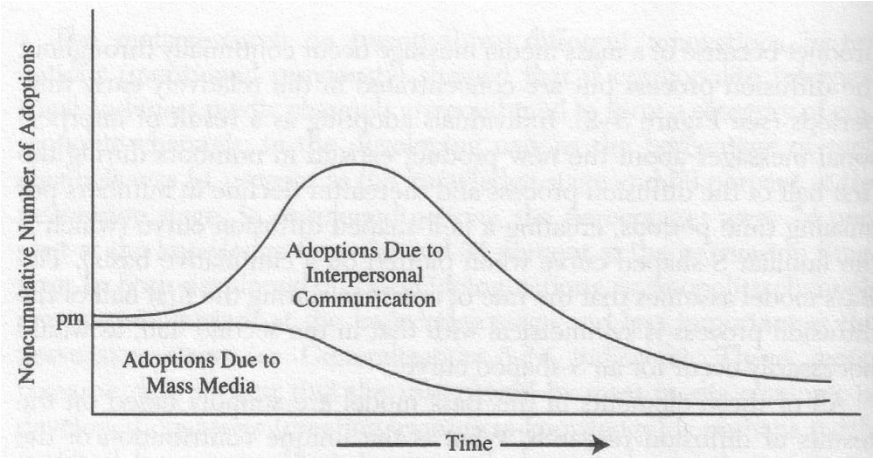
Two levels of communication; from mass media to individuals, between individuals (Katz & Lazarsfeld, 1955)

Communication Channel

Most individuals do not evaluate scientific studies (except first adopters)

Most people depend mainly on subjective evaluation from other people

Bass Modell:



Homophily and Diffusion

Transfer of ideas occur mostly between individuals who are similar

One problem of successful diffusion of innovation is that participants are usually quite heterophilous

“Change agent”:

- Must share most of personal characteristics
- Having already adopted is different enough

Time

Three time dimensions:

Innovation decision process

- From first knowledge to adoption

Innovativeness

- When is the innovation adopted?

Innovation’s rate of a system

- Number of people adopted an innovation

Innovation Decision Process

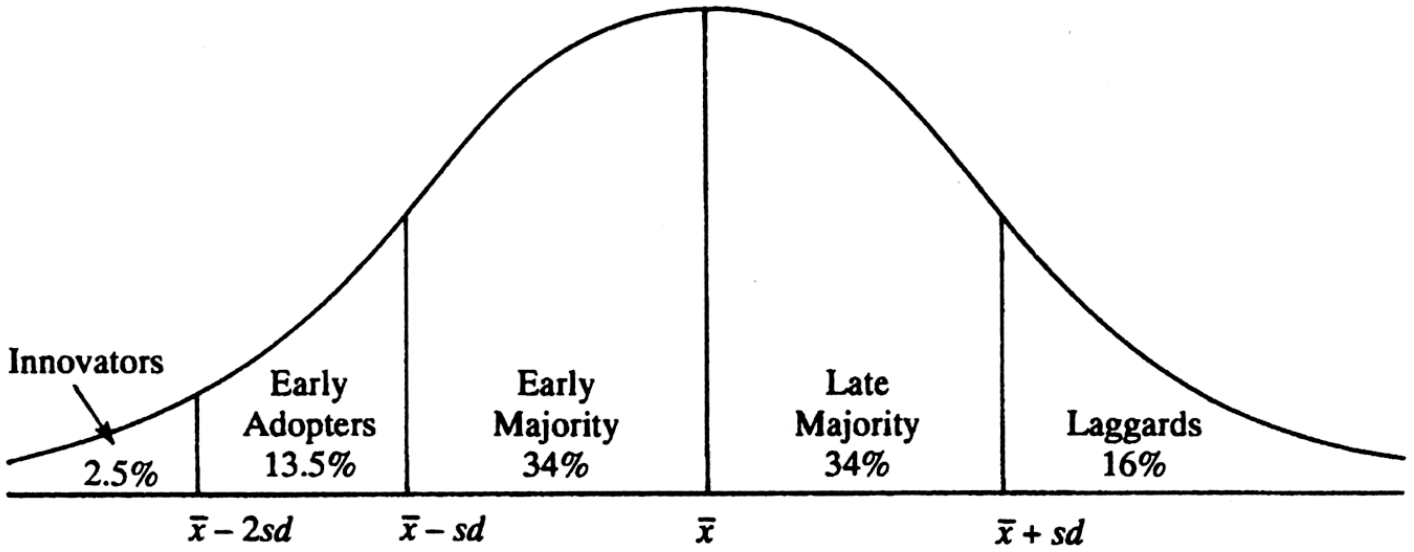
Five step of the decision process:

1. Knowledge (commercials)
2. Persuasion (interpersonal network)
3. Decision (adoption/rejection)
4. Implementation (reinvention)
5. Confirmation (reinforcement)

→Information-seeking, information-processing, and information-evaluation activity

Innovativeness

Five adopter categories:

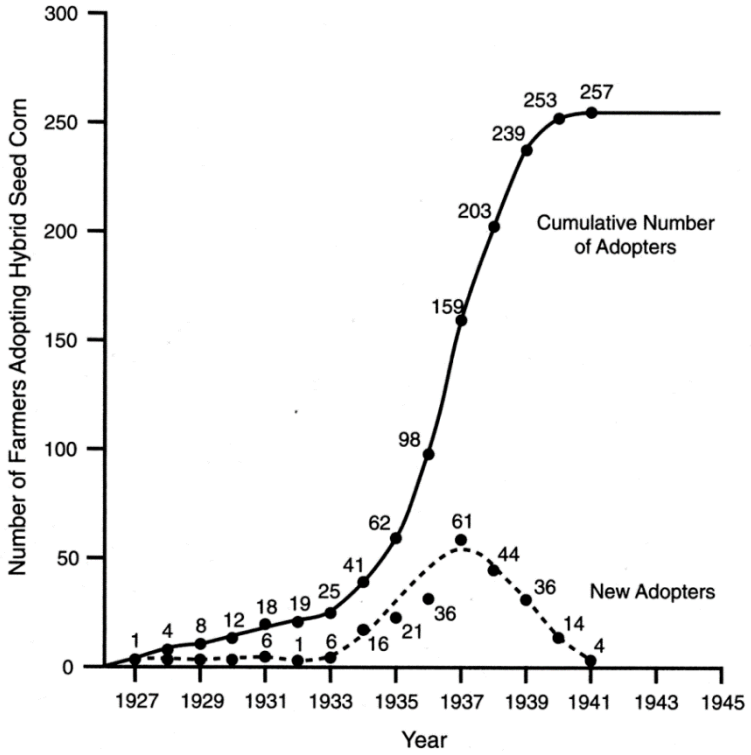


The innovativeness dimension, as measured by the time at which an individual adopts an innovation or innovations, is continuous. The innovativeness variable is partitioned into five adopter categories by laying off standard deviations (sd) from the average time of adoption ($\bar{x}$).

Innovation’s Rate of a System

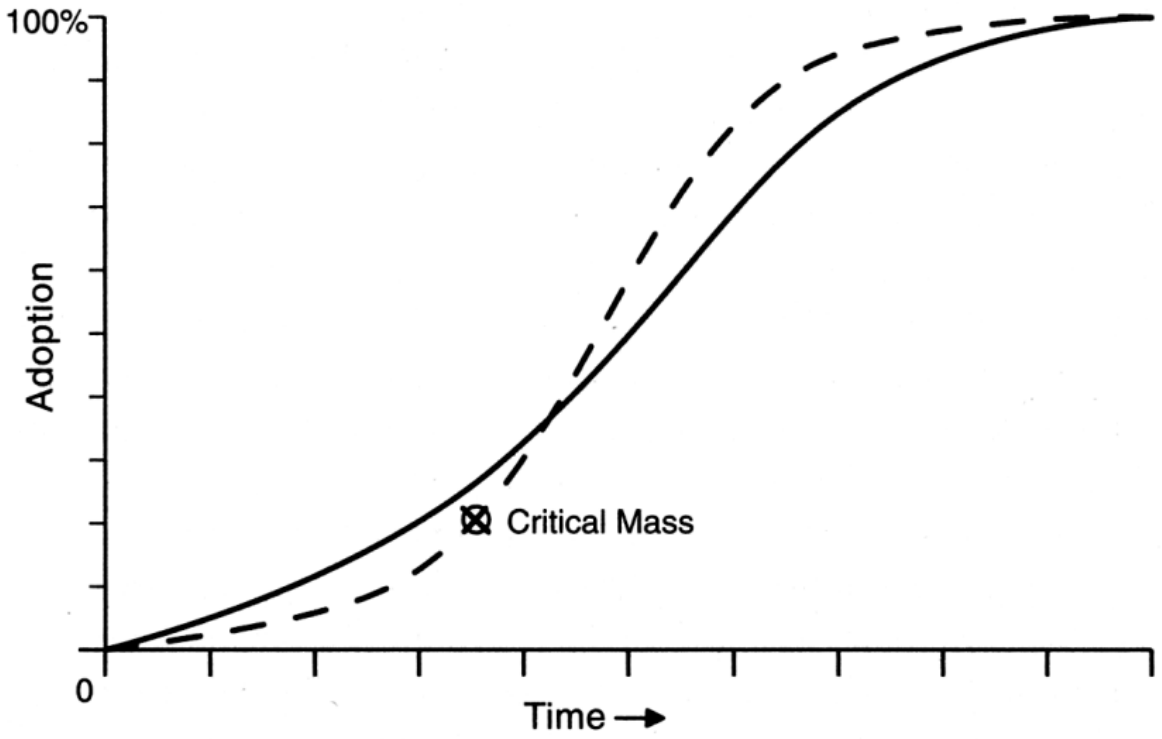
S-shaped curve when plotted cumulative over time

Figure 7-1. The Number of New Adopters Each Year, and the Cumulative Number of Adopters, of Hybrid Seed Corn in Two Iowa Communities



Critical Mass

Enough individuals have adopted so that the innovation's further rate of adoption becomes self-sustaining



Social System

Diffusion occurs within social systems

Social structure, formal and informal structure

Social network analysis to understand and describe social structure

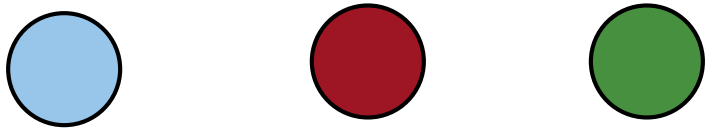
Important actors for diffusion in networks

“It is as unthinkable to study diffusion without some knowledge of the social structure in which potential adopters are located as it is to study blood circulation without adequate knowledge of the veins and arteries.” (Katz, 1961)

Epidemic Concept I

Groups to describe the agent's/element's status according to the infection:

- Susceptible
- Infected
- Refractory
- Immune



Incidence: Number of newly infected in a specific time period

Prevalence: The overall number of infected agents

Endemic: A disease remains permanently in the population

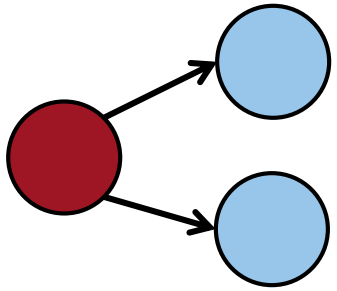
Epidemic Concept II

Latency/Incubation Period: Time from infection to disease outbreak

Generation Time: Time from A's disease outbreak to the disease outbreak of those infected by A

Infection: The moment a susceptible agent is infected through a contact with an infected agent

Basic Reproduction Number: Average number of infected through a single agent

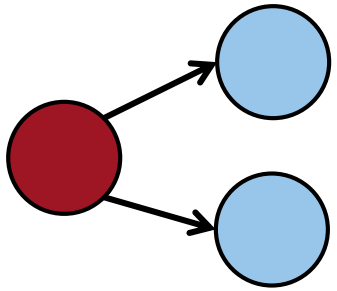


Epidemic Concept III

Predisposition, Relative Risk: The responsiveness of an agent to an infection

Contagion Index: The probability that an agent becomes infected after interacting with an infected agent, range 0-1

Alternate Host: Propagation happens not directly between agents



Different Forms of Diffusion

Diffusion of ideas and information, political optinions

Diffusion of diseases

Dispersion of money and resources

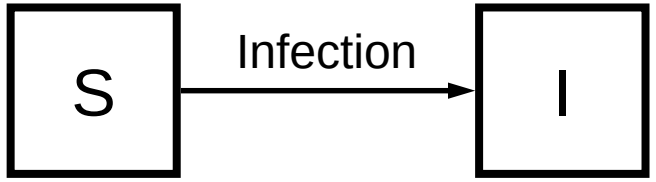
Adoption of technology

“Ideas are not like apples“

SI - Model

Susceptible elements get infected

E.g. information diffusion

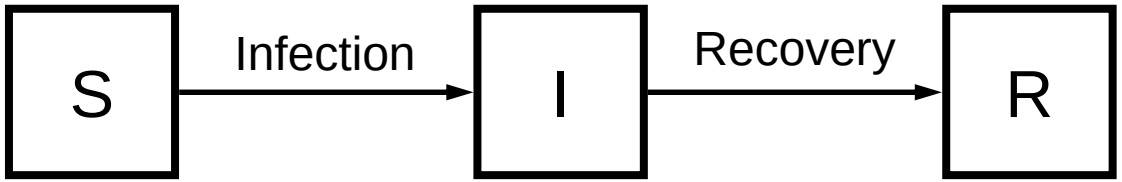


SIR - Model

Susceptible elements get infected

Infected recover and become immune

E.g. childhood disease, measles



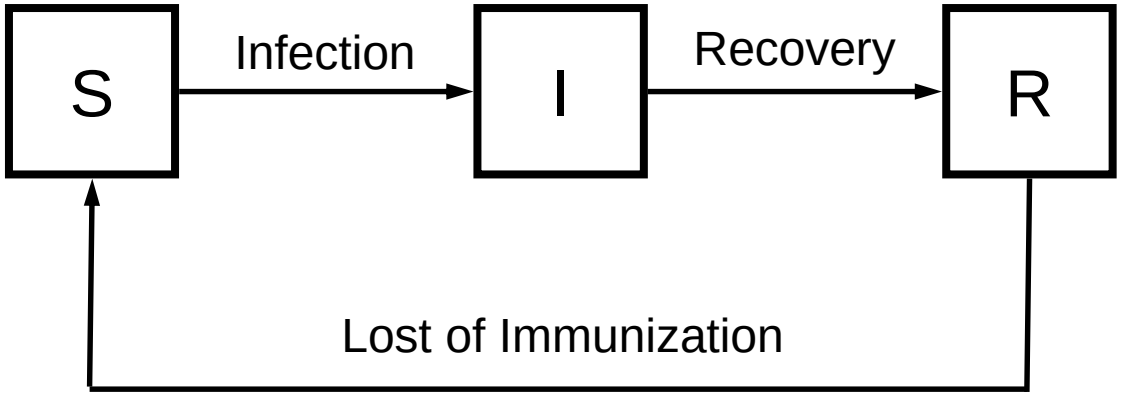
SIRS - Model

Susceptible elements get infected

Infected recover and become immune

After a time period elements become susceptible again

E.g. influenza

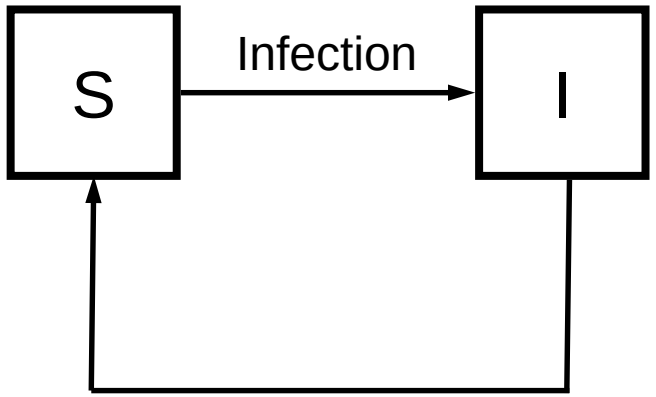


SIS - Model

No recovery state

Elements become susceptible again after being recovered

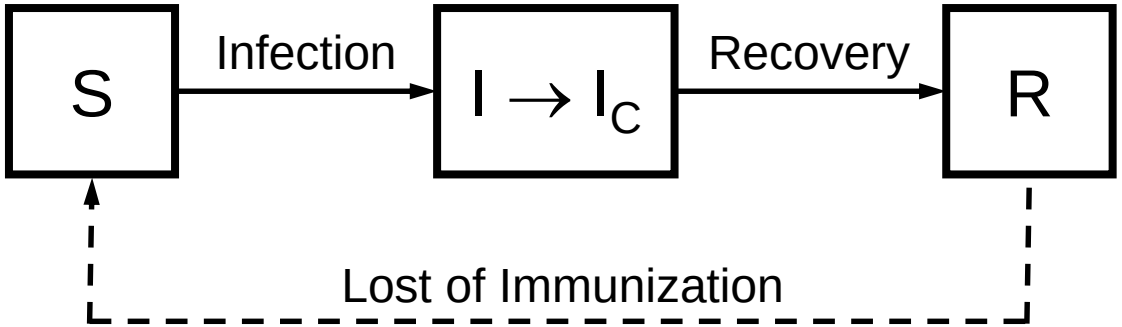
E.g. common cold, computer virus



SIRS - Model

Infection + contagious

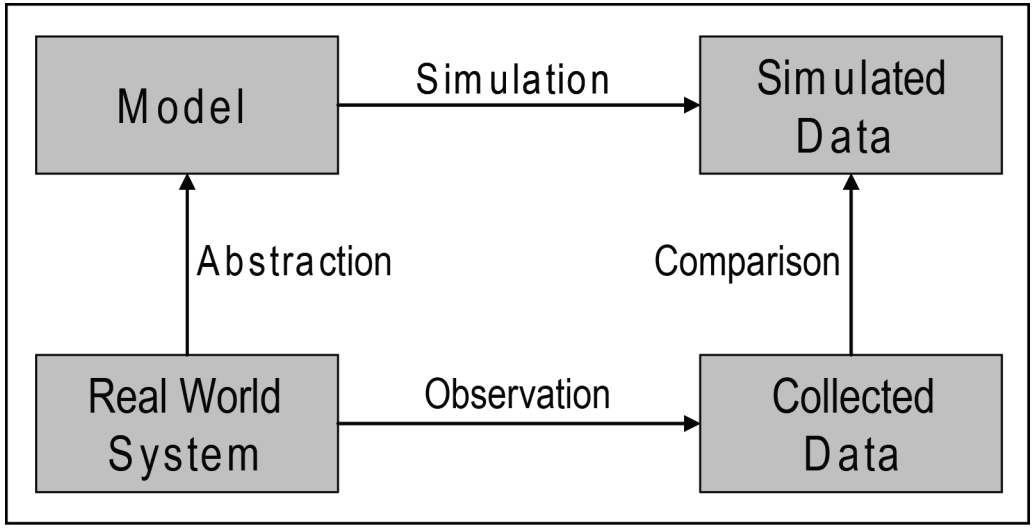
Active and passive infected



What is a Model?

Guideline 3633 of the Association of German Engineers:
A model is a “simplified replication of a planed or really existing system”

Simulation: The “replication of a system with its dynamic processes that lends itself to experimentation to come to conclusions which are transferable to reality”.



General Model Theory

Herbert Stachowiak, 1973:

Mapping. The model is always a representation of a real world system.

Shortening. It is not possible to map all the attributes of the real world system. Those attributes of the system should be modeled which are relevant to the questions.

Pragmatism. A model never tells its own tale. It has to be interpreted.

Models

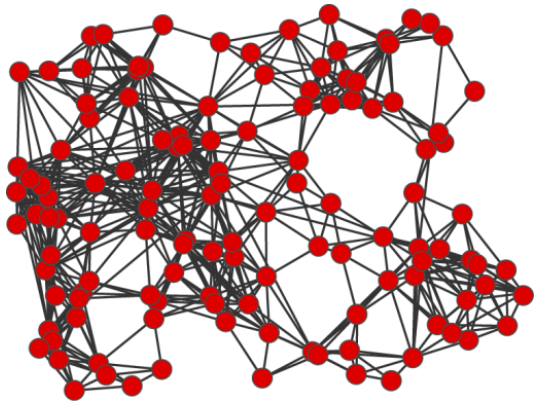
Different ways to describe the same system

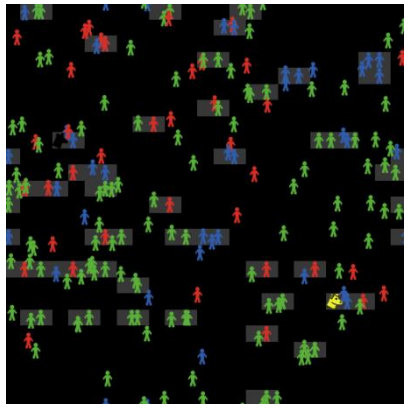
Micro level:

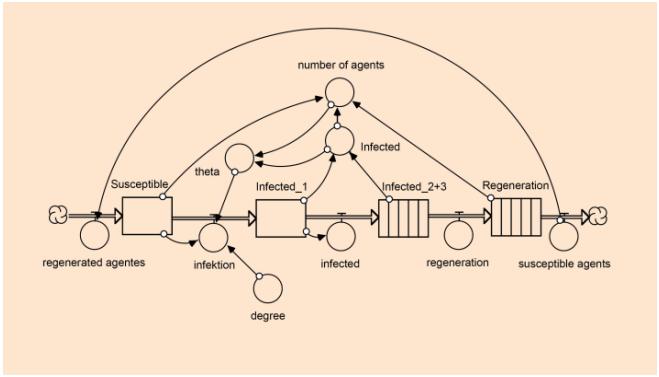
- Networks - Focus on connections and structure
- Agent Based Simulations - Focus on behavior of agents

Macro level:

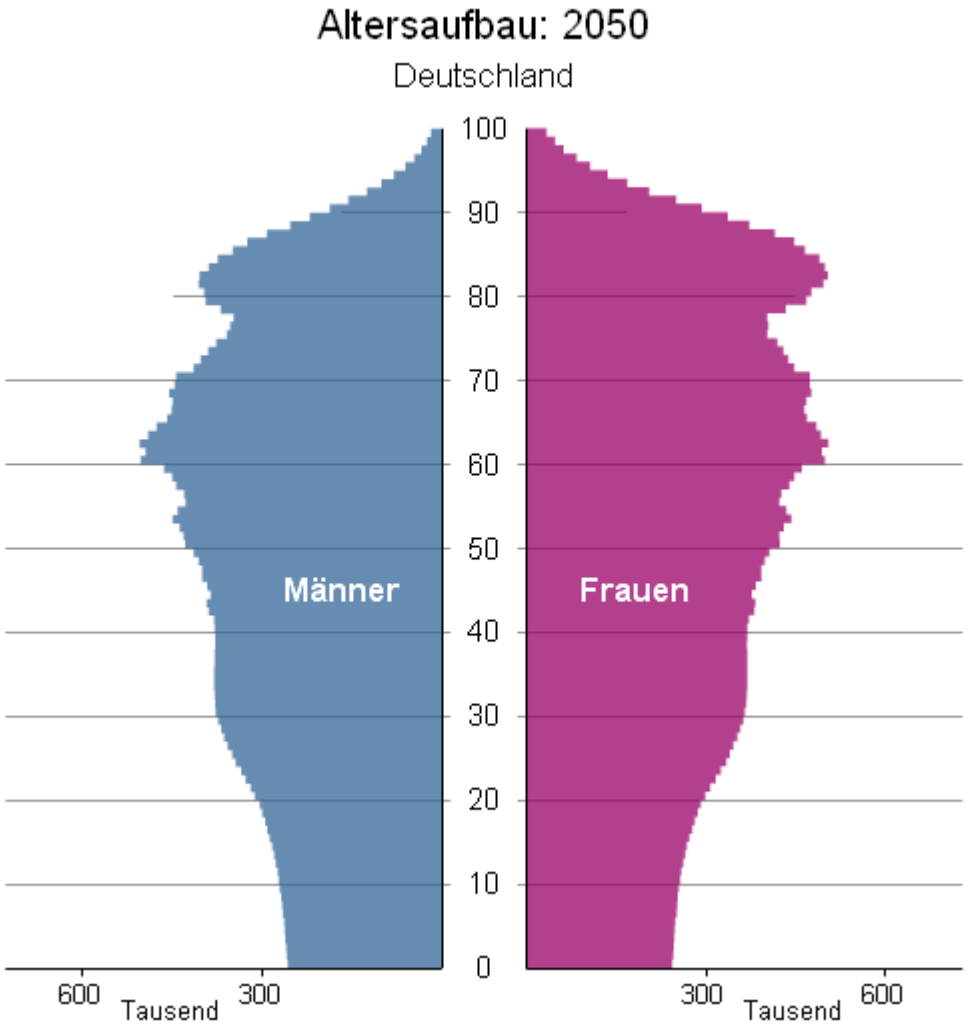
- System Dynamics - Focus on system behavior

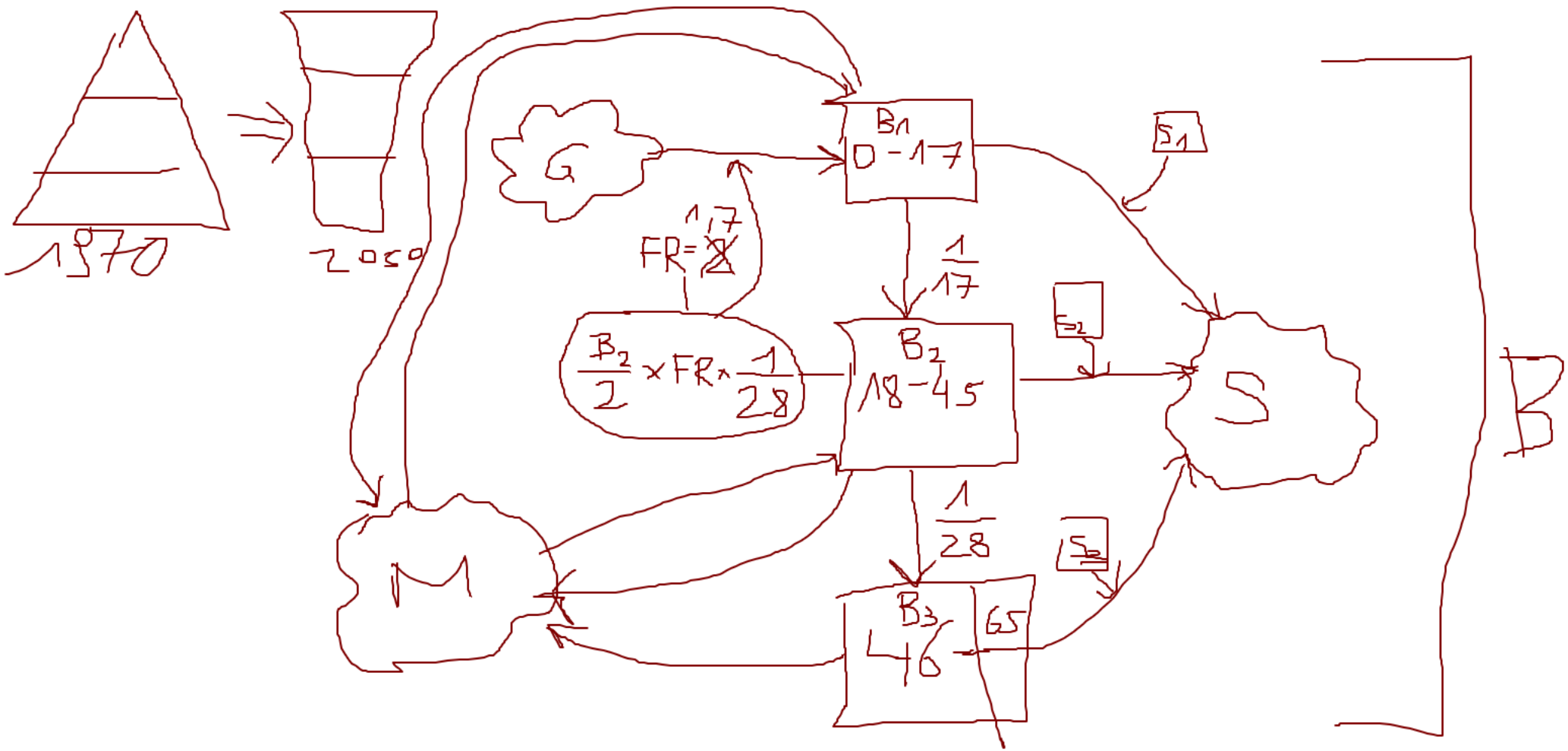






Beispiel Bevölkerungsentwicklung

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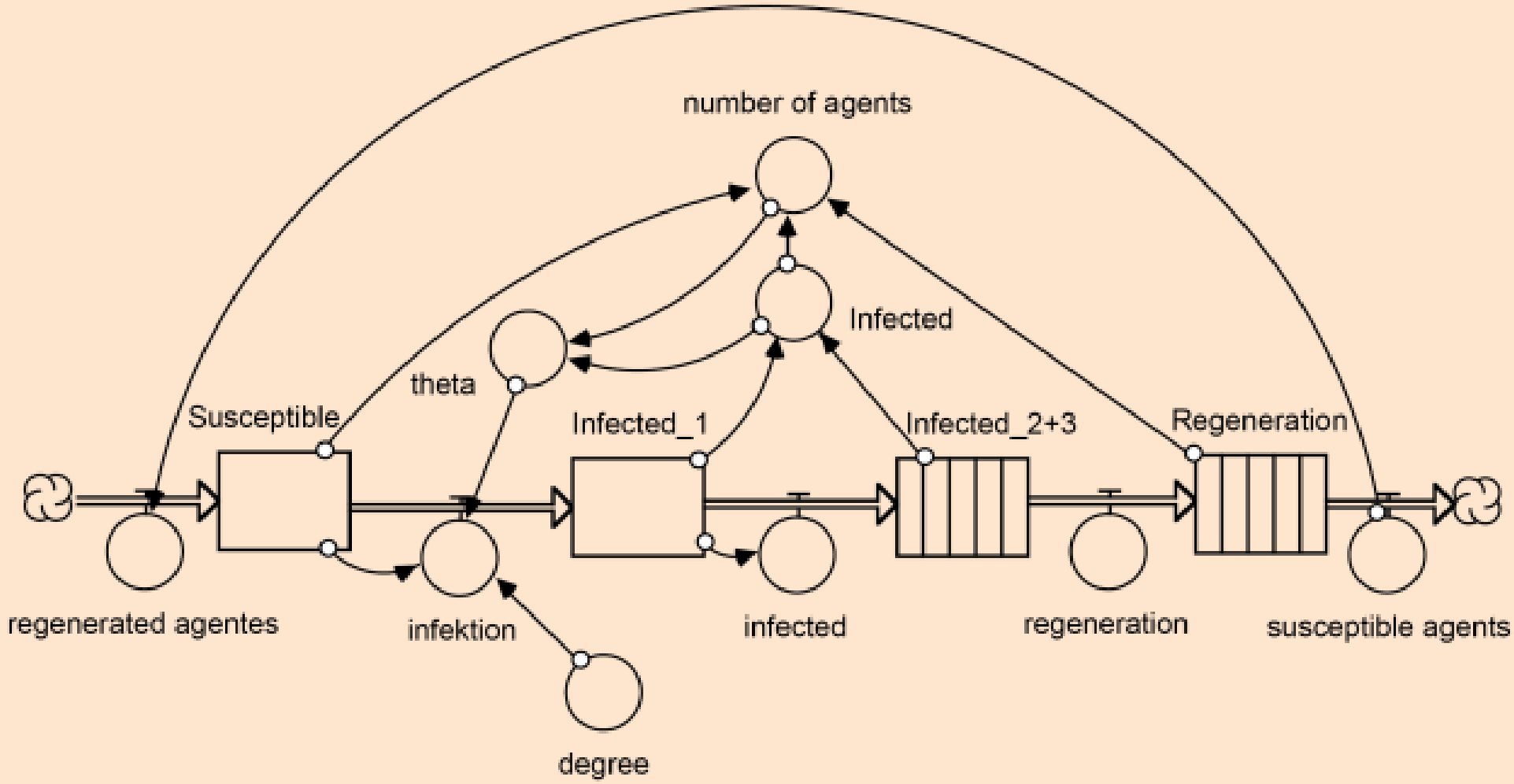
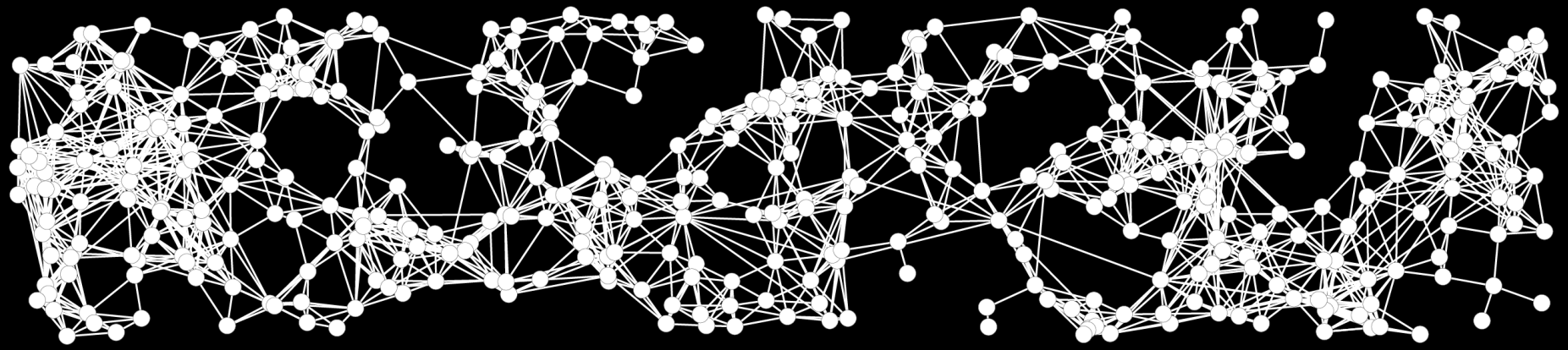

number of agents
Infected
theta
Susceptible
Infected_1
Infected_2+3
Regeneration
regenerated agentes
infektion
infected
regeneration
susceptible agents
degree

“Our mission is to go forward, and it has only just begun.
There's still much to do, still so much to learn. Engage!”
Jean-Luc Picard, Star Trek TNG, Season 1 Episode 26



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