A Simple Study about Organization Size with a Simulation Model

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Abstract

This simple simulation model (the classroom model) studies the effects of organization (a classroom) size on the network of individuals (students) and their behaviors. In the model, there is a classroom which has several desks for students. The desks are set in a circle for the convenience of programming. Students come into the classroom randomly and choose their desks freely. But the rule for choosing their desks is the attractiveness of desks to them. The attractiveness means the chance for a student to communicate with his neighbor classmates who he is already intimate with.

The results show that the classmates who a student more often communicated with for early periods tend to remain as those who he more often communicates with for later periods. Second, the concentration of the friendship decreases but becomes nearly constant as the size of the class gets larger. Third, the number of friends tends to be smaller as the size of the class gets larger. Last and more interesting result says that students can make more friends by ignoring some classmates.

I. Introduction

There were lot of researches, between 1950s and 1970s, on the effects on human relations of formal characteristics of organization such as organization size, number of levels of supervision, extent of division of labor and functional specialization, number of men per supervisor, and so forth. Especially, almost all of the studies on the relationship between organizational size and member participation had shown a negative relationship (Paul H. Wilken, 1971). Sergio Talacchi (1960), for example, empirically studied employee behavior and level of satisfaction associated with organization size differences. According to him, the larger the organization is, the lower the employee level of satisfaction is. Paul H. Wilken (1971) also found the size of the church congregation is negatively related to participation of members. The general theoretical framework proposed by various theorists in the field of industrial sociology is provided by the following model: (Sergio

Talacchi, 1960)

Organization size → interaction → attitudes → behavior

This study re-investigates the same topic which had been studied many years ago but with a modern tool, a computer simulation. I think this re-investigation can complement previous researches especially in individuals' interactions within an organization. Chapter 2 provides general explanation of the simulation model including some rules of agents. Chapter 3 shows some results of the simulation with Repast. [1] Chapter 4 concludes this paper in brief.

II. Simulation Model

There is a classroom which has several desks for students. The desks are set in a circle for the convenience of programming[2]. So, all desks have two neighbors in this model. For example, the desk 'a' has the desk 'b' and the desk 'c' as its neighbors. (Figure 1)

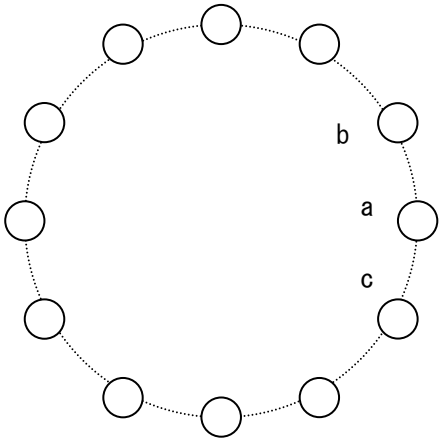

Figure 1. A classroom where desks are set in a circle

Students come into the classroom randomly, which means the sequence of the entrance has not been determined. In a real world, however, there may be some tendency in the entering sequence. Some students tend to arrive at the classroom early, while others tend to be late. But the simplified model of this paper assumes there is no such tendency. A student may get to class first, second, …, or last with the same probability.

Rule 1. Students come to a classroom in a random sequence, which means one can arrive there first, second, …, or last with the same probability.

When arriving at the classroom, students can choose their desks at their pleasure. That is, there is no such rule as one should sit on his assigned desk during classes. Therefore students can choose their favorite

[1] Repast: Recursive Porus Agent Simulation Toolkit, http://repast.sourceforge.net/

[2] In a real classroom, desks are usually set in a square like matrix. Since Repast provides 'grid space', one can run a simulation for a classroom with desks arranged in a square. This simulation, however, chose a classroom with desks arranged in a circle to make all desks have the same number of neighbors.

desks which are most attractive to them. The attractiveness of a desk is defined as the pleasure a student can enjoy by communicating with their neighbor students during class. The degree of pleasure varies with that of friendship (the number of times they have already communicated with each other so far)[3] between them. The deeper the friendship is, the higher the pleasure he can get. If there are more than one desk giving the same pleasure, a student chooses one among them at random.

For example, if student 'A' happens to come to the classroom first, he will sit on any desk randomly because all desks are empty and give him the same pleasure, exactly 'no pleasure'. What will happen if student 'B' enters the classroom next? Which desk will he choose? It depends on the friendship between A and B. If there is any friendship between them, student B will sit on A's neighbor desk, 'b' or 'c', where he can communicate with A. On the other hand, if there is no friendship between them (they have not yet met before), student B will sit on any vacant desk randomly. (Figure 2)

Rule 2. Students can choose their desks freely which are most attractive to them.

Rule 3. The attractiveness of a desk is defined as the pleasure a student can enjoy by communicating with their neighbor students during class. The degree of the pleasure depends on that of friendship between them, which is determined by the number of times they have already communicated with each other.

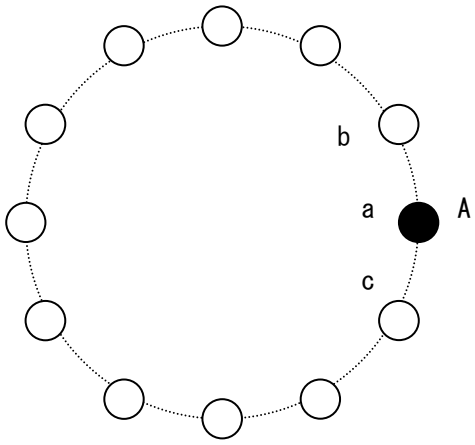

Figure 2. Student 'B"s choice of his desk when student 'A' have already sat on desk 'a'

Let us go more into the attractiveness of a desk. As described above, every desk has two neighbors in the model of this paper. It means a student can communicate with two classmates during class. So, his total pleasure comes from two communications. This simulation model assumes the total attractiveness of a desk is calculated by summing both pleasures. In figure 3, if student 'C' has 2 and 3 degree of friendship with the student 'A' and 'B' respectively, the attractiveness of desk 'a' to the student 'C' is 5 (=2+3).

[3] In a real world, the friendship between two students depends on a lot of factors such as dispositions, characteristics similarity, situations and so on (Gerald H. Graham, 1971). This simplified simulation, however, assumes that the friendship depends only on the frequency of communication which happened before.

Rule 4. The total attractiveness of a desk is calculated by summing both pleasures from communication with each neighbor.

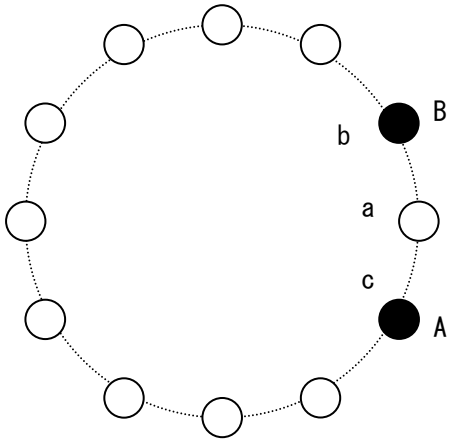

Figure 3. The attractiveness of desk 'a' to student 'C'

After all students taking their seats, the class starts. Students communicate with their neighbors during class and their friendships go up by one degree. There is no argument or quarrel between students in this model which can decrease their friendship. Therefore, the higher the number of times of communicating is, the higher their friendship is.

If this friendship goes beyond some degree, two students become 'friends'. Friends make them happy. So students try to make their friends in the classroom even though they are told that they are there not to make friends but to study. Gerald H. Graham (1971) gathered the evidence relating to the inclination of individuals to select other individuals as informal work companions and as social companions in a formally organized framework.

III. Simulation Results with Repast

The overall procedure of the classroom model is as followings.

Step 1. Create a group of 'Desks' and 'Students'.

Step 2. Choose one student randomly who enters the classroom.

Step 3. The chosen student at step 2 evaluates all the empty desks and takes a seat on the desk most attractive to him. (If there are more than one most attractive to him, he choose one among them at random)

Step 4. Do the step2~step3 until all students finish sitting.

Step 5. Update students' friendship between neighbors and the class ends (students leave the classroom).

Step 6. Repeat the step 2 ~ step 6 for a given number of times (during a semester).

Step 7. Get the results.

Result 1. The classmates who a student more often communicated with for early periods tend to remain as those who he more often communicates with for later periods.

Parameters:

The number of students and desks: 10

The number of classes during a semester: 1000

Result Graph:

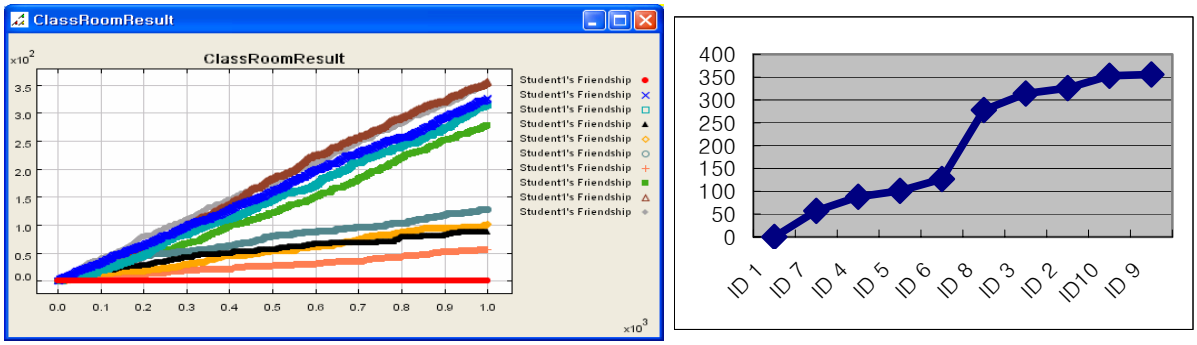

Figure 4. A sample student (RED, ID 1)'s friendships with his classmates during a semester

Figure 4 is the result graph of a sample student (RED of the left, ID 1 of the right)'s friendships with his classmates during a semester. The left graph represents dynamic changes of friendships (the vertical) in terms of time (the horizontal), while the right one represents the final state of friendships (the vertical) in terms of his classmates (the horizontal). As we can see on the left graph, the classmates whom the sample student more often communicated with for early periods tend to remain as those whom he more often communicates with for later periods. This tendency comes from the rule that one would like to sit on the neighbor of his classmate friendship with whom is high. So, classmates who one communicates with during early period are likely to become his friends during the semester.

Result 2. The concentration of the friendship decreases but becomes nearly constant as the length of a semester gets longer.

Parameters:

The number of students and desks: 50

The number of classes during a semester: 100, 200, 300, …, 5000

Result Graph:

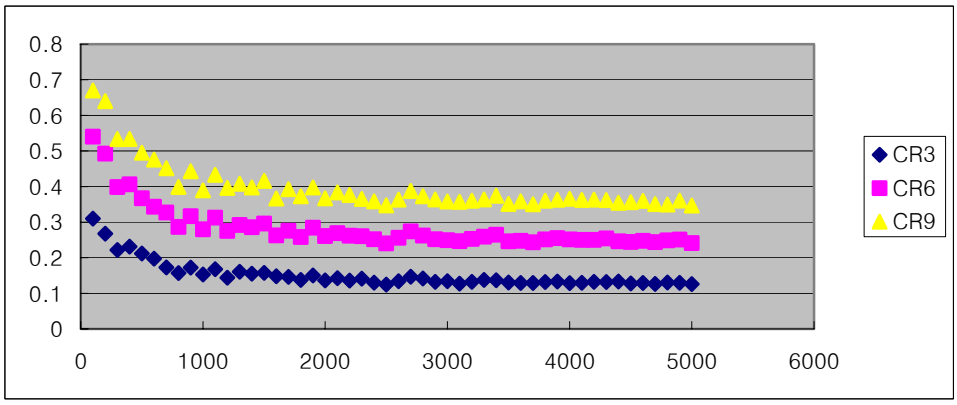

Figure 5. A sample student's concentration of friendships in terms of the length of a semester

Figure 5 is the result graph of a sample student's concentration of friendships with his classmates in terms of the length of a semester. The horizontal represents the number of classes during a semester, while the vertical represents the concentration ratio. The concentration ratio means the degree of concentration in friendship. CR3 (CR6) consists of the percentage of three (six) highest friendships in the total friendship. [4] So, high concentration ratio indicates that a student communicates mainly with a few classmates, while low one indicates that he communicates with lots of classmates. In other words, the higher concentration ratio is, the narrower one's friendship is.

Result 3. The concentration of the friendship decreases but becomes nearly constant as the size of the class (the number of students) gets larger.

Parameters:

The number of students and desks: 10, 20, 30. …, 300

The number of classes during a semester: 3000

Result Graph:

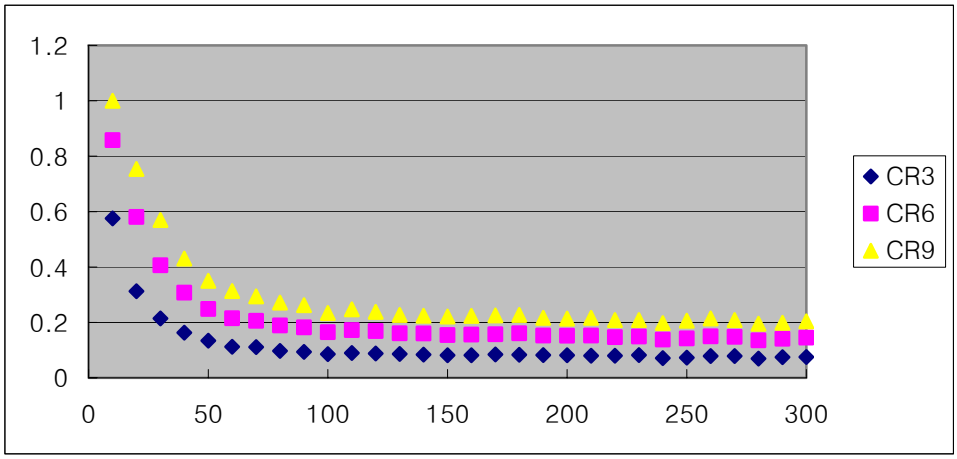

Figure 6. A sample student's concentration of friendships in terms of the number of students

Figure 6 is the result graph of a sample student's concentration of friendships with his classmates in terms of the number of students (the size of the class). The horizontal represents the size of the class and the vertical represents the concentration ratio.

Result 4. The number of friends varies with the size of the class. As the size of the class gets larger, the number of friends tends to be smaller.

Parameters:

The number of students and desks: 10, 20, 30, 40, 50

The number of sitting during a semester: 1000

[4] The CR(concentration ratio) is used as an indicator of the relative size of firms in relation to the industry as a whole in economics.

Result Graph:

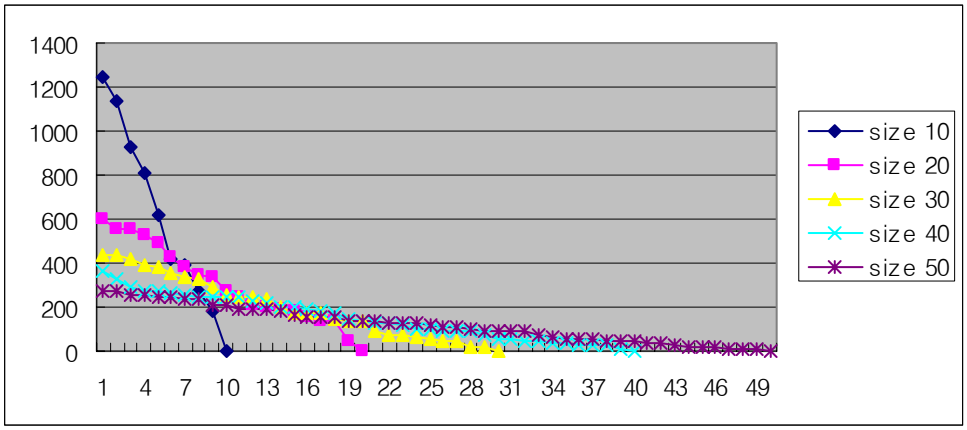

Figure 7. A sample student's friendships with his classmates in terms of the size of the class

Figure 7 is the result graph of a sample student's friendships with his classmates in terms of the size of the class. The horizontal represents the number of students and the vertical represents the degree of friendship. The classmates are sorted decreasingly by the degree of friendship. For example, with size 10, the closest classmate of the sample student has about 1250 degrees of friendship and the next one about 1150. According to the result, if we define friends as classmates whose friendship is over 400 degrees, the sample students has 6 friends in size 10, 6 in size 20, only 3 in size 30 and zero in other sizes.

Result 5. Students can make more friends by ignoring some classmates.

Parameters:

The number of students and desks: 50

The number of sitting during a semester: 1000

The ignorance time: 10, 110, 210, …, 910

Result Graph:

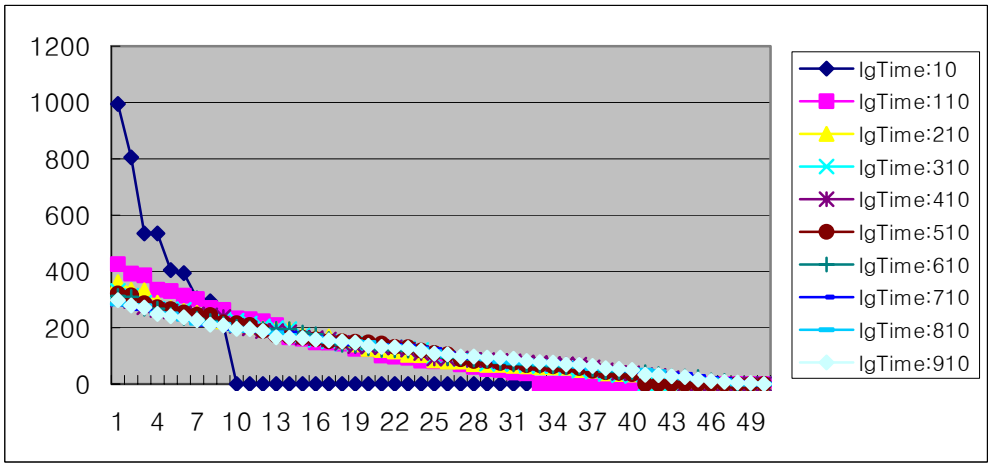

Figure 8. A sample student's friendships with his classmates in terms of the ignorance time (IgTime)

Figure 8 is the result graph of a sample student's friendships with his classmates in terms of the

ignorance time. Ignorance means that one does not communicate with unacquainted students whose friendship is zero. For example, if the ignorance time is 10, the sample student communicates with any classmates in his neighbors before the tenth class. But after that, he ignores his neighbors if he has not met them before.

From figure 8, the sample student can make friends (classmates whose friendship is over 400) by ignoring unacquainted classmates even though the size of the class is 50 where he would not have any friend at all without ignoring (figure 7). The earlier the ignorance time is, the more friends he can make while the less acquaintances he has.

IV. Conclusion

So far, we investigated the effects of organization (a classroom) size on the network of individuals (students) and their behaviors with a simulation model. There had been a lot of researches about the effects of organization many years ago. This study, however, uses a new tool, a computer simulation model.

Result 1, 2 and 3 represents some characteristics of the networks of individuals in an organization. The classmates who a student more often communicated with for early periods tend to remain as those who he more often communicates with for later periods. The concentration of the friendship decreases but becomes nearly constant as the length of a semester gets longer and as the size of the class gets larger. Result 4 of this simulation model coincides with previous researches: a negative relationship between organization size and individuals' satisfaction. As the size of the class gets larger the number of friends tends to be smaller. Result 5 explains the reason people in a large organization tend to neglect each other. It can be a way for the individuals to increase their satisfaction (happiness with friends). Students can make more friends by ignoring some classmates.

I expect this re-investigation on old topics to induce further researches on the effects of organization size from different perspectives by using a computer simulation. I think those further researches can raise practical suggestions for companies and modern society where the number of members grows bigger and bigger.

Reference

[1] Gerald H. Graham, 1971, Interpersonal Attraction As a Basis of Informal Organization, Academy of Management Journal, December, p.483-496.

[2] Michael Beer, 1964, Organizational Size and Job Satisfaction, Academy of Management, March, p.34-44.

[3] Paul H. Wilken, 1971, Size of Organizations and Member Participation in Church Congregations, Administrative Science Quarterly, p.173-179.

[4] Sergio Talacchi, 1960, Organization Size, Individual Attitudes and Behavior: An Empirical Study, Administrative Science Quarterly, p.398-420.