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Tightening the iron cage or path dependence in norm formation? A system dynamics approach

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Abstract

Observing the creation and solidification of norms in self-managing teams, Barker (1993) suggests that these teams develop rules more restrictive than those of traditional bureaucracies. Looking at the process of norm development suggests the existence of structures leading to path dependence in this process. A simple system dynamics model is developed and analyzed to describe path dependence in formation of norms in self-managing teams; observations of Barker are explained from this standpoint. Some policy issues are addressed based on the insights generated from the analysis of the model.

Keywords: Norm formation, System Dynamics, Path Dependence

Introduction

In research on self-managed teams in a factory, Barker (1993) reached the puzzling conclusion that giving autonomy to teams triggers a process that develops a set of binding rules and norms. After this process has been underway for sufficient time, these norms coalesce around a set of explicit rules that are more constraining than a hierarchical structure. He concludes: " … my analysis suggests that concertive control does not free workers from Weber's iron cage of rational rules… The powerful combination of peer pressure and rational rules in the concertive system creates a new iron cage whose bars are almost invisible to the workers it incarcerates." However, there is abundant empirical and anecdotal evidence that self-managed teams do increase their members' freedom. This results in increased team and, hopefully, organizational performance (Yeats & Hyten, 1998)

In an attempt to reconcile these results, we draw on the concept of path dependence in the formation of norms. Path dependence is a pattern of behavior in which the ultimate equilibrium depends on the initial conditions and random shocks as the system evolves (Sterman, 2000). The notion of path dependence is relatively new in the literature. Examining and understanding different instances of this pattern of behavior started from understanding the adoption of technologies (David, 1986) and has been growing during last decade, especially in the fields of technology and macroeconomics. This research trend has mainly focused on path dependence resulting from increasing returns to adoption (Arthur, 1988). But there are other positive loops that can generate path dependent behavior in other systems, including groups, the dynamics of which has yet to be studied.

Capable of capturing feedback loops underlying path-dependent behavior in quantitative models, system dynamics has proved to be an effective methodology for investigating path-dependence. By developing a dynamic model of the birth, growth and death of scientific paradigms, Sterman (1999) explains inherent path dependence in knowledge formation.

There are positive feedback loops in the process of norm formation that suggest the possibility of path dependence as a viable mode of behavior. We build a simple system dynamics model of norm formation and try to explain Barker's observations based on dynamic conclusions derived from our analysis.

Dynamic Hypothesis

We define group norms as the informal rules adopted by groups to regulate and regularize group members' behavior (Feldman, 1984). These rules are usually implicit rather than written, inferred and internalized by group members through their social interaction inside the group. Norms are substantial elements in a team’s course of action because they are one of the important determinants of individuals' behaviors in the group (Hackman, 1976). The enforcement of norms on individuals' actions may originate from several reasons. Norms facilitate individual decision making by constraining the set of possible actions and therefore reducing the uncertainty faced by individuals and preventing embarrassment. (Goffman, 1955). They also provide a way for group members to express their central values and clarify the group identity while proving their actions legitimate (Katz & Kahn, 1978). Sanctions directed to members who deviate from norms also reinforce the effect of norms on individual's actions. The processes discussed above explain why individuals' decisions are influenced by and aligned with group norms. We describe the strength of this influence by the norm strength.

In his case, Barker describes a strong basis for influence of norms on individuals. Workers facing a completely new setting, seek some basic rules and practices to regulate their work and prevent conflict. Hence, they strongly adhere to new practices emerging in the group. Later on as individuals perceive and talk about evolving norms, they start putting sanctions on non-conforming members, which further increases visibility and power of the norms.

On the other hand, one of the most obvious (but also most important) factors in establishing group norms is the behavior of the members of the group (Feldman, 1984). Following from that, norms are actualized when perceived by group members. As a result, norms are strengthened when other group members observe individuals acting upon those norms. In Barker's account, this process happens in the initial phase of development of concertive control as individuals

negotiate value consensus and a new substantive rationality emerges. He also illustrates formalization and rule formation as other processes that strengthen the norms' efficiency in guiding individuals' actions. Based on this discussion, we expect frequency of actions based on a norm and their visibility in organization to increase the norm's strength.

The basic processes of formation and enforcement of norms frame a positive feedback loop, which is central to our discussion. Norms affect an individual's actions, and the stronger a norm is, the more conformity the individual shows with respect to that norm. On the other hand, individuals' actions in concert with a norm strengthen that norm in a group (Figure 1). This positive loop, if dominating the behavior of the group, is expected to reinforce the norm's strength and individuals' conformity to the norm. We suggest that transformation of the initial value consensus to rigid norms in Barker's account is a result of the active operation of the discussed positive loop.

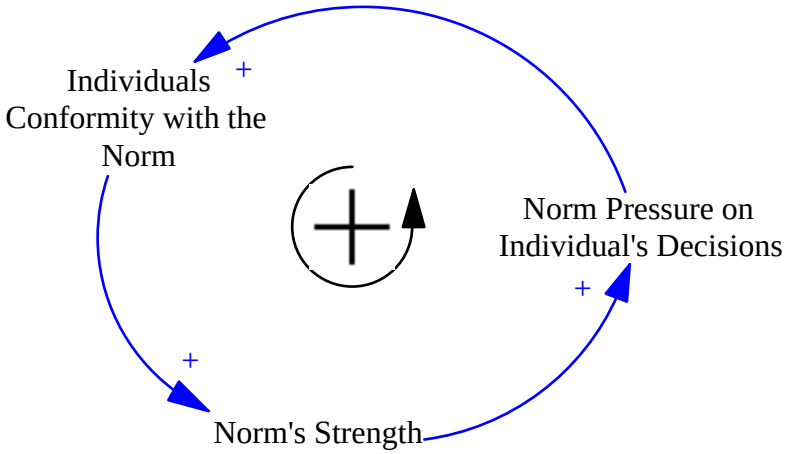

Figure 1- Positive feedback loop for reinforcing the norm's strength

In the discussion above, the exact attributes and characteristics that are normalized are not mentioned. In fact, we suggest that these attributes and characteristics can be anything that gives way to operation of the positive loop of norm reinforcement. If some way of behavior in the organization is acceptable in the environment and to the organization's members, then it potentially can become a norm. It follows that if this internal group process of norm formation becomes dominant, there are usually numerous sets of behavioral characteristics that potentially can become norms in a specific group setting.

However, we finally observe only a few of those behaviors. The question of which set of characteristics is normalized brings about the notion of path dependence. If the group members are free to choose among a large pool of choices, the behavioral patterns that can be selected without any special preference in the beginning of the group's interaction can be reinforced and develop into strong norms in the discussed positive loop. Other actions, which were potentially possible in the beginning of the group interaction, soon oppose norms and therefore are not favored or even are punished by the group.

We suggest that observations of Barker follow the formation and reinforcement of a set of possible behavioral policies into rigid norms; however, these observations do not imply that all self-managing teams would follow the same set of behavioral characteristics. In the following section we develop a simple system dynamics model to capture this idea and further analyze different implications of the dynamics of norm formation.

Structure of the model

This paper focuses on the dynamics common across different teams and groups; furthermore, we concentrate on the dynamics concerning the positive loop of norm-action. As a result we focus on internal factors concerning norm formation and enforcement in building the model. This is not to suggest that external factors and environment play unimportant roles in norm formation.

To keep the model small, we focus on a single team and on one of their actions and the norm related to that action. Further, we analyze only one aspect of the norm about the particular action. For example, we can look at the action of "Coming to work in the morning" and the group norms related to this action and focus on the dimension of "Earliness" among those norms.

Important variables and formulations of the model are introduced below:

Team members- the stock of people who interact in the team. Having a single stock imposes the assumption that people of different experience and group status contribute in the same way to the formation of the norms. This assumption does not hold in most real cases (Feldman, 1984) and can be released by differentiation between members of different status or experience and constituting separate stocks and aging chains (Sterman, 2000); however, this assumption does not affect the described dynamics and improves the model's simplicity.

Action- the rate of doing relevant actions by team members. In the above example, it can be the number of instances of "Coming to work in the morning" that happens in the boundary of the team. A team of 10 peoples, each coming to work (once) everyday would have a 250 action/month rate of action.

Action Dimension- Each action happening is accompanied by a specific value from the set of possible alternatives in our dimension of interest. For example each individual coming to work can decide to arrive somewhere between 20 minutes early and 20 minutes late. The value that he chooses shows the dimension of his action. In the model we have represented the set of possible alternatives by the interval of [0,1].

In our analysis, we assume that individuals would choose their dimension of action based on two elements, a norm pressure and a random factor. In the absence of norms, we assume that they choose any value in interval [0,1] with the same probability (uniform distribution). The effect of a norm is represented in two ways. First, the dimension of the norm determines the average dimension of the individual's action. Second, the strength of the norm determines the variance of the individual's action around the average. We initially use the normal distribution for individual's action's dimension with average of norm and variance determined by strength of norm. However our distribution is confined in [0,1], as a result, the action dimension falls in the continuum between a normal distribution centered around norm with some minimum variance

(represented as the minimum variance of action dimension) and uniform distribution in [0,1]. The Vensim software's formula for action dimension is:

Individuals Action Dimension =

*RANDOM NORMAL(0, 1 ,Organization's Norm on Dimension X ,Minimum Variance of Action's Dimension*Influence of Peer Pressure on Decisions , Noise Seed)*

Equation 1- Individuals Action Dimension

The variable Influence of Peer Pressure on Decisions, is determined from Normalized Strength of Norm in a table function. Figure2 shows this table function.

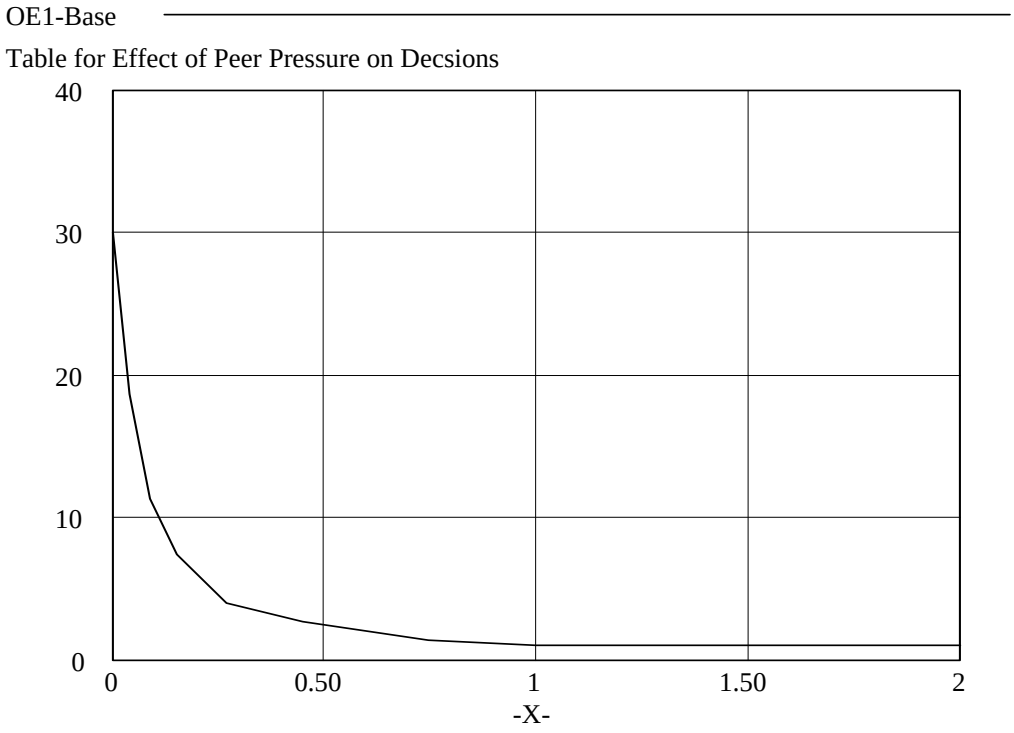

Figure 2- Table function relating the Normalized Norm Strength to the Influence of Peer Pressure on Decision.

This representation implies that on average, environmental pressures as well as average individuals' internal preference do not favor any specific dimension. Both of these are strong assumptions (Bettenhausen and Murnighan, 1985) that can be released by adding to the complexity of the model. See the section “Bias in acting based on norms” analysis for a simple way of handling this issue. Sherif (1935), in his famous black room experience, provides an empirical example that matches the above formulation well. Figure 3 shows the histogram for

behavior of this formula under the two limit conditions. The Minimum Variance of Action's Dimension is set at 0.05.

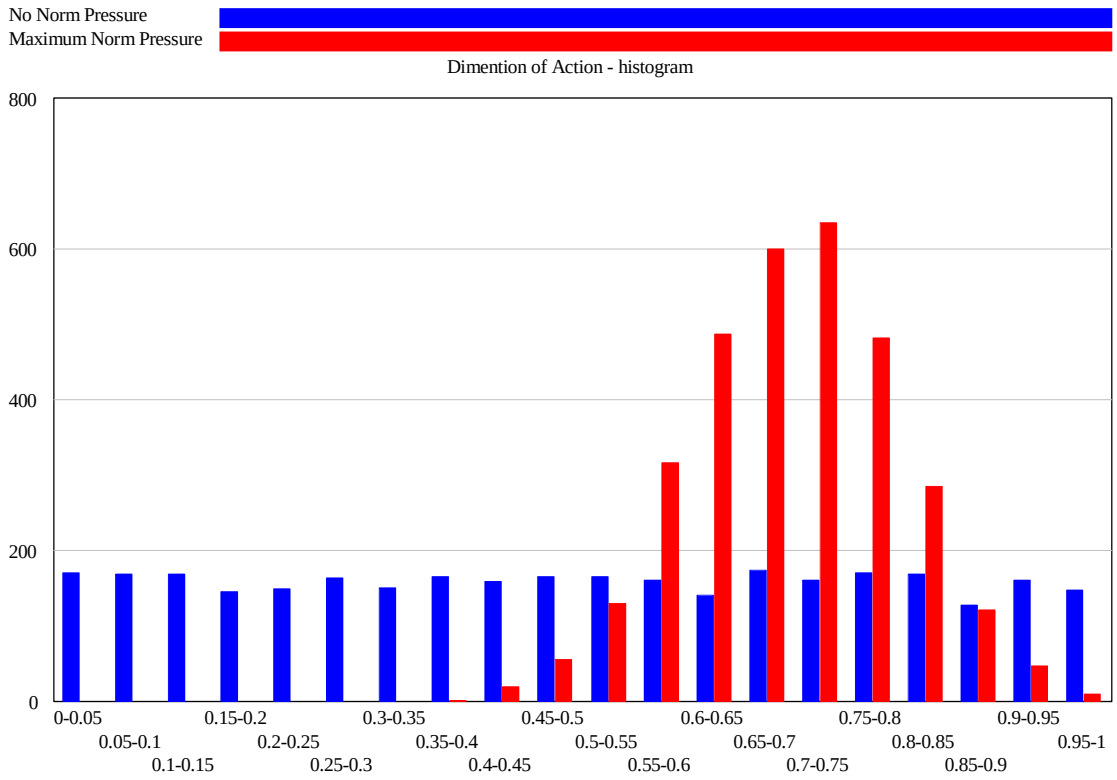

Figure 3- Distribution of action dimension in [0,1] interval for the cases of maximum norm pressure and no norm pressure. In both cases, the value of norm dimension is set to 0.7.

Norm- as discussed above, we trace the formation of a norm of the group around one dimension of one action. Norms exist in individuals' perceptions; as a result, they are introduced as embedded in the collective memory of the group. Individuals' actions, as perceived and remembered by other members, create the norms. The dimension of the norm is represented as an average of the previous action's dimensions that are remembered by group members. Individuals are assumed to lose their memories in a first-order decay process. The strength of the norm is defined based on a co-flow structure (Sterman, 2000) for collective memory of the group and the aggregate dimension of actions in memories, can capture this representation of the norm and its strength.

An important assumption of this simple formulation is that individuals similarly contribute to formation of norms by their similar actions. This is usually not the case in actions of people with leadership characteristics, as their actions are much more influential in establishing norms.

One can expect an increase in path-dependent behavior as a result of releasing this assumption because it leads to actions of some individuals being very influential in the formation of norms. Those leading individuals are less influenced by the structure of the team and even environment and therefore their actions are less predictable. The stock and flow structure of the model is represented in Figure 4 and complete list of model formulations is in Appendix 1.

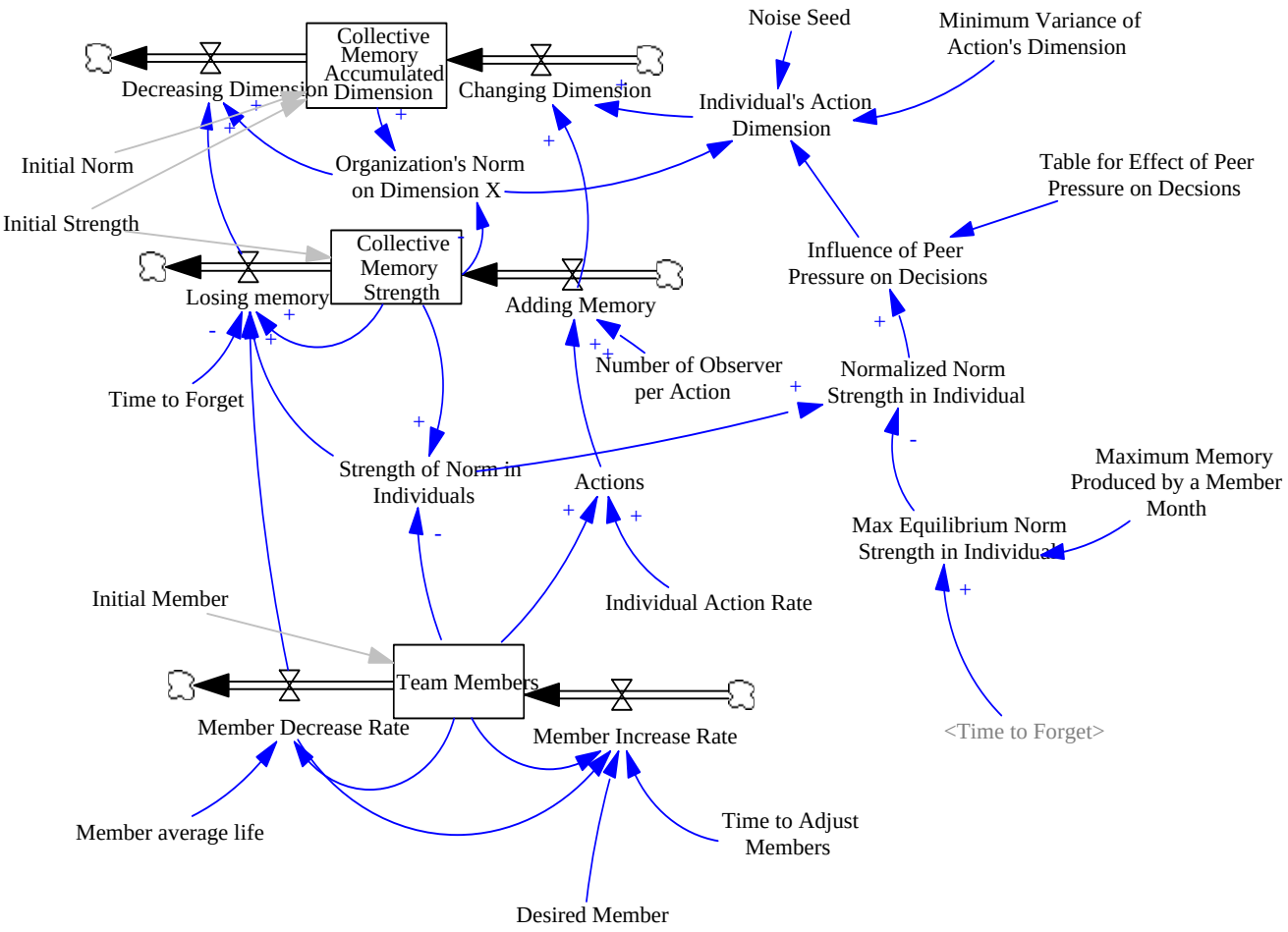

Figure 4- Stock and flow diagram of simple model

Analysis

Having dimensional consistency, the model shows a robust behavior under extreme conditions of having no team member, having no action take place and having no memory. In this section first we describe the base behavior of the model and its implications. Then we

analyze the model under some different conditions to improve our understanding of its dynamic behavior.

Base run- In the base run, the model is started with a new group with no initial collective tendency towards a specific dimension of action in the minds of its members. The above assumption enables us to view the dynamics arising purely from the structure of the group rather than initial conditions of team members.

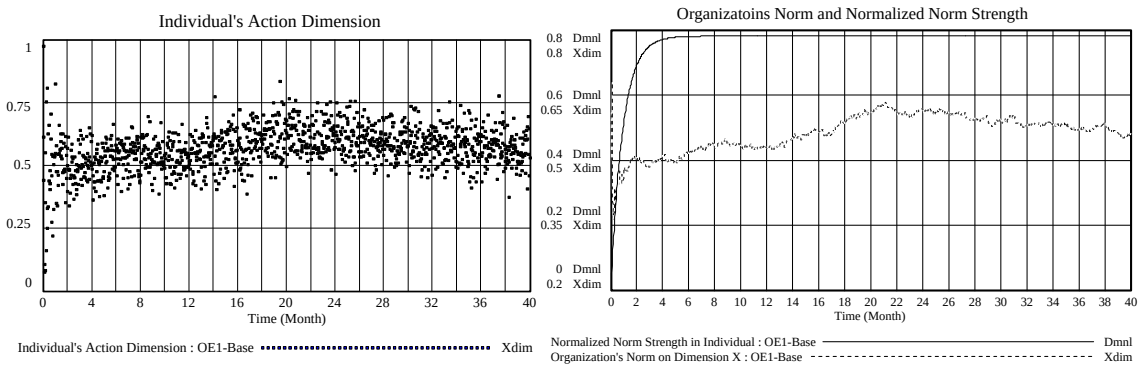

Figure 5- Individual's action dimension, normalized norm pressure and organization's norm in the base run

As the graphs show (Figure 5), at the beginning of team interaction, individuals have a higher degree of freedom and therefore they show a higher variance in their behavior (Higher variance in the left side of the "Individual Action Dimension" graph). However, when the norm gains strength (Solid line in right graph), it reduces the freedom of the individuals and they mostly just act around the norm (Lower variance in the right side of the Individual Action Dimension graph). The norm itself also becomes firm, after a few major shifts at the beginning of the interaction (Dotted line in right graph).

In the next graph (Figure 6) we have analyzed the sensitivity of the model to changes in the noise seed, which is generating the stream of random numbers. In this set of simulations, 50 different noise seeds are generating the random numbers. Note that nothing else is changed from the base run.

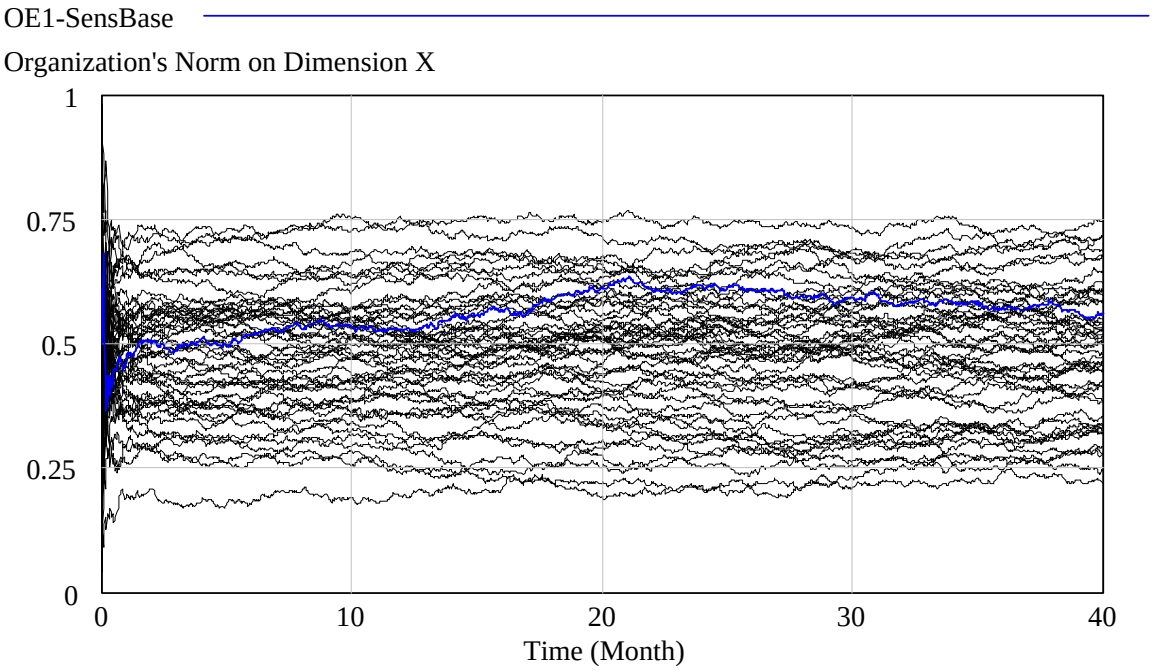

Figure 6- Different organization's norms established with different noise seeds

Figure 6 shows an instance of the path dependence behavior in the formation of norms. Despite the very same structure underlying all the runs, changing the streams of random variables without changing their parameters causes very different behaviors in the final values of the norms that are crystallized in the group. The graph also shows that in spite of variability among different runs, in each simulation the norm gets established fast and remains almost rigid in the rest of the simulation. These behaviors suggest that internal dynamics of norm formation can potentially lead to very different outcomes.

Another important implication of the observed behavior is the transition of norms among group members. In the base run, team members, stay with the team for an average of 15 months and then new members replace those who leave, keeping a constant number of members. Old members who leave take with them their share of collective memory and therefore weaken the norm. In spite of this renovation of group members the norm transcends individuals and stays inside the group. This is in concert with the findings of Zucker (1975) on how norms perpetuate through generations, when people perceive themselves as members of the same social system.

In this model, the speed in which the norm reaches its maximum strength depends on “Time to Forget” variable, while the maximum level of norm strength depends on “Number of Observers per Action,” “Individual Action Rate” and “Time to Forget.” The reason for this observation is that stock of collective memory will reach its equilibrium level in maximum norm strength and how fast this equilibrium is reached depends on the “Time to Forget” variable. On the other hand, the level of this strength depends on how fast memory is added to this stock, which depends on the variables “Number of Observers per Action,” “Individual Action Rate” and “Time to Forget.”

Existence of initial norm- In the base run, we used the assumption that people do not know each other and therefore start interaction with no prior norm. This is not exactly the case in Barker's account. Team members in his organization used to work with each other and therefore they had some prior perceptions among themselves. In general, people in teams may have perceptions about each other's behavior, and therefore may come to the group with some initial norm. Our dynamic hypothesis suggests that with the existence of some initial norm, there should be less variability in the possible set of behaviors that can be established in the organization, because there are more restrictions imposed on individuals at the beginning of interaction. To test this hypothesis, we ran the sensitivity analysis with respect to noise seed, changing the initial strength of the norm to 0.25 of its final equilibrium value. Figure 7 shows the behavior of the model, using the same streams of random numbers as in the simulations of Figure 6.

The observed behavior confirms our expectations about the importance of initial familiarity and perceptions among group members. It suggests that the number of alternative behavioral patterns that can be established as a norm in a group decreases significantly if team members are familiar with each other before interacting in a new group.

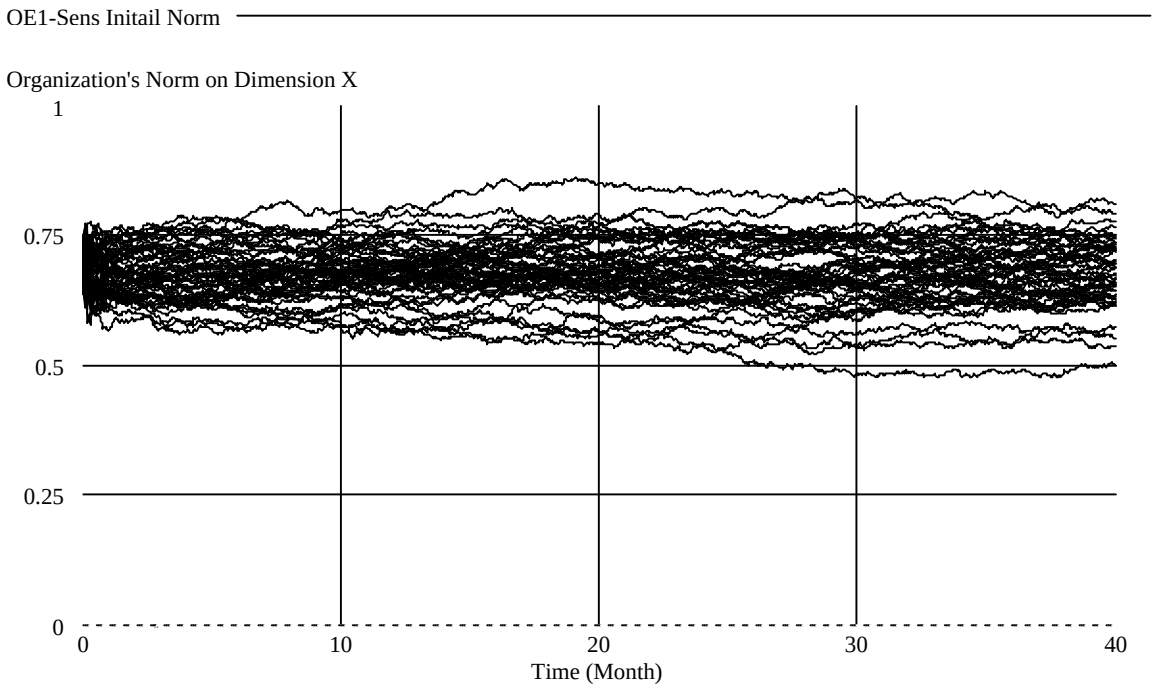

Figure 7- The sensitivity of norm development to existence of initial norm

High turnover- Another issue to investigate is the effect of high turnover rates on behavior and stability of norms. Jacobs and Campbell (1961) empirically tested this issue and concluded that the norms should change through time if we change the team members faster. For this experiment, we decreased the average time that individuals stayed with their teams to 1 month and simulated the model. Figure 8 shows the behavior of the organization's norm in high turnover vs. base case.

The organization's norm shows a higher variability in response to a higher turnover rate. The standard deviation of this variable more than doubles from the base case (0.042 to 0.092). Since the group members leave the system faster, they dilute the norm and therefore the behavioral patterns can change faster and easier in the team.

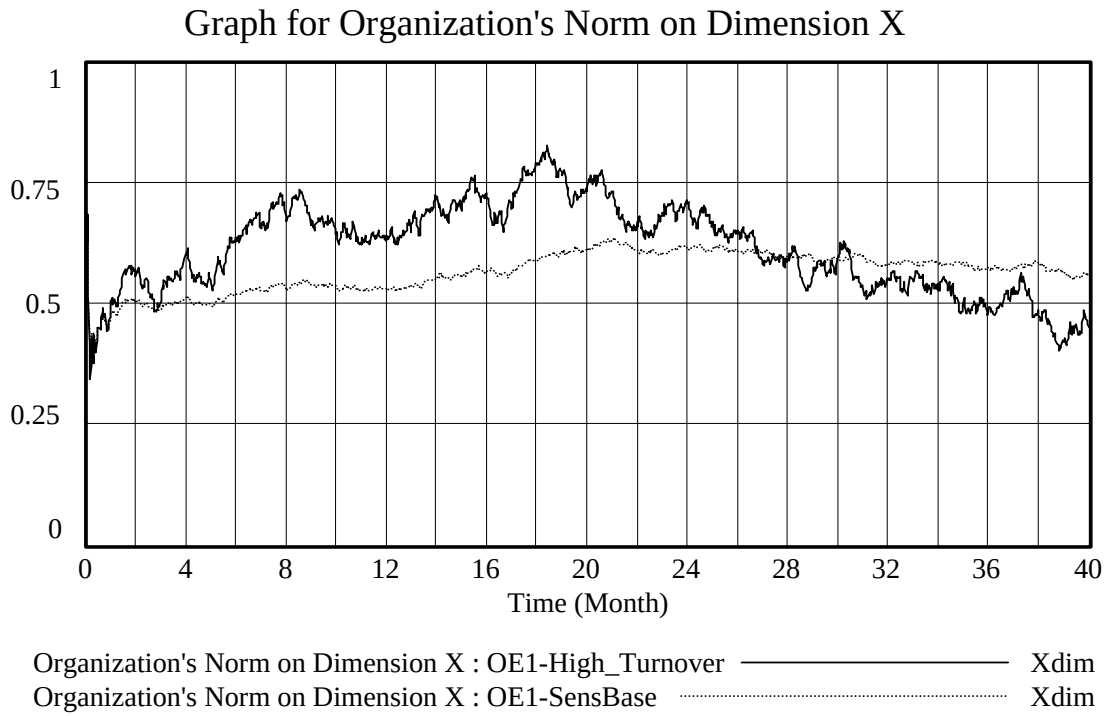

Figure 8- Organization's norm in high turnover vs. base case.

An interesting question to investigate considers the reverse of this relationship: does an increase in norm strength increase the average employee life? Or in other terms: do cohesive norms form cohesive groups? The existence of such a relationship will add another positive loop to the norm formation process: stronger norms result in members staying longer with the group/organization, which further increases the norm strength.

In Barker's account one cannot find any evidence for this mechanism being active. In fact the restrictive norms generated put a lot of pressure on individuals and tended to increase the turnover rate in a process opposite that described. In general the answer seems to be dependent on the nature of the norms that are being developed, and whether a strong norm is preferred by group members or not. Closer study of this feedback in specific cases will improve the insights that are generated from the modeling process and can help establish some criteria for how strong norms can become.

Bias in acting based on norm- One norm is not the only factor determining the behavior of the individuals in some specific action. Different pressures from environment, culture, rules, as well as preference of individuals will influence the decisions. Also, there may be different kinds

of norms influencing one action. Looking at these factors as external to the dynamics of the model, we have captured some of these effects in the randomness of behavior around the norm; however, this is not enough when there is some systemic bias in the average "Individual's Action Dimension." For example organization's norm can be different from that of society on a specific issue and this will introduce some bias in the mean of the "Individual's Action Dimension." There might also be some internal pressure in the organization to shift the norm in some direction. To investigate these issues we introduce a bias in the mean of the individual's action dimension so that, on average, actions are pushed toward one side and their mean does not equal the norm's dimension, unless in very low values. In this formulation, the mean of "Individual's Action Dimension" is changed from that of equation 1 to that of equation 2:

Individual's Action Dimension =

Individual's mean Dimension table (Organization's Norm on Dimension X)

Equation 2- Individual's Action Dimension

The lookup table "Individuals Mean Dimension table" is represented in Figure 9. It shows a bias towards the smaller values of dimension, so that if the norm is high, the individuals tend to act with a dimension smaller than the norm, while they would stick to the norm if it is low enough.

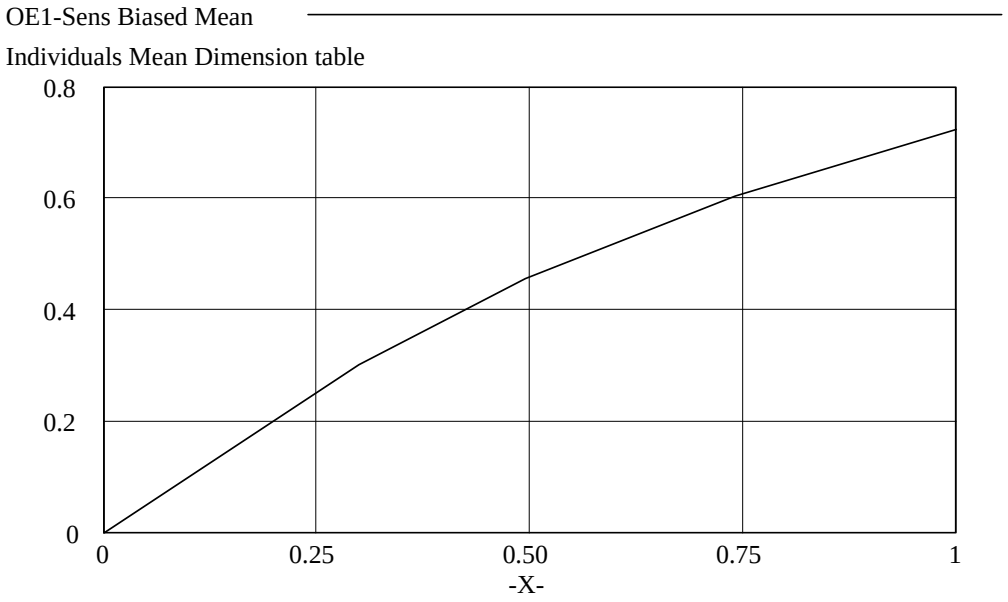

Figure 9- Table for average individual's norm dimension vs. organization's norm

Running the model under these assumptions with the same 50 streams of random variables, we obtain the behavior of Figure 10 for the organization's norm.

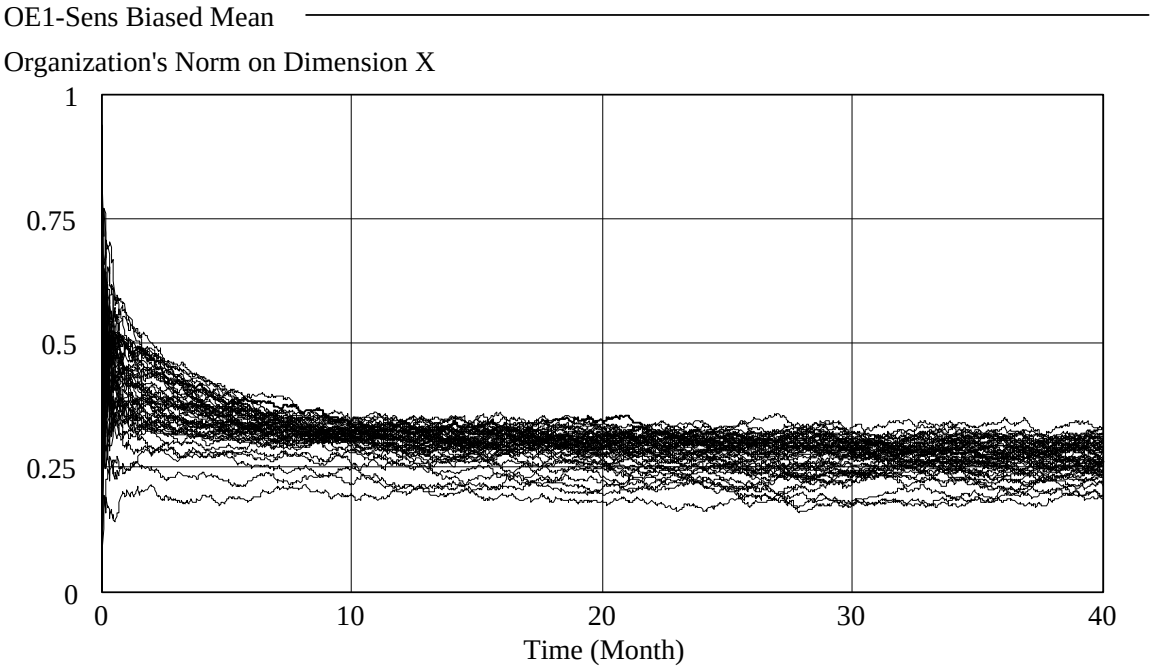

Figure 10- Organization's norm in biased mean case. Sensitivity graph for 50 random number streams.

The observed behavior shows two important characteristics. First, as one could expect, the emergent norm is biased in the same direction. This indicates that if there is some persistent pressure on individuals to go towards some specific kind of action, then the organization's norm cannot establish inharmoniously with this tendency. Second, the degree of path dependency has decreased in the set of final norms that can solidify in the organization.

Discussion

The dynamic model of norm formation explains one of the important underlying structures that is active in the process of norm formation. This structure, which is based on the positive loop of norm reinforcement, can potentially introduce path dependence in establishment of norms in organizations and teams. The positive loop is based on two main causal relationships that are usually acceptable in different contexts: 1. Norms are important determinants of the individual's action and their level of influence is related to their strength; 2. Norms are strengthened by individuals acting upon them when other members of the system observe these actions.

Presence of these elements can potentially facilitate any behavioral pattern that gets promoted in the beginning of the group interaction. The path dependence structure will raise the importance of first interactions in the system. This dynamic suggests that influencing the initial actions that take place in a group can be very important in forming the norms that will gradually solidify. But this model does not discuss what determines those initial actions. Different influencing factors from the environment of the group as well as individual dispositions can shape a set of feasible initial actions. While the crystallization of any of these choices as a norm is possible, if the initial set of feasible actions is very limited itself, then we cannot expect a high level of variation in the final norms.

In Barker's account, we can see a very important element that guides the initial actions of the group members. The vision statement introduced at the point of transition to new self-managing teams plays an important role in setting the group’s basic norms, especially with regard to primacy of performance and productivity in group decisions. These basic norms then affect many other initial actions and decisions that can become new norms in all different areas of work. These norms can also introduce some bias in the individuals’ decisions and attitudes toward higher performance. This kind of bias, which was discussed in analysis section, then will drive most other norms toward an extreme in terms of compliance to performance and will considerably eliminate the path-dependence effect. Therefore, as described by Barker, the observed outcome would emerge as a very high level of compliance to a set of restrictive norms and rules in the groups.

Building on his observations, Barker suggests the emergence of extremely restrictive norms as an inherent tendency in self-managing teams. Based on our analysis, we argue that Barker's observations can be explained without a need for such general attribution. These teams can develop a variety of different behavioral patterns; however, initial interactions influence the final established norms intensely. As a result, the behavior of a team is not only based on its structure, and one needs to take this point into account even to understand the aggregate behavior of team members. The importance of initial actions in groups is extensively documented in literature (Bettenhausen and Murnighan, 1985) and is in concert with our dynamic hypothesis of the norm formation process.

We suggest that the issue of path dependence in norm formation is more evident and important in independent groups, self-managing teams and any group of people whose actions are regulated by consensus and norms rather than formal rules. In formal organizations, formal rules are among the important determinants of individual actions, and therefore, the causality between norms and individuals' actions is weakened. Furthermore, individuals' actions, based on rules, do not reinforce those actions as norms. As a result, the discussed positive loop does not regulate the group interaction in those aspects of work that are regulated by formal rules and we don't expect path-dependent behavior to be eminent in such settings.

The discussed structure and analysis also brings about some practical insights for management of teams. The importance of initial actions suggests that there should be a conscious emphasis on guiding the initial actions of team members. Some methods for facilitating this process include having a vision statements, motivating and coordinating initial meetings and having more experienced members in the team at the beginning.

Another important insight derived from the analysis is the possibility of shaping the group norms by having some initial norm strength. In practice, this means that we can have new teams adopt norms close to those of old teams, by including a few members of older teams in the new

one. The individuals coming from the old team have the norms of their old system embedded in their minds and will start acting based on norms similar to those of the old team. The reverse of this issue is also important; to take an undesirable culture out of the work teams, one should not let members of old teams into new ones; in fact, new teams are better off if they do not observe the actions of the old team at all. Based on this insight, we can explain the persistence of constraining norms in different teams as described by Barker. All the teams were observing each other's actions and in many cases had a competitive environment among themselves. Furthermore, as the company grew, for shaping new teams, they took some experienced members of older teams and put them in the new teams. Both of these practices reinforce the persistence of similar norms in different teams.

We need to emphasize on the point that the goal of this paper is to improve out understanding of one of the important mechanisms active in norm formation rather than explaining all the aspects of this process. This focus is helpful in identifying structures and modes of behavior that are not dominant in every empirical study and therefore harder to identify; yet we should be cautious not to draw too general conclusions from this work regarding the aspects that it does not try to examine.

The outcome of the interaction among different competing norms, how they change and how they can be aggregated into organizational culture is too complex to be tackled with mental simulations. While different, single elements of these relationships have been under investigation for several years, the complexity of behavior arises from interactions among these elements. The current model takes a first step towards capturing these interactions in quantifiable models. Building on the proposed model one can think of interesting research opportunities, which are discussed in the following:

Extending this model to capture individual differences in choosing how they act, how they are influenced by norms and their perceived prominence in shaping group norms can be very fruitful. It not only can capture different negotiation patterns among group members, but also can open a new perspective for understanding which individuals' actions can be consequential in emergent group norms leading to more insight through questions like: why and how can leaders be influential?

We also suggest that structures susceptible to path dependence and similar to the one in formation of norms can be observed in other levels of analysis, so that one can use many of the insights generated from this study to pursue quantitative models in other levels.

In the level of social norms and culture, Berger and Luckmann in their classic work, "The Social Construction of Reality" (1967) describe a similar process for how different ideas can become institutionalized in societies to the extent that they are well accepted as real and their roots are not questioned. The creation and solidification of these socially constructed realities follow a positive loop in which creation and initial use of an action pattern is followed by higher probability of that pattern being followed, as it is a known, successful option. Further use and justification of this pattern then changes its nature from an agreement between two parties to a solid, unquestioned, aspect of routine life, which is followed more extensively in future.

In the organization level, institutionalization of organizational forms provides another important context in which we can trace the same dynamics. New institutionalism (Mayer and Rowan, 1977) framework has been a fruitful research project in improving our understanding of how similar organizational forms tend to be adopted in different organizations despite different

environments and efficiency considerations. Organizations tend to adopt well-established forms based on coercive, mimetic and normative considerations (DiMaggio and Powell, 1983). On the other hand, adoption of a form would further establish it in the eyes of other organizations. This positive loop as the driving engine of isomorphism can be captured in a similar dynamic model. This can provide an open ground for tackling dynamic questions such as negotiation of conflict among different dimensions of organizational forms and adaptation of forms to environmental pressures.

Finally, this analysis has interesting counterparts in individual level. Formation of, and adherence to habits follow a similar pattern through which casual actions initially chosen by individuals can develop into firm habits. Following this line of study can result in practical insights for personal management.

References

- Arthur, B., 1988, Competing technologies: An overview. In G. Dosi, C. Freeman, R. Nelson, G. Silverberg, and L. Soete (Eds.), Technical change and economic theory, 590-607, Printer: London.
- Barker, J. R., 1993, Tightening the Iron Cage: Concertive Control in Self-Managing Teams, Administrative Science Quarterly, 38: 48-437
- Berger, Peter L., and Thomas Luckmann. 1967, The Social Construction of Reality. New York: Doubleday.
- Bettenhausen, K. and Murnighan, J. K. The emergence of norms in competitive decision making groups. Administrative Science Quarterly, 1985, 30:350-372.
- David, P.1986. Understanding the necessity of QWERTY: The necessity of history. In W. Parker (Ed.), Economic history and the modern economist, (pp. 30-49). London: Blackwell.
- DiMaggio, P., & Powell, W. 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 97:147-160.
- Feldman, D., 1984, The development and enforcement of group norms. Academy of Management Review, 9/1: 47-53
- Goffman, E. 1955. On face-work: An analysis of ritual elements in social interaction. Psychiatry. 18: 213-231
- Hackman, J. 1976, Group influences on individuals. In M. Dunette (Ed.) Handbook of Industrial and Organizational Psychology. Rand McNally: Chicago, 1455-1525
- Jacobs, R. C., and Campbell D. T. 1961. The perpetuation of an arbitrary tradition through several generations of a laboratory micro-culture. Journal of Abnormal and Social Psychology, 62: 649-658
- Katz, D. and Kahn, R. L. 1978. The social psychology of organizations. 2nd ed. Wiley: New York

- Meyer, J., and Rowan, B. 1977. Institutionalized organizations: Formal structure as myth and ceremony. American Journal of Sociology, 83:340-363.
- Sherif, M. 1935. A study of some social factors in perception. Archives of Psychology, 27, No. 187
- Sterman, J. D. 1999, Path dependence, competition, and succession in the dynamics of scientific revolution, Organization Science, 10(3): 322-341
- Sterman, J. D. 2000, Business Dynamics: Systems Thinking and Modeling for a Complex World, McGraw-Hill: Irwin
- Yeats, D. and Hyten, C. 1998. High-Performing Self-Managed Work Teams: A comparison of theory to practice. Thousand Oaks, CA: Sage

Appendix 1- Complete list of model formulations in Vensim.

Actions=

Individual Action Rate*Team Members

Units: action/Month

rate of relevant actions taken in the organization

Adding Memory=

Number of Observer per Action*Actions

Units: memory/Month

The rate of increase in collective memory of the organization

Changing Dimension=

Adding Memory*Individual's Action Dimension

Units: Xdim*memory/Month

The rate of increase in the accumulated Xdim action

Collective Memory Accumulated Dimension= INTEG (

Changing Dimension-Decreasing Dimension,

Initial Norm*Initial Strength)

Units: Xdim*memory

The cumulative value of dimention X of memories in the

organizition.

Collective Memory Strength= INTEG (

Adding Memory-Losing memory,

Initial Strength)

Units: memory

The number of memories in organization from common issues

Decreasing Dimension=

Losing memory*Organization's Norm on Dimension X

Units: Xdim*memory/Month

The organizations rate of loosing cumulative dimention X memory

Desired Member=

10

Units: Person

The desired number of employees based on production requirements

FINAL TIME = 40

Units: Month

The final time for the simulation.

Individual Action Rate=

25

Units: action/Month/Person

Average number of actions an employee undertakes in one month

Individual's Action Dimension=

RANDOM NORMAL(0, 1 ,Individuals Mean Dimension table(Organization's Norm on Dimension X) ,Minimum Variance of Action's Dimension*Influence of Peer Pressure on Decisions , Noise Seed)

Units: Xdim

The average dimention of individuals actions taken in the organization. The individuals action can have a value between 0 and 1 in the dimention X.

Individuals Mean Dimension table(

[(0,0)-(1,1)],(0,0),(0.3,0.3),(0.494774,0.454023),(0.738676,0.603448),(0.996516,0.724138))

Units: Dmnl

Individuals Dimension of action mean as determined from the this table based on the current norm in the organization. This table basically shows the average individuals inclination toward different dimensions of action.

Influence of Peer Pressure on Decisions=

Table for Effect of Peer Pressure on Decsions(Normalized Norm Strength in Individual)

Units: Dmnl

The weight of peer pressure influence in determining the individuals action

Initial Member=

10
Units: Person
Initial number of employees

Initial Norm=
0
Units: Xdim
Initial value of norm in the organization

Initial Strength=
0
Units: memory
Initail Strengh of the norm in the organization

INITIAL TIME = 0
Units: Month
The initial time for the simulation.

Losing memory=
Collective Memory Strength/Time to Forget+Strength of Norm in Individuals*
Member Decrease Rate
Units: memory/Month
The rate of losing memory by loosing old employees or by
forgetting

Max Equilibrium Norm Strength in Individual=
Maximum Memory Produced by a Member in Month*Time to Forget
Units: memory/Person
Maximum number of clue in the memory of a person in equilibrium

Maximum Memory Produced by a Member in Month=
90
Units: memory/Person/Month
The maximum rate of generating clues for others to
change/strenghten the norms by one person.

Member average life=

15

Units: Month

The average staying time of Employees with the organization

Member Decrease Rate=

Team Members/Member average life

Units: Person/Month

The rate of decrease in employees

Member Increase Rate=

Max(0,(Desired Member-Team Members)/Time to Adjust Members+Member Decrease Rate)

Units: Person/Month

The rate of increase in Employees

Minimum Variance of Action's Dimension=

0.05

Units: Xdim

This shows how much variance individuals actions would have

under the strongest norm possible.

No employee no pressure:THE CONDITION:

Team Members=RC STEP(Team Members, 0.1,5):IMPLIES:Influence of Peer Pressure on Decisions>9

Units: **undefined**

Noise Seed=

1

Units: Dmnl

Normalized Norm Strength in Individual=

Strength of Norm in Individuals/Max Equilibrium Norm Strength in Individual

Units: Dmnl

Average, standard level of collective memory in each person

Number of Observer per Action=

3

Units: memory/action

Number of memories formed based on each action done

Organization's Norm on Dimension X=

XIDZ(Collective Memory Accumulated Dimension, Collective Memory Strength , 0.5)

Units: Xdim

The average norm of organization in respect to dimention X.

SAVEPER =

TIME STEP

Units: Month

The frequency with which output is stored.

Strength of Norm in Individuals=

Collective Memory Strength/Team Members

Units: memory/Person

Average number of memories an employee holds on issues related to this dimention

Table for Effect of Peer Pressure on Decsions(

[(0,0)-(2,30)],(0,30),(0.0418118,18.6207),(0.0905923,11.2644),(0.15331,7.35632),(0.269896,3.96552),(0.449827,2.70115),(0.747405,1.37931),(1,0.95),(2,1))

Units: Dmnl

Effect of peer pressure table. Strength of norms in determining individuals actions can vary between 0 to 95% and in the situation of maximum equilibrium norm strengh, it is assumed to be 85%

Team Members= INTEG (

+Member Increase Rate-Member Decrease Rate,

Initial Member)

Units: Person

Number of Employees in the organization

TIME STEP = 0.03125

Units: Month

The time step for the simulation.

Time to Adjust Members=

3

Units: Month

Time needed to find and hire required new workforce

Time to Forget=

1

Units: Month

The average time for forgetting actions observed