A simulation model for organizational evolution

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In today's ever-changing and complicated environment, organization faces a difficult challenge. The keys to success in an organization lie in its flexibility, creativity, and ability to learn. This implies that change is the center of managerial and organizational theory. During the recent developments of organization theory and other fields' effects, self-organization has obviously become the core concept among all the theories. With the unpredictable environmental changes, self-organization clearly demonstrates an organization's flexibility, creativity, responsibility and the ability to learn. The goal of this research is to explore the process of how a team can restructure itself through self-organization to successfully adapt to the changing environment. Similar to other areas of self-organizational research, it has been discovered that a successful self-organizing team relies on a mechanism called "evolutionary feedback". In addition, this research will help us understand the usefulness and contribution of organizational changes during the process of self-organization.

1. Introduction

"Organization society" is a reflection of today's life; organizations affect our life and its rhythm to a large extent. In addition, most of society's tasks are accomplished through organization (Drucker, 1993). Although organization is already incorporated everywhere, we still do not understand and manage it as much as we would like to. People's understanding of organization usually implies images (Morgan 1997a, 1997b) that vary with the change of time, environment, and the change in wanted character and functionality.

Tool and mechanical metaphors still occupy most of our understanding in organization today (Morgan 1997a, Davis 1996). The behaviours of organization are not always as expected; in fact, most of the time it has surprising outcomes. However, this paradigm of organization is just as common as Newton's paradigm in natural science developments. In the past, organizational and managerial-theory-related concepts and methods have had great success under the main development of their meanings. But under the implications, movements, complications in the environment and evolutions and complexity sciences, organization has shown diverse aspects and theories never seen before. This indicates the necessity for people to seek different organizational concepts, principles and mechanisms.

How an organization can overcome the changing environment seems to be the one of the most important issues today. The new emphasis is put on whether organization is able to retain flexibility, responsibility, adaptability, and learning to develop the future despite the unpredictable environmental changes. Adaptive Complexity Systems' implications, unfolding and discovery in the area of organization (Morel & Ramanujam 1999, Anderson

1999) is an example of how people developed a deeper understanding of the changing essence in organizations.

Although organizational change and evolution are not new concepts, organizational change theory needs further developments. On one hand, in the ever changing, complex environment, emphasizing centralism, top down design, control and change has led to more and more conflicts among each other for adaptability and learning ability. This is a major reason why various organizational designs and models have appeared in the recent years. (For example, Galbraith 1994, Morgan 1997b, Manz 1990, Manz & Henry P. Sims 1993, Mohrman & Allan M. Mohrman, 1997, Levinthal & Warglien 1999, Weick 2003, etc.) The common point among the above-mentioned theories is that organization has to rely on its units' and members' flexibility, responsibility and learning ability in order to adapt to the changing environment. This indicates that another way of organizational change not only steers towards but also has to utilize "self-organization" to adapt to the environment (Hutchins 1996, Stacey 1992). By using sub-systems and proactively adapting to the changing environment and other sub-systems we can successfully establish a new structure to demonstrate the organizational adaptability. This path is not only associated with change itself, but also indicates every person's meaning and value (For example, Ghoshal & Bartlett 1999, Morgan 1997b, Seifter & Economy 2001, Davidow & Malone 1992, Collins & Porras 1994, Maslow, Stephen and Heil 1998).

On the other hand, organizational change theory lacks further development in its implied meaning – reorganizing and restructuring - in a micro way; this is to view the issue from complexity systems' perspective and approach to understand and discuss the process of organization. This results in the inability to advance past pattern and conditional discussion towards change and evolution (Hackman 1998), which was clearly indicated by Perrow (1994) who suggests that a development towards a rarely understood process is crucial. If we develop this micro aspect further, the way an organization's flexibility, reactivity, adaptively and learning ability overcomes the environment can naturally be turned into how organization continuously re-organizes in a changing environment. If we see the connection and inter-relationships between parts as a structure, then the above-mentioned transformation will lead us to focus on the aspect of continuous and structure dynamics. In other words, we should be focusing on an organizations' break down and restructuring process during its structure transformation.

The real meaning of exploring microscopic restructuring lies the dynamics of change. The microscopic approach here means the systemic inter-relationships that are the practical behaviour mechanisms in the process of self-organization. In analyzing the actions and causal feedbacks among the member of an organization, we can understand the inner dynamics of self-organizing process and also explain the patterns that emerge during the change process. The micro-process approach is useful to answer why or when organizations are involved in self-organization and what mechanisms are required to have a successful self-organization. In fact, using feedback loops to explain and understand organizational and societal systems' process and dynamics has already become an important method (Richardson, 1991; Mydal, 1944; Merton, 1948; Simon, 1976; Masuch, 1985; Hall, 1976;

Sterman, Repenning, and Kofman, 1997; Weick, 1979; Sterman, 1994). Thus, the main goal of this research is to discover and explore the feedback loops of self-organization process. Through an analysis of the feedback loops we can understand the system behaviours of self-organization and the role each process of self-organization plays in it.

Hutchins' (1996) research offered a direct microscopic view and related data for team self-organizations. Utilizing his research as a starting point will assist us in an understanding of how teams endogenously change their structure and what important mechanisms are involved and why they occur. To further discuss team self-organizational processes and phenomena, this research will adopt Hutchins' (1996) fundamentals to establish a mathematical computer simulation to demonstrate and discuss the process of team self-organization. By manipulating the simulation, it is possible to further understand the attributes of team self-organizing behaviour and its inner works. Additionally, the important issue of what affects self-organizing factors can be discussed.

As a new knowledge source, simulations not only uncover hard-to-observe behaviours, but also show the interactions among the various parts that compose a system. For poorly understood systems, simulations can explain, analyze and predict behaviours by comparing them to facts and theories, enhance our understanding of the system, and possibly offer us further research indicators (Simon 1996, Forrester 1961).

2. Self-Organizing Teams

In the past, it was believed that organizational changes are a result of planning and designing. However, Hutchins (1991, 1996) indicated that the reorganization of operating structure can also be caused by sub-systems adaptation and local design and its mutual collaboration. Hutchins used the ship's navigation team example to explain the process of change in organization. When the navigation team faces an unpredictable environmental change that threatens the functioning of the team, the team is still able to develop a new operating structure in a very short period of time to overcome the challenges and maintain its function's effectiveness. From the beginning to the end, the entire process is driven by the team's internal power. This type of successful endogenous re-organization has an important influence on the development of organizational and managerial theory where change is the nucleus.

The navigation of a ship is a very complex process; its goal involves confirming the time and route, the location, and the next move that is about to happen. The navigation team's mission during the traveling period is to locate the current position and decide the next navigational path through observation, calculation and plotting to constantly guide the vessel. The accuracy and timeliness of in the execution of the mission by the team is crucial. Navigation is achieved through a lot of related tasks such as observation, computing, plotting, control and operation of various equipments. It also involves team work with all other units on the vessel. As a result, the accuracy of the outcome heavily depends on the smooth and tight cooperation among the members. All members and equipment of the team need to form an effective functional organization.

Take the navigation of a ship for example. During a return trip to the port, the ship all of a sudden lost its power, which resulted in the malfunction of almost all electronic devices and equipments. In addition, the steering had to be controlled manually using manpower when the ship needed to manoeuvre through a narrow and winding path. The ship was immediately exposed to the risk of crashing or being stranded ashore. The navigational team needed to guide the ship in safety despite the malfunctioning equipment and pressing time constraints. The team established a new operating model to adapt to the situation while achieving the mission. During the entire mission, the navigational team executed a total of 66 navigational computations to allow for the safe stop of the ship. Each computation involved the calculation of the ship's current location, direction, speed, and its predicted route (in short LOP). At the beginning, the team appeared to be in chaos; however at the 33rd LOP, it displayed a new operational structure which included computation and social structure. The order was shown in computational modules, category code numbers, computational procedure, recording method, collaborative computation and the mutual interaction among members to achieve the computation. The team developed a shared structure.

In a similar observation, Gersick(1988, 1989) has indicated that a team's operational structure will incur non-continuous changes with the approach of the mission's deadline at approximately half the time period. It does not make a difference whether the mission period is scheduled for several months or several days, the operational structure will change regardless. The process of change will greatly affect the team's efficiency. Gersick also discovered that this type of structural change cannot be explained using the traditional linear, additive team development model or partial theory.

In the phenomenon of self-organization described above, we find that (1) A team's spontaneous change is largely a result of changes in the environment such that the original operational structure was ineffective for achieving the goal; (2) Members of the team realize the large difference in efficiency to achieve the goal and thus triggered a change; (3) The main objective of team self-organization is to effectively achieve the requirements of the goal. Teams adapt to the environmental requirements through operational structure changes; (4) The process of self-organization includes interaction, method of mission executions and even the explanation towards the environment and information; (5) The macroscopic behaviour of structural change shows discontinuity; (6) The process of change and the result of it is un-planned and occurs trough local change and spread through the whole system; (7) the success of change requires intensive interactions among team members in order to establish a shared operational structure; (9) The success in change relies heavily on the team and the environment's mutual interaction, which means that the team needs to be open to obtain information and resources or adjust its behaviour.

However, the more important issue is how self-organization happens, why self-organizational behaviour is able to produce a new operational structure and what mechanisms are involved in self-organization. With respect to this question, Hutchins has indicated that there are four principles in obtaining the navigational team structure's re-organization. Gersick (1989), on the other hand, assumes some reasons for the teams' discontinuity phenomena. Although the former research has allowed us to understand the basics of team self-organization, it is still not sufficient for us to understand the main goal of self-organization from a microscopic view. From a managerial perspective, we need to understand what type of behavioural mechanisms exist for self-organization, what the mechanism role is, how they produce the entire external dynamic behaviours, and how they are mutually related to achieve a successful structural change. In short, we need to understand more about the working mechanisms of a system. The general theory and understanding of the dissipative theory for self-organization will assist us in gaining a deeper understanding of more complex systems and their work processes and dynamic behaviour.

3. Modeling for a self-organizing team

Based on Hutchins 1996 research, we will establish a model that includes environmental changes and main team mechanisms to understand self-organization's behaviour and their interactive mechanisms relationship through simulation of the self organization during environmental changes. A model contains several sectors that include the action of adjusting performance, the load of cognition, local innovation and change, the sharing of the operating structure, error detection, recovery and the learning environment in the team. Each part's mutual interaction is displayed in Figure 2.

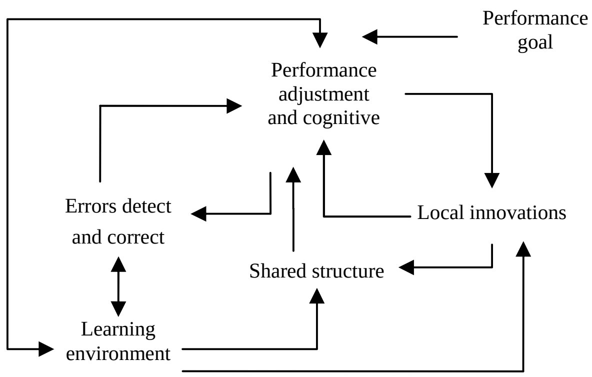


Figure 2 Overview of model structure

3.1 Performance adjustment process

A team's existence is to carry on certain functions and achieve performance goals. The seeking of carrying out a function and achieving performance goals are the basic source of movement in team behaviour. For a self-organizing team, understanding the target performance in different situations is the most important factor for a team to develop self-organizing behaviours. Being able to understand the changes in environment and the required performance will allow the team to adjust its performance by itself. In the example of navigation, a team needs to clearly understand the team's mission execution requirements as well as various situations including different observations and measurements for time intervals to further adjust a team's interactive structure. Otherwise, the ship will not remain safe (Hutchins 1996, p.41, 47, 133, 178, 322). Performance adjustment is a fundamental feedback mechanism for a team to adapt to the environment. It is the source of change.

Different performance levels imply that members need to invest different cognitions (such as memory, information processing, attention, etc.). High work performance will require the team to invest even more cognitive resources. However, the resources of cognition are limited. Therefore, increasing the resources of cognition is equivalent to increasing the cognitive load (p.275, 164, 325-7). The adjustment process is shown in Figure 3.

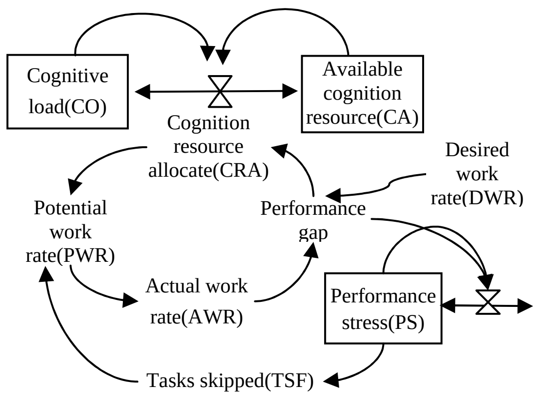


Figure 3 Process of Performance adjustments in team

The total quantity of members' average cognition resource is assumed to be 1, which is the sum of available resources (CA), allocated resources (CO), and resources that have already been dedicated to detection and avoidance of errors (COE). The bigger the performance difference, the more cognitive resources need to be invested (f(DWR/AWR)). If the ratio (DWR/AWR) is greater than 1, the target is greater than the current situation (the team needs to invest more cognitive resources, 0=<CRA<=CA); in contrast, if the ratio is smaller than 1, the current situation is greater than the target (the team needs to lower the allocation of cognitive resources, CRA<0). If the total is equal to 1, the target is equal to the current situation. The model assumes that the relation between the change in performance difference and invested cognitive resources is a linear one (CPF=f(DWR/AWR), f(0)=0 f(2)=2, f'=1). The potential work performance is the possible output performance of invested cognitive resources. The actual work performance (AWR), equal to the potential work performance minus errors and all the rework related to the error, is the actual valid performance value.

Although a team can increase its performance through increasing the cognitive load, in many actual situations, the requirement is way over a team's maximum capacity. In this type of situation, the team will attempt to maintain their function and skip a part of the process or work (TSF) in order to reach the performance requirement. In order to resolve the pressure associated with performance difference (PS), the team will sacrifice part of the work quality to meet the performance target (p. 325, 327). The larger the performance difference the larger the pressure (SPF=f(DWR/AWR), f(1)=0 f(2)=1, f' >=0, f'' >0). The relationship between team performance pressure and skipping work processes (TSF=f(PS), 0.8<=PS<=1, f(0)=1, f(1)=0.8, f'<=0, f''<0) means that the higher the pressure the more work processes will be omitted. However, only under high pressure (PS>=0.8) will the team skip steps. The number of steps that can be omitted also has an upper limitation, and the model assumes that the upper limit is 20% of the entire work process ((f(PS=1)=0.2)). The more work processes are skipped, the more target can be achieved per unit time.

3.2 Local innovation and changes

The cognitive economy principle explains that humans cannot remain under high cognitive load for an extended period of time (p. 92, 295, 325). Thus, when a team continues to be under high work load, the members will search for any possible means or method to assist them in their work in order to lower their pressure under cognitive load. The possible methods, changes or tools a member of the team can seek for all rely on their task environment, which includes the availability of data, paper, pen, ruler, calculator, modularizing computation and even newly invented vocabulary etc.; anything that a member may deem necessary to save their work efforts (such as memory, calculation, etc.) will be used during the adjustment period to change the original working process or even create a new process (p. 325-8). The adjustment process is illustrated in Figure 4.

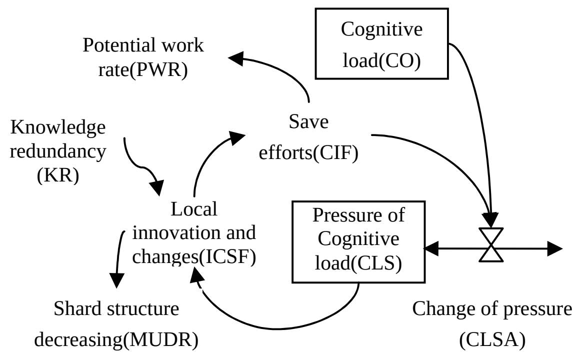


Figure 4 Team Members' Adjustment towards Cognitive Load

The relationship between already invested cognitive resources (CO) and a team's information processing pressure (CLS) is as follows: When more cognitive resources are being invested, the higher the pressure; in contrast, the lower the cognitive resources are invested, the lower the pressure that is being created. The value of the pressure created by cognitive resource investment (CLS) is between 0 and 1 with an initial value set at 0.65, showing the pressure created by the initial cognitive load (0.7). When the investment of cognition is gradually increased, the created pressure by it also gradually increases ((f'>=0). When cognition investment reaches 0.9 the associated pressure is 1 (f(0.9)=1). When members are facing high pressure from information processing (CLS>=0.8), they will lower their pressure by local innovation or change due to the Cognitive Economy Principle. (pp. 326-8). The quantifying of innovative behaviour is measured by using new events as a unit. However, since different events result in different effects, the model assumes that the average new event – the innovative unit – is used as the unit. When the pressure reaches its highest value, the innovative unit will be equal to 1. Under the assumption that all conditions remain unchanged, the higher the pressure, the higher the production of innovative units by team members (ICSF=f(CLS=1)=1,f’>=0 f’’<=0). The relationship between local innovation and change towards save of efforts (CIF) and model assumption is a linear one. However, the effects of local innovation need to be learned and adapted to over a period of time before performance can increase. The delay time is set to be at 5 time units.

In the adjustment of the load, team members lower their cognitive load by innovation and change of process. In addition, this process involves the change in cooperation by team members. The appearance of these local innovations and changes will cause the original established operational structure to be destroyed and members will not be able to complete the job by using the original method. Members need to adapt to each other’s changes, understand each other’s meaning behind the action, and their cooperation during the progress of the mission. However the redistribution and cooperation of a mission cannot occur at any given time; it has to be based on Knowledge Redundancy among team members. The higher the Knowledge Redundancy, the larger the cooperation level will be, meaning that a team’s cognitive load can be further dispersed and lowered, resulting in a higher performance of the team (p. 219-25,227,265-7) as illustrated in Figure 4. Knowledge Redundancy’s (KR) effect on partial innovation and change (f(KR)) is shown as multiplication of ICSF and lies between 0.5 and 2. A value of 0.5 indicates that under low KR values (KR=0), the lowest innovation effect unit is 0.5 times the current one. A value of 2 shows the maximum innovation effect under high KR (KR=1), where 1 is the team’s current situation. This explains that even in very low KR situations, members will still have innovative behaviours. However, these behaviours will only be limited to the individual’s work and restricted mutual interaction with each other, and thus will not be able to create an influence on a larger scope.

KR is estimated by measuring each member’s task replacement possibility (p.266). For example, if there are three members A, B, C, the replacement possibility can be shown in a 3-by-3 matrix which means there is a total of 6 replacement relations. Each position in the matrix is occupied by value ranging from 0 to 1 indicating the redundancy from the completely replaceable to the completely irreplaceable respectively. Taking the values of the upper and lower triangles, the average value will be the estimated value. Member A can completely replace the two other member’s work (A,B)=(A,C)=1, followed in order by (B,A)=0,(B,C)=1,(C,A)=0, (C,B)=0. The average KR value is 3/6=0.5. (A,B,C mission replacement matrix $\begin{matrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{matrix}$) .

3.3 Shared structure

Structure sharing means that during the execution of a mission, each member’s behaviour is understood and predictable which is the essential thing of coordination and cooperation. Due to the distributed nature, it requires the continuous interaction and socialization among members to establish a shared structure. During the interaction process, members will learn their mutual behaviour and effectively cooperate with and adapt (p. 219-21,225,226). However, members do not need to understand all missions and will still be able to gain knowledge about each other's behaviour and meaning within their own activities (p. 200,240-2). The establishment and destruction of a shared structure is a self-reinforcement process (p. 340,350,310). This point is similar to Tushman & Romanelli's (1985) description of the inert establishment of structures (pp. 227). Sastry (1997) then further formalizes the process. The shared structure process is shown in Figure 5.

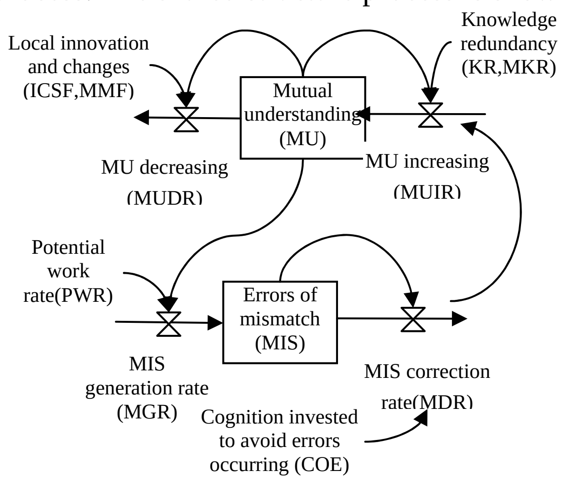


Figure 5 the process of structure sharing

The degree of the sharing of a structure (MU) is a level (p. 131). The maxima value is 1, meaning the members have a unified sharing structure. The minimal value is 0 meaning there is no shared structure among members. The decrease of shared structure (MUDR) stems from a team's un-planned innovative and changing behaviour. When the team's shared structure is being destroyed by innovations and changes (MU<1), members will develop mismatch (MIS). The lower the shared structure, the more mismatch will occur. Corrections of errors have a delay effect, and the average delay is the time of three missions (p. 323,331-4) (p. 334-6), with non-detected errors still being in the system.

When team members discover their mismatch, they will attempt to understand each other's behaviour and meaning and find a possible way to cooperate with each other through observation of interaction, communication, assistance and change during the execution of mission. At that time, the generally chaotic scenario and various internal and external environmental changes may exist at the same time (p. 336,337,338-41).

The increase rate in the shared structure (MUIR= (0.01+ MDR*MKR*MU)* MUIF)), represents the four aspects that affect the increase in shared structure. Since a shared structure contains a self-reinforcing process (p.323), the functions MUIF (=f(MU)) indicates the current degree of sharing that will have an effect on the increase in sharing. When the degree of sharing is low, the increase in sharing occurs very slowly; on the other hand, when the degree of sharing is slowly increasing, the increase in sharing will occur faster. When the degree of sharing is very low (MUIF=(MU=0)=1), the increase in sharing is affected by the smallest basic increase rate (0.01). When the degree of sharing gradually increases, the increase in sharing is affected by the degree of sharing itself (MU*MUIF), showing that it is a positive feedback loop. Besides these reasons, the degree of rate increase in structural sharing is also influenced by the knowledge redundancy in the team (MKR=f(KR)). Because the basis of reorganizing a structure is communication and understanding, the more knowledge redundancy among team members, the more efficient their communication and understanding among each other, which will in turn affect the entire team's efficiency while establishing a new structure. The higher the knowledge redundancy is, the more efficient the establishment of a shared structure will be. When KR is very small, the multiplier will be very small as well (MKR=f(KR),0<=f<=5, f(0.5)=1, f'>=0 f''>=0).

3.4 Error detecting, recovery and learning

Occurrences of errors are inevitable in human systems. In the discussions of this model the errors are mainly due to systematic reasons. The reason that a team creates errors is human's need of on-the-job learning (p. 263,267-72). Norman (1983, 1986, 1987) argues that people have three classes of design goal with respect to errors: to eliminate, avoid, prevent errors wherever possible; to facilitate the recovery of the system from any errors that do occur; and to facilitate learning from any errors that do occur so that future errors become less likely. In addition, these three methods have a mutually balancing relationship among themselves (p. 276-9). The reaction and associated recovery process in the occurrence of errors is demonstrated in Figure 6.

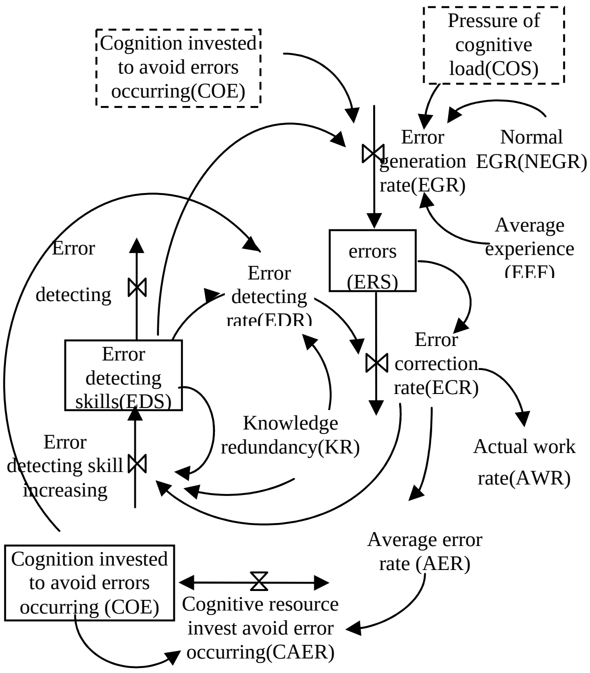


Figure 6. Error detecting, recovery and learning

The ERS represents the cumulative number of errors that have not been corrected yet. The main reasons for a team's error occurrence are human error (normal error rate NEGR=0.1), cognitive load stress (COS), the average experience among team members (EEF), member's cognitive resource investment into avoiding errors (COE) and error detecting skills (EDS). The more stress is created through investment of cognitive resources, the more errors will occur (pp.275). When the average experience is low among members, the more errors will occur since, even though the new members have been trained, they are more prone to introduce errors than the more experienced members (p.181, 313). In the model, team member's experience is represented by the amount of experienced members on the team (ENR). Avoiding the occurrence of errors by investing cognitive resources (COE) and error detection skill (EDS) is represented as a multiplication (f(COE*EDS)). The multiplication explains that, while avoiding the occurrence of errors, the investment of error detection abilities and cognitive resources are necessary for the development. The error generation rate (EGR) is the product of previously mentioned phenomena.

The normal error detection rate (NEDR) is decided based on the team members' skills and their experience (EDS). The obtaining of error detection's experience and ability comes from correcting mistakes and observing other member's detection and correction process (p. 277-9). The functions value (NEDR=f(EDS)) lies between 0.5 and 1 meaning that when members lack experience (f(EDS=0)=0.5), their ability comes from the training and education prior to their work, resulting in possession of the very basic detection abilities. When the experience and skill level increases, detection ability and detection rate increases respectively. The model assumes that the function value of 1 is achieved when the experience value is equal to its largest number 1. However, detection ability's execution is still being influenced by the COE the team has invested. The more COE a team invests, the higher the error detection rate. The effect is represented as a normal error detection rate's multiplier (EKF=f(COE)) where f(0)=0, f(0.3)=1.5, f(0.1)=1, f'>=0. The higher the KR is, the more it will assist in the team's error detection and recovery. Due to the low repetitive knowledge, the team will have a very low administrative ability. When the team's knowledge redundancy increases, the administrative ability will increase with it as well. The influence on error detection and correction through knowledge redundancy is shown as the normal error detection rate multiplier (KRED=f(KR)) where f(0)=0.5, f(0.5)=1, f(1)=1.3, f'>=0.

Learning from mistakes is a major ability of a self-organized team. The increase in EDS (EDSI) shows that members are learning from mistakes. Due to their own error correction or through observation of other member's detection and correction process, the detection experience and skill of the members will also increase. The accumulation of skills and experiences are also affected by their own possession of ability and experience. The EDS decreasing rate (EDSD) mainly comes from turn over of the members. When experienced or high knowledge redundancy workers leave, the team will loose the ability to detect errors. The model assumes that the loss rate is represented as EDS/EXPM multiplied by the rate of experienced workers leaving.

When the team is under high cognitive load, despite the fact that the goal is to achieve the target, when the error occurrence hits a non ignorable level, the team will have to engage in the avoidance of errors. Members need to adjust their cognitive resources to decrease the occurrence of errors. The AER indicates the team's recognition state of work quality in each member's heart. The higher the AER is, the worse the work quality will be which in turn will result in higher pressure and more usage of COE on avoidance of errors. The opposite is true as well. The model assumes that the highest possible average error correction rate is 3 times the normal circumstances (3*0.1=0.3) wit the lowest value being 0. The relationship of the effects from investing in cognition to avoid errors is a linear one (f(AER)) with a value between 0 and 0.3. The average error rate, the ratio of the number of corrections and the potential work performance value, is assumed to have an average time equal to the moving average of 3.

4.6 Learning environment in team

Social organization carries the basic responsibility of flexibility, robustness, member's socialization and communication aside from influencing the actual work performance. Members of a team rely on their social relationship to perform their duties. Social organization reflects the task execution (computational) structure. Thus, the influence of the turn over of members cannot be neglected (p. 175-8,185-6,203,284,340-1,345). A change of team members is shown in Figure 7.

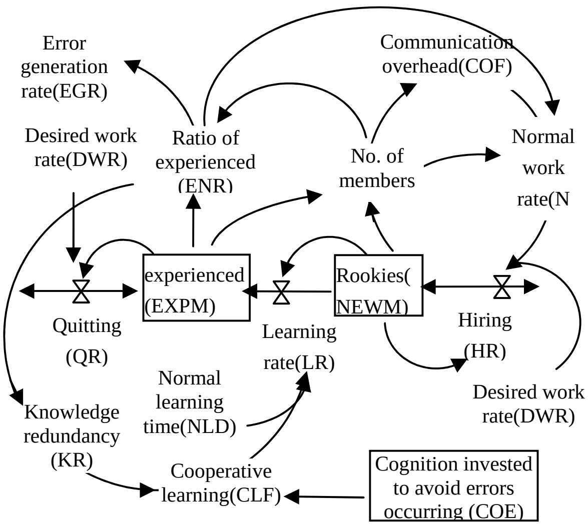


Figure 7: The process of a team member's change.

Normal Work rate (NWF) indicates the work performance under regular environments and is decided by the total number of members (TM), the number of experienced workers (ENR) and communication efficiency (COF). The increase of members and the increase in performance have a non-linear relationship (f'(TM)>=0, f'(TM)>=0). The main reason is that a more distributed work environment among a lot of members will allow for parallel processing which will result in higher work performance (p. 189,190). However, the overhead of communication (COF=f(TM)) is one of the costs associated with distributive environments; the more members are involved, the more communication overhead (pp. 228-9,232-3,284). The model assumes accordingly that (f(TM=1)=0, f(TM=10)=0.2, f'>=0 f''>=0). Also, the performance of the team will be influenced by different ratios of experienced members. The influence on the work performance can be represented by a work performance multiplier where the value lies between 0.7(f(0)=0.7) and 1.3(f(1)=1.3). The ratio of 50% of experienced workers on a team is 1 (f'=1). The movement among members (joining or quitting) will not be included in the model as the observation period is very short in comparison to the average worker at the job position. Thus, in a short period of time, a members' normal behaviour of quitting will not be accounted for. A simulation can be used to discuss the internal movement of members in a system.

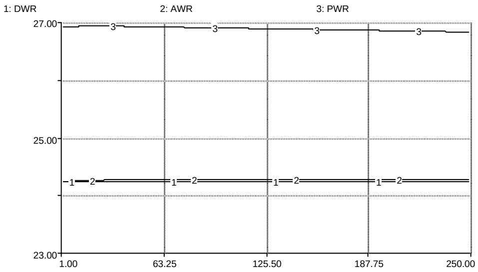
To a rookie, the team is the learning environment, and thus a rookie's learning efficiency has a direct relationship to the learning environment a team offers. Members in a team environment mainly learn directly through mission execution, observation, receiving instructions, and governance (p. 263-285). A rookie's learning rate is influenced by normal learning (NLD) and cooperative learning (CLF) (p. 224-5). Normal learning is defined as the time it takes for a rookie to become an experienced member on the team under normal circumstances. The CLF function represents the influence on the member's learning efficiency through team members' learning from not only their own observation but also other members' governance. The efficiency in cooperation among members is mainly a result of two factors; one is the KR in the team and the amount of resources spent on COE. The more the knowledge redundancy and incest resources are, the faster a rookie will learn. Otherwise, the rookies will only be able to learn from the basic ways (educational training and self discovery). Thus, the function value is determined by the multiplication of resources used by repetitive knowledge, discovery, and administration (CLF=f(KR*COE)). The function value is the multiplication of a rookie's average learning time that lies between 0.7 and 1.5. The smallest value of 0.7 represents the very basic efficiency rate for a rookie whereas 1.5 represents the largest contribution to a rookie. The team's current situation has (f(0.5*COE/0.1), COE=0.1) a function value of 1.

4. Simulating the formal model

The model will be tested using a systematic approach. The main tests include unit consistency, parameter test, extreme value test, equilibrium testing and behaviour test (Forrester 1961, Forrester and Senge 1980). The goal of environment change testing is to simulate different changes in environment through different parameters and conditions, and to understand various mechanisms' effect on the systems dynamic behaviour in a team and the relationship and effects of various mechanisms.

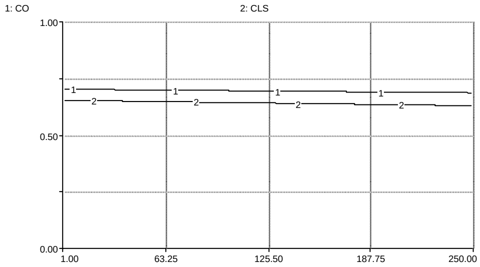
5.1 Model equilibrium tests

The main goal in this category is to assume that the environment has not changed. With DWR and AWR being the same, the team does not need to proceed with any changes and the model should be in absolute equilibrium as shown in Figure 8. The small changes created by PWR in Figure 8a are mainly due to the learning of rookies that has improved



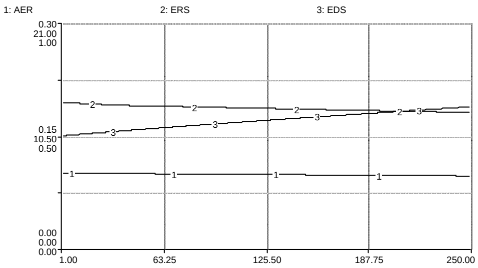
Time (minutes)

Figure 8a DWR, AWR and PWR (tasks/minute) under equilibrium test



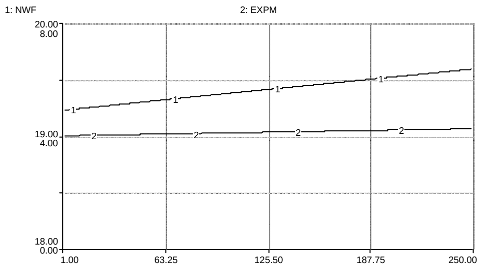
Time (minutes)

Figure 8b CO (cognition units) and CLS (pressure units) under equilibrium test



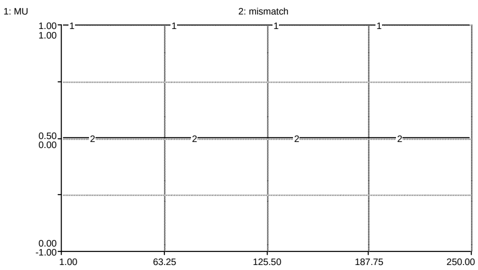
Time (minutes)

Figure 8c AER(errors/minute), ERS(errors) and EDS (capability units)under equilibrium test



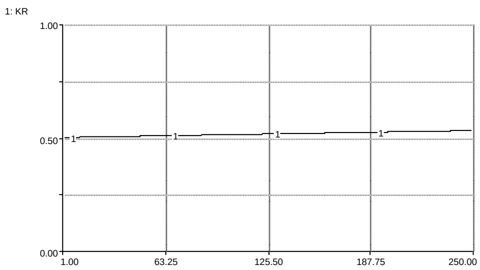
Time (minutes)

Figure 8d NWF (tasks/minute) and EXPM (persons) under equilibrium test



Time (minutes)

Figure 8e MU (MU units)and Mismatch (mismatches) under equilibrium test



Time (minutes)

Figure 8f KR (knowledge units) under equilibrium test

the work performance. The performance decrease after that is due to the increase in real work performance when the team adjusts its cognitive load. In Figure 8b, the team faces CLR during the mission execution, resulting in a slight decrease in performance. The main reason is previous increase in real work performance that in turn allows the team to lower the CO investment required to execute the mission. IN Figure 8c, the lowering of ERS is caused by the team's increase in EDS ability together with the gain in team experience (through the growth of rookies). This allowed for an increase in the EDR and a lowering in the EGR. In Figure 8d, the increase in NWF is due to the growth in experience by rookies that results in the increase in the number of experienced members

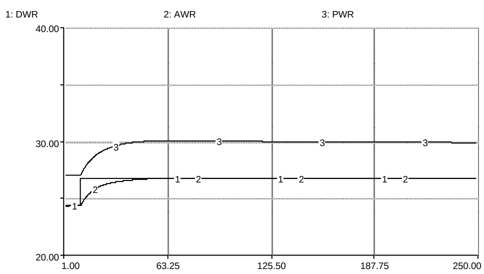
(EXMP) as well as an overall increase in veteran ratio. Figure 8e shows that the previously established MU and error mismatch both remain the same. Figure 8f shows the team's organizational form after members gain experience that results in an increase in KR. Under a non-changing environment in the model, there are no other changes aside from the effects of learning by members.

5.2 Environment change tests

The environmental conditions are changed through the initial value of DWR. Although environmental changes are diverse in nature, most changes can be traced back to the effect of performance difference. For example, change of goal, limit in time, emergency operation etc.

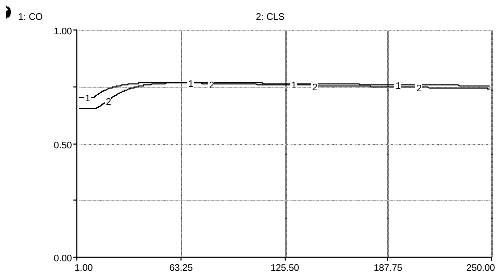
5.2.1 Structure Maintenance with small change

Simulations have revealed that under different performance requirement changes, the model exhibits very different behaviour and processes. When the change is small (such as increase in performance goal by 10%), the model demonstrates a behaviour that resists the disturbance to achieve the new goal as well as to steady itself. The process is shown in Figure 9. Figure 9a shows that when the performance goal is suddenly increased by 10% in the 10th period, the team's real work performance will slowly reach the new requirement after a certain period of time. However, the potential work performance needs to be advanced to an even higher level. Figure 9b shows that after the environmental change, teams will invest more cognitive resources and create a higher load pressure. In figure 9c demonstrates that despite the environmental changes, no partially creative behaviour was created in a team (INV) and the level of mutual sharing of structure (MU) also remains the same. In Figure 9d, elevating the work performance goal will also increase EGR at the same time. More errors will accumulate during the mission (ERS) and more corrective actions need to be taken as well (ECR).



Time (minutes)

Figure 9a DWR, AWR and PWR (tasks/minute) over time, with small change in environment



Time (minutes)

Figure 9b CO (cognition units) and CLS (pressure units) over time, with small change in environment

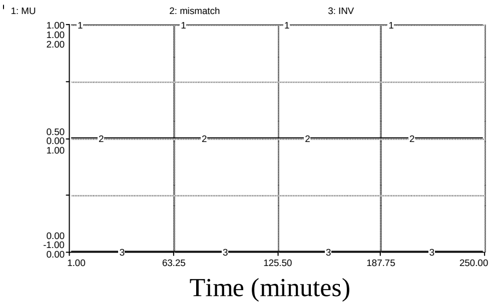


Figure 9c INV (INV units), MU (MU units) and Mismatch (mismatches) over time, with small change in environment

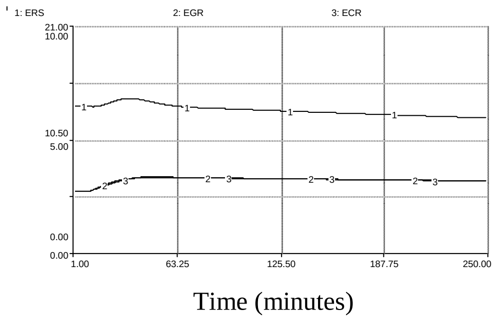


Figure 9d EGR (errors/minute), ERS (errors), and ECR (errors/minute) over time, with small change in environment

How does a team display resistance to the disturbance in an environment through internal mechanisms and what internal changes have occurred in the team? Through an analysis of model structure, Figure 10 shows the main operational process of a team through causal feedback.

Model behaviour will be created through three main functional mechanisms in a slightly disturbed environment, loop 1, loop 2, and loop 3. Loop 1 is a negative feedback loop and is the process where the team discovers the environmental changes. When the environmental changes create a difference in performance and goal, members will firstly increase their workload, also known as increasing their cognitive resources, to improve their work performance and alleviate the performance difference (Figure 9a). However, it is unavoidable that loop 1 will create loop 2 due to the increased pressure from increasing cognitive resources (Figure 9b) after reaching a certain stage. Loop 2 is a positive loop, and can be said to be the side effect of increasing a team's work efficiency, meaning that with the increased pressure, more members are prone to make mistakes. Not only will more undetected and uncorrected errors accumulate, more error correction or rework will occur (Figure 9d) and thus resulting in a partial offset in work performance. When a team detects more errors, it will create loop 3. Loop 3 is a negative feedback loop. When the team creates and corrects more mistakes, members will increase their governance and attention on the work process due to the recognition of a lower work quality. This in turn will lower the error rate and discourage the team from putting in more resources into the increase of work performance. Although loop 2 has a positive loop feature, it does not actually result in that behaviour due to changes in the environment that allow the team to increase the workload to achieve the behaviour instead. Despite the many errors created during the process, loop 3's role of discouraging errors becomes larger and this can thus avoid the corrosion done by side effect created by increasing the workload. Loop 1 and loop 2 have a conflict that makes a team's recognition on work quality and standard an important control factor. This is one of the many issues teams are facing. It also explains why teams cannot use simple operational mechanisms to overcome greater changes in the environment. Simply speaking, with a small change in environment, teams will have enough ability to improve their work performance through the above-mentioned mechanisms to achieve the requested goal and maintain their original operational structure.

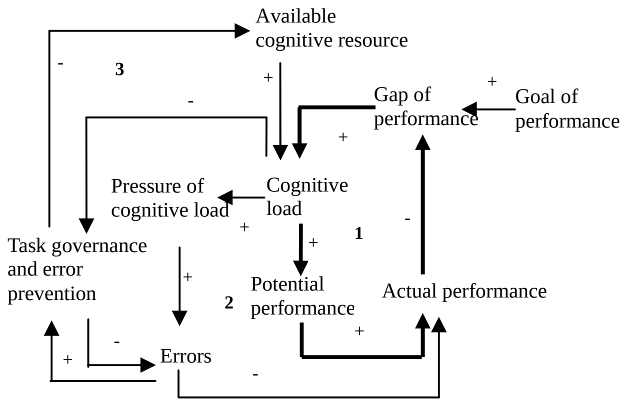
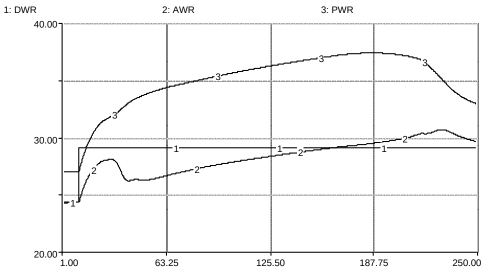


Figure 10 Simplified causal diagram of self-organizing team's adaptation with small change in environment

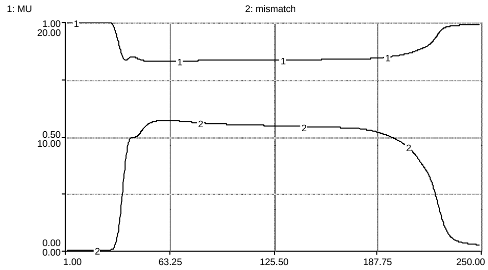
5.2.2 Restructuring with radical change

When the disturbance in the environment increases (an increase of 20% of work performance target for instance), the model exhibits a very different dynamic behaviour. From the behaviour in figure 11 it can be seen that teams do experience self-organization to successfully overcome the changes in the environment. Figure 11a shows that work performance target suddenly increases to 20% during the 10th period. After a rapid increase of potential work rate (PWR) for a certain amount of time, it increases slowly until the AWR reaches the DWR when it starts to decreases again. The actual performance rapidly increases with the increase of potential work performance, but will speedily decrease before reaching the performance target. Then, work performance exhibits a gradual growing trend and grows slightly beyond the desired performance goal. Figure 11b shows that the increase of the work performance goal force the team to increase CO to cope with the change and remain there until the new performance target is reached by the team at which time it will decrease again. CLS rapidly increases in a similar manner in a form (close to 1) that exceeds the team member's maximum capable load for a prolonged period of time. The model shows that when the pressure on the team members reaches a certain point, it will create frequent local innovation in a very short period (INV) and will remain there for a period of time and then rapidly come to a stop. Figure 11c shows the changing team at the initial stage when AER, ERS, and error correction all show obvious increase. However, after a certain amount of time it will return to approximately the original level. Due to local innovation, figure 11d shows that the sharing of the operational structure among members (MU) will suddenly decrease after a fixed amount of time and then suddenly establish a highly shared situation again. Errors created by team members' mismatch (MIS) are almost exactly the same but there is an opposite change in situation due to the destruction of mutual understanding. The lowering and returning of the shared structure within the operation structure shows that it has already successfully re-organized an efficient operational structure. The model's process of structural change and its non-linear behavioural properties match the ones of self-organization system (e.g. Dissipative Structure). It also matches the observations made by Gersick（1988, 1989）, Try & Olikowski (1994), Tushman & Romanelli(1985) and Hutchins（1996）. Figure 11e shows that teams increase their COE to avoid and detect errors during the process of change so that they can maintain their work quality and limit the CO which will gradually decrease to approximately the original level after a certain amount of time. Figure 11f explains a situation where steps or jobs will be omitted within an acceptable range (TSF) when teams face performance goal differences (PS). The higher the pressure of performance goal difference faced by team members, the more working steps or processes will be omitted by the members.



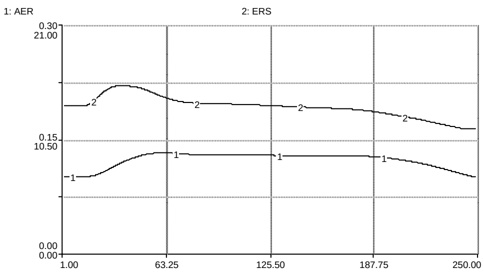
Time (minutes)

Figure 11a DWR, AWR and PWR (tasks/minute) over time with big change in environment



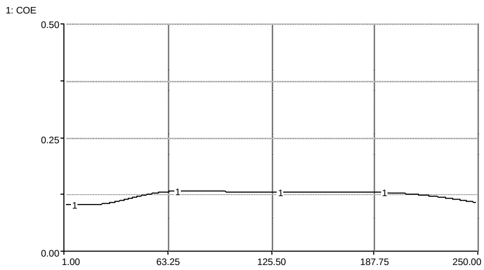
Time (minute)

Figure 11b CO (cognition units), CLS (pressure units) and INV (innovation units) over time with big change in environment



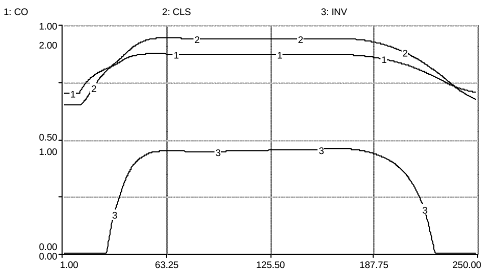
Time (minutes)

Figure 11c AER (errors/minute) and ERS (errors) over time with big change in environment



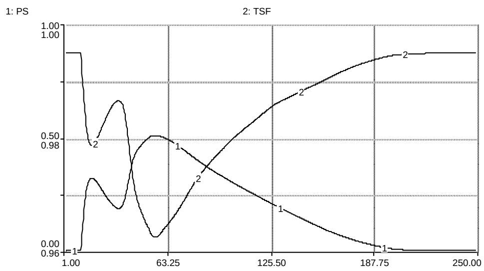
Time (minute)

Figure 11d MU (MU units) and Mismatch (mismatches) over time with big change in environment



Time (minute)

Figure 11e COE (cognition units) over time with big change in environment



Time (minute)

Figure 11f PS (pressure units) and TSF (percentage) over time with big change in environment

With greater environmental changes, teams that have been through simple adjustment of mechanisms mentioned in the last section to self-organization of structures will successfully overcome the changes through self-organization. During this process, the model strongly shows that that the self-reinforce feedback loop plays an important role in the revolution of the team. The causality feedback in Figure 12 explains the reason of the model's feature dynamic behaviour process. When the performance goal suddenly increases, the team's first reaction is depicted in figure 11a. The team will then increase their work efficiency through the mechanisms of the loop 1. However, the team still is unable to achieve the requested target, and thus, under high workload, accumulates a lot of pressure through the investment of high cognitive resources (Figure 11b) that results in the increase of errors and offsets the actual work performance (loop 2)(Figure 11c). Since the team is unable to reach the goal, the team members are constantly exposed under high cognitive load. Due to economical principles of cognition, members with a high cognitive load will seek for local innovations and changes to lower the load (loop6) (Figure 11b). The result of partial innovations and change, not only affects the cognitive load of members and their potential team performance (loop 8), but also changes the originally established shared structure and furthermore leads to the destruction of the shared structure and the re-organization process (Figure 11d). As local innovations and changes are un-planned for and urgent, highly dependent on the environment it is surrounded by and the degree members depend on each other at work, it is unavoidable that local innovations and changes destroy the original structure. When members discover that they are no longer matched, they will attempt to re-organize an effective structure through local innovation, mutual negotiation, and cooperation. As mentioned previously, the destruction and reorganization of a shared structure is a self-reinforce feedback process by nature and involves time delay. Loop 5 and loop 7 clearly show their interaction. Despite the analysis of the model structure's main loop, the above-mentioned process is unable to completely explain Figure 11b and 11d's partial innovation and the dynamic behaviour of the structure. The creation and application of loop 4 in Figure 12 plays a key role. From the path in the figure it is shown that loop 4 is not created by team members' individual or mutual ability to have a goal-seeking type of adjusting feedback process, but rather stems from the related adjusting loops that lead to the positive feedback loop. During the destruction stage, it has an accelerating and expanding effect; during the re-organizational growth stage, it has a function of accelerating success and stabilizing the development. These stages lead to the destruction of mutual understanding, local innovation and mismatch discontinuous behaviours (Figure 11d). Finally, in order to cooperate with the influence of loop 8, the team's real performance is increased which in turn creates another stage of shared structure of discontinuous behaviours. The function and role of loop 4 in the team's revolution have the same function and role as the evolutionary feedback in the self-organization systems (e.g. Nicolis & Prigogine 1977, Prigogine & Stengers 1984).

To maintain work quality is also an important issue in the dominate processes of loop 2 and loop 4. Due to the functions of loop 2, more human errors will occur. In addition, teams are forced to omit certain steps or processes due to the pressure created by the difference in actual performance and performance goal (Figure 11f). All these issues will affect the work quality of the team. In order to maintain the effectiveness of a function, the team has to maintain a certain quality of work. To do this, members need to invest in relatively more cognitive resources to avoid the detection and increase the correction or errors (Figure 11e). Furthermore, a team's detection, avoidance and correction efficiency of errors is dependant on their ability to detect errors. The main method to increase the team's ability to detect errors comes from self or other member's correction and learning process. Although this is not a direct key factor affecting the team's self-organizational behaviour, it is one of the necessary elements of self-organization. Otherwise, low work quality will destroy the self-organizing ability of the team.

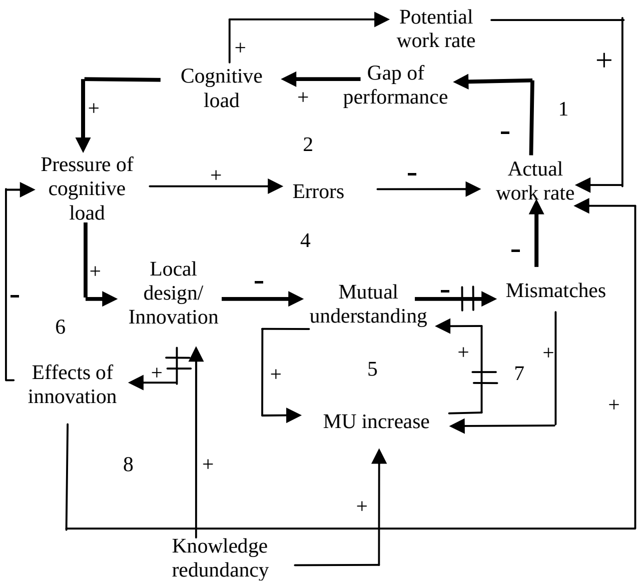


Figure 12 Simplified causal diagram of self-organizing team's adaptation with great change in environment

To maintain work quality is also an important issue in the dominate processes of loop 2 and loop 4. Due to the functions of loop 2, more human errors will occur. In addition, teams are forced to omit certain steps or processes due to the pressure created by the difference in actual performance and performance goal (Figure 11f). All these issues will affect the work quality of the team. In order to maintain the effectiveness of a function, the team has to maintain a certain quality of work. To do this, members need to invest in relatively more cognitive resources to avoid the detection and increase the correction or errors (Figure 11e). Furthermore, a team's detection, avoidance and correction efficiency of errors is dependant on their ability to detect errors. The main method to increase the team's ability to detect errors comes from self or other member's correction and learning process. Although this is not a direct key factor affecting the team's self-organizational behaviour, it is one of the necessary elements of self-organization. Otherwise, low work quality will destroy the self-organizing ability of the team.

5.2.3 Discontinuous change at critical point

To a team, a critical point lies in a change in environment where the team is in a situation and is blurry on whether to start the revolution or not. When a team is faced with the critical point, it will also produce a discontinues phenomenon between change and no change. This means that once the structure incurs a change, it will go through the process of destroying and re-establishing the structure to some extent which leads to a similar dynamic behaviour depicted in Figure 11a. When the team is at the critical point, the team is easily influenced by both external and internal incidents that result in crossing the point and entering change or repressing the forces of change. The difference in this between change or not is very small. This property is also similar to self-organization system in other fields. (e.g. dissipative structure)

6. Discussion

The model's dynamic behaviour and exposed internal mechanisms explain that the self-organizing team definitely has the features of evolutionary feedback. These points also indicate that it may be worthwhile to further develop the self-organization theory (e.g. Dissipative Structure Theory) to be an organization's revolutionary management assumption and hypothesis. The model has explained some problems that include why and when a team will go through spontaneous structural changes, why a team can successfully re-organize, what the core mechanism of self-organizational team is, and what dynamic behaviours will occur during the self-organization of a team. As for the revolution in the team, the model offers a more realistic explanation.

Whether a team will incur self-organizational revolution or stay with the original operational structure when faced with changes in the environment heavily depends on whether members need to change their work method to effectively lower cognition or workload given that they have to achieve the goal. Increasing work efficiency and investment of cognition is usually the first reaction towards overcoming the changes of environment. However, when the pressure of cognitive load gradually increases (or exceeds a certain value), enough to make members seek change to achieve the goal, it is only then when the team starts to self-organize. Otherwise, teams will not automatically seek for change (Gersick, 1989). The structure of the model explains that one of the motivations and origins of the team stems from members' decision and recognition towards the entire performance goal. This carries the same argument as the theories related to team goal and target setting (Levinthal and March 1981, Tushman and Romanelli 1985). Furthermore, the model also indicates that team members' recognition of environmental change is the key to whether a team will enter revolution (loop1) because environmental conditions are important factors in affecting and changing the goal as well as the starting point of a revolution. Not having the cognitive towards environmental change is not having the motivation to improve the performance and the team will loose its opportunity to revolutionize. This argument is actually the same as Sastry's point (1997) that it is also possible that an organization's change comes from the cognition of appropriateness in goal and environment. Therefore, members can establish an effective feedback mechanism to improve performance more easily through the sharing of the entire team's condition as well as environmental information.

During the self-organization process, the local changes need to be advanced into a full scale structural change which requires the spreading of change. The main path of spreading comes from the interdependencies within work as well as the member's social relationship. Members need to understand and organize each other's behaviour and work during the change process in order to complete the task. These include the trialing and experimenting of alternatives. Since changes cannot be predicted, the revolution and re-organizational process may seem chaotic as there seems to be no planning and design for changes. However, this process is the necessary path to destroying the old structure and finding a new solution. The model explains that the key to a team's self-organizational revolution is the evolutionary feedback developed in the positive feedback loop such as loop 4 in Figure 12. The model indicates that this evolutionary feedback is the creation of the feedback of performance adjustment (loop 1), member's cognition economy (loop 6), and member's mutual understanding (loop 5, 7). The existence and effectiveness of these related feedback loops are one of the important contributions to evolutionary feedback loops. The evolutionary feedback plays a double role. It is the reason why a structure is destroyed, but is also the main force behind the creation of the new structure. The system will be in a very sensitive stage; any internal or external influences may create asymmetry of different development directions and thus be the active reason a new structure is established. Gersick's(1988, 1989) and Hutchins'(1996) research show the same view. Members need to actively communicate and interact with the environment to seek usable resources at that time. The discovered solutions during the internal and external interactions among team members will decide the format of the new structure. Simply speaking, during the process of organization, the active changes and freedom of experimenting by members and the highly cooperative nature in an open environment are the main reasons behind a team's change of direction from destruction to establishment of structure during evolutionary feedback.

However, the low performance and the increase in errors during the process of change will create trouble. Teams may face even higher pressure or even be interfered with by the manager from the outside. Thus, if the team or outer management lack the understanding of this process and engage in influencing the team, it is very likely that the self-organizing mechanism of the team and their related benefit will be suppressed. It is unfortunate that most teams will face this type of situation that will inhibit the possibility of self-organization. At such times, outer manager should support and facilitate the feedback process to substitute direct intervenes in the team. Self-organization as described before is dependant on the change in evolutionary feedback loop direction. Facilitating the related feedback processes that evolutionary feedback has emerged from is the fundamental reason to create and change in evolutionary feedback. Seen from another aspect, to avoid the corrosion of work quality, the avoidance, detection and correction mechanisms in a team's operation are also very important. Therefore, aside from leading the evolutionary feedback change, the role of the error detection mechanism is also a necessity during the changing process. However, similar to many other cases, quality is often overlooked when under pressure during a revolution which will ultimately lead to the final result of corrosive change and thus destroy a team's self-organizing ability.

The model also offers a behavioural perspective and explains why different teams adapt differently when faced with environmental change. However, why is it that some teams can develop mechanisms and some do not? One of the usual reasons is that organizations do not support teams to have the whole system on self-organization or teams are unable to self-create the necessary mechanisms of a revolution. Concerning the first reason, too much interference often delay the feedback loop so that the feedback loop is reacting too slowly or even prohibiting the creation of important feedback loops. Therefore, team members themselves are unable to effectively control or establish the necessary feedback mechanisms and react to various internal and external changes. Seen from a long development perspective, this guidance type of external control management will destroy a team's ability to establish self-organization. The second reason lies in the fact that team members are unable to communicate efficiently (e.g. not enough bandwidth, job role not clear), lack the necessary knowledge redundancy (which makes re-organization of structure seems difficult), (result in) lack of sharing in internal and external conditions, or inefficient learning context in team. Just like Hutchins and other researchers' indication, these reasons will directly affect the creation and operation of the self-organizational mechanism. The same dynamic results can be obtained from simulation of the model. Teams need a longer time to re-organize and create even more errors (not listed) as a result of low communication efficiencies and repetitive knowledge.

With respect to the changes in members, despite the fact that during the simulation members' joining and quitting were not tested, we can see from Figure 7 that the influence on process of change mainly comes from knowledge redundancy, efficient communication and normal work performance. Thus, if the result of a member's change has a negative effect on either three sources, the team will experience a disadvantage in the ability of self-organizational revolution.

Through a deeper understanding of the model's mechanism and dynamics and the obtained meaning through the simulation, an explanation can also be offered from a self-organizing perspective to other methods of organizational changes. Examples of these are the importation of new technology and the adaptation of organization which are very important issues to the organization today because the new technologies used are not only being integrated but also leads to the change in organizational structure (Van de Ven, 1986). The understanding and management of technology adaptive process by management is the decisive factor to performance. Orlikowski & Try (1994) have discovered that technology in a team's adaptive process is not a continuous improvement but one that after a short period of structural change will change will have a rapidly decreasing possibility of change until the completion of change.

No matter whether changes are originating from internal or external sources, from the view of model mechanism, it undoubtedly leaves people guessing on whether revolution needs to experience self-organization first in reality before succeeding or exerting a larger effectiveness. This type of doubt is actually very reasonable since, similar to the research by Olikowski & Try, the reasons and models behind an unsuccessful revolution or a successful one are obviously comparable to the feedback loops described in the other models.

Although self-organization indicates a revolutionary method that is different from the traditional one, from the model's extreme value changes, it is clear that the larger the environmental changes are, the longer the team will have to go through revolution. The main reason is because evolutionary feedback is unable to change from destructing model to structuring model in a short period of time. The model's structure indicates that the reason why teams need more time is the assumption that the effects of local innovation on performance are fixed and thus is unable to effectively create a decisive operational structure. Although Hutchins (1996, p.348-9) believes that the evolution through local innovation and change can lead to success at the end, an effective solution is eventually to be found through continuous interaction with the environment. Judging from this perspective, we believe that the created revolution and innovation cannot be predicted due to the growing changes which will not necessarily lead to a longer time frame for the self-organizational process. However, the larger the environmental changes will lead undoubtedly to bigger challenges and difficulties under normal circumstances and may require an even deeper revolution. Longer times represent higher pressures and larger risks, but whether this type of self-organizational revolution will have any applicative restrictions needs to be further researched and investigated.

7. Conclusions

Further discussions of the model and dynamic behaviour concern researches related to complexity systems as metaphor. From the analysis of related mechanisms, we can see that the adaptive process to the environment for self-organizing teams is also dependent on "evolutionary feedback", and results in a non-linear behaviour. The model uses practical behavioural mechanisms and their produced dynamic behaviour to realistically discuss the general theoretical descriptions and concepts. The obtained key feedback loop and dynamic behavioural features can be used as the foundation of management during the revolution.

The changing method of self-organization not only points out the possibility of other non-traditional changes, but also explains the reason behind team differences in their ability to overcome environmental changes. The model and its produced dynamic behaviour not only offer an explanation for some of the important questions in a self-organizational process, including why and when the self-organizational process occur, what the features of internal mechanisms during a self-organizational process are, but also offer a further possible explanation towards the dynamics of an organization's revolution. The core meaning of self-organizational revolution is to successfully adapt to the environmental changes through cognition for environmental changes and through the systems' internal re-organizational process. Cognition towards environmental changes is important as it is the originator of the revolution. Teams or organizations need to turn their recognition of changes in the environment from objectives to new performance targets or target systems and, through the process of eliminating the difference in target and reality, evoke revolution as a source. The endogenous re-organization of a system indicates that the beginning and completion of revolution comes from self-control of the establishment of self-organizing mechanisms and the systems entirety (including the environmental cognition). Due to the extreme necessity of processes in communication and interaction between internal and external environments, anything that involves remote or external feedback mechanisms may not produce the desired feedback effect and affect the entire mechanisms operational effectiveness. Only when the members can completely handle the feedback mechanisms of revolution can the team be able to produce the necessary motivation for structural change. Besides, with the stimulation of the internal and external environment, it plays the role of opportunity giver. It manipulates the outcome and development of re-organization, and thus maintains the openness in an environment which is an essential condition in self-organization.

Certainly, simplification and limitations are common in all models as the model cannot include all relationships in reality. However, what we would like to show is an efficient strategy and method to discover new knowledge such as the beliefs of Simon (1996) Forrester(1961) and Sterman (1999). Societal systems elementally have non-linear feedbacks and time delaying features. Narrative methods will limit the understanding of system's operational processes and dynamic behaviours. The establishment of a model will assist in the discovery of hidden non-uniformity, blurriness, as well as negligence of hypothetical results that occur during inspection. Through the discussion of this model, the theory development can be more carefully carried out, and, at the same time, it may open opportunities to discover new knowledge. In addition, through the discussion of this model, a deeper understanding of the internal operational mechanisms' role and function can be obtained. For dynamic complexity systems and behaviours, the simulation on formalizations and models to be of supportive content towards the related research is a worthy one. The author can provide complete documentations on the model, and invites other researchers to correct and further develop it.

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