Organization Learning Process in a Complex System: Reflection from the work of Jhon D. Sterman

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ABSTRACT: *The researcher studied four research papers which are more cited and famous written by Jhon D. Sterman for the purpose of author review. The researcher found the key issues of each paper. Two papers based on the case studies of companies like Analog Device Inc. and Hanover Insurance Company. Which are real world examples that how companies tackle the complexities and learn effectively while rest of the two papers defines that how do individuals and organizations learn in complex systems? The importance of virtual world and experiments and simulations (Methodologies) were also discussed in detail. This review provides the comprehensive picture of the major research work of Jhon D. Sterman in the field of Learning Organization. The barriers of learning tools of effective learning, policy resistance problems and its solutions were discussed. This write up is an attempt to highlight his major contribution in field learning organizations.*

Keywords: Jhon D Sterman, dynamic and complex system, simulation, policy resistance, learning laboratory.

Constant change is modern times is continuously increasing the complexity world. Economic activities, population and technology are the factors that have altered our world from realistic to profound. Some changes are productive while some changes are undesirable that have ruined the world and become a threat for human life. Henry Adams has presented a "Law of Acceleration" by observing the complexities in America. Ha has described that there is a sheer need of new ways of thinking and mindset or "System Thinking" ------- to understand how the things are interconnected? And how these things effect on each other? For humanity system thinking development is of great importance and need of time as well. John D. Sterman has discussed in detail the learning process in complex systems. Although such learning is too complex and uncommon due to presence of some structural obstructions that always impede Feedback processes in learning. Feedback is essential element of learning which enable us to change our decisions. Through feedback we get information, build mental models and revise our decisions. So the work of Jhon D. Sterman highlighted the importance of simulations, learning laboratories, virtual world and experimentation for effective learning in area of learning organization. More over how to avoid policy resistance and efficient working of improvement programs (TQM) are his major contributions. Following are some major areas of his work in field of learning organization.

Certain Ways of Successful Learning

i. Effective formulation of feedback structure, extraction of knowledge, tenets and setup of issues so that feedback structures can be build on the basis of extracted knowledge.
ii. Experience and try new policies and skills to help the above phase.
iii. Develop the ways to increase the scientific and logical thinking.

When there is no change in mental model Argyris called it Single Loop learning while Double loop learning not only change our decisions about that information feeds back to change our mental model. Schon described learning is a process to invent, observe, reflect and action in repetitive manner. There are certain barriers in the way of successful learning procedures that obstruct the information feedback. Delays in decision making and their implementation is also a barrier in learning. It creates imbalance in systems. Similarly Limited information is also a cause of ineffective learning. We make decisions on the basis of estimates. These estimates based on statistical procedures, sampling and measurements so there are always chances of errors. Our mental models are challenged by the perceptions and

expectations of feedback that limits our learning. Ill-defined variables e.g. misperceptions about feedback in a complex system make management difficult. Our decisions may not prove a true solution of problems due to continuous change. Sometime feedback information is misperceived by decision makers and their wrong decisions lead towards failure. Often learning is poor in complex and dynamic world. (Paich & Sterman,1993).

Mental model complexity is related to the misperceptions of feedback and poor performance. In complex system multiple variables are correlated which make difficult to judge the cause. The basic characteristic of mental model is causal ascription (cause and effect) cognitive frames are formed by people about different actions. The process of double loop learning even will be difficult if the causal models and structures are perfect. Bounded rationality is that factor which holds back the complexity of cognitive frames and enhances our ability to use mental models is dynamic systems. This skill must be possessed by decision makers which enable them to learn even when feedback is unclear and ambiguous. Poor reasoning skills and defensive behavior are also barriers towards successful learning. We must observe the issues in different perspectives so that our mental models can be expanded. Some time we are well aware about existence of certain issues but we don't discuss them such defensive behavior hide the mental models of members in a group. Execution failure also obstructs learning.

Actions to be practiced in an organization are not exercised in an organized manner. Private dockets, inducements, and asymmetrical information cause failure of action plan. Management is more concerned about the outcomes not the way of implementing the strategies and action plans. So there is a need to apply new policies that not only save the organization from failure but also secure huge profits and success in future. What we need to tackle those barriers are to make new decision rules with passage of time and reward those rules which results improved performance in future. But those best rules are difficult to select over time. Evolution can overcome the barriers of learning in case:

a) When there is a variety to generate new rules
b) Best decision rules are used frequently in future
c) A comparative study must be done to measure the difference in system before and after change of decision rule.

### Improvement in Learning Procedure

For effective learning experiments are essential in both real and virtual worlds. In Virtual world decision makers can review their skills, conduct testing of the decisions

(Experiments). Virtual world is cost effective for learning. Less time and space are required for experimentation. In virtual world those strategies can also be tested which are considered dangerous in real world thus it results improved learning and outcome. In virtual world controlled experiments are performed which allows learner to control strategies. Although virtual world is more effective to learn in complex system but it does not ensure to overcome the defects in mental models. Logical and reasoning skills can only be effective when decision makers actively participate in construction of models.

Importance of Simulation

Simulation is a technique to represent the real world by a computer program. So in complex world our abstract ideas are difficult to implement without formal modeling. Without simulation the models or maps can only be tested by trusting the learning feedback information from the real world (see Figure 1). But this feedback process is too slow and ineffective in complex systems. So simulation is the only way to experiment and test the hypothesis arising from induction technique and issue structuring process. Without simulation effective learning is impossible. Simulation is only ne the best and effective way for learners to discover more. There is need to train managers and learners and discover more efficient and effective ways to use the tools and techniques of modeling procedures and their impact on individual and organizational learning. More logical studies and rigor application of these principles lead us to understand how to learn in complex systems.

Figure 1. Feedback learning process

Feedback from real world changes the mental models
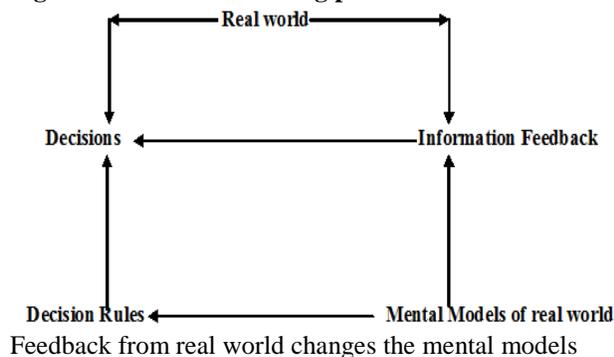
Case study of Analog Devices Incorporation

The observed problem was that with application of Total Quality Management (TQM) the performance was improved but the financial position of the corporation was not matching the performance. As share price value was decreasing and profitability was low. How this is possible that performance is high but financial position is not of that level as expected by employees and other stakeholders. Usually poor implementation of such improvement programs like TQM is the basic reason of its failure. There must be integration of such programs with the corporate strategies to reap the true benefits of such programs. But the scenario was different in this case study. Analog's TQM program was self contradictory because improved performance did not show impact on financial position. An advanced quality program was designed like balance scorecard software, half life system and training to personnel. Half life system is the basic of learning process in which reasons of defects and flaws are identified and ranked by their importance level. After designing models, testing and evaluation proper solutions are implemented.

Simple projects takes half life time span based on few months and with the complexity of the projects that time span increases. Analog Device Inc acquired Precision Monolithic Inc. due to major changes in the business. The reason of the mismatch was that TQM was unable to gain full attention of managers. Strategies like downsizing and cut the cost were adopted. TQM not only brought dramatic benefits to company but also some side effects. Where the productivity was increased, the relationship between direct and indirect cost was also disturbed which resulted mismatch of financial performance with actual production performance. The improvement levels were unbalanced in all the departments of the company. There must be integration of improvement programs, employee's job commitment and job security to secure long term benefits and improved learning.

Policy Making

With impact of the environment changes, organizations have to change its practices and structures more rapidly. The basic task of managers is Strategic Management to improve their mental models and leave traditional practices. In past organization is all about to plan, manage and control but now Learning Organization is the game of clear vision, values and building mental models (Senge, 1990). Now organization learning can be viewed as sustainable advantage. System thinking is the remedy for all the problems of policy making and to sustain benefits for the long run. In complex world System Dynamics is the procedure to learn effectively. System Dynamics based on Simulation and models to assist in learning in complex system. Our limited, less reliable and inactive mental models and limited understanding about complex systems are the main reasons of opposition of polices.

Causes of Policy Resistance

How we see and explain our experience is also a cause of policy resistance. We blame others for our failures. Feedback is result of our activities. Without feedback understanding of this world seems more complex, uncertain and unpredictable. Delays lead the firms to instability. From decision making to its results delay may create troubles for firms. It reduces our ability to timely perform experiment, test hypothesis and learn. Poor understanding about assets and resources also cause policy resistance. Like tangible assets (plants machinery) intangible assets like customer loyalty, skills and employee's capabilities are resources of the firm.
People often blame other's behavior and don't blame the system in which they perform. Usually people are unaware about the system which forms their behavior. So they learn false lessons with dangerous and harmful consequences.

Our meaningless system thinking is main reason of policy resistance. Until we don't understand our system and its complex dynamics we cannot make such policies which ensure bright future for us. Learning Laboratories are also called micro world or simulation is the new approach in which real organization practices are performed. If that practices bring successful results then same strategies are implemented in real world. So there are less chances of failure and fewer resources are wasted. It also provides training and develop managerial skills more shared vision, system thinking and develop better understanding of complex problems. So individual and groups learn a lot in this artificial environment with experiments.

In past mangers took decisions on the basis of their experience so they provide consultancy services but now a days in Micro World models are developed and hypothesis are tested evaluated and implemented. To make the learning process more practicable and systematic Jhon D Sterman put emphasize on learning laboratories.

Stages for Effective Learning

There are three stages developed for effective learning.
1- Building mental models: explain and make assumptions through system models.
2- Challenging mental models: bring out the internal incompatibility of assumptions.
3- Improving mental models: test and extend mental models by time continuously.
It may take long period for effective learning. In the case study of Hanover Insurance Company issue was highly dynamic. The growing numbers of claims need more judicial proceedings. First Shared Model of the issue is developed with involvement of the top managers. Then a Simulation Model was developed named Claim Learning Laboratory. A session of three days was conducted to cure the issue. 100 managers were invited to participate in this session. System Thinking tools were introduced during this workshop and the consequences of system thinking is evaluated later via longitudinal inspections. That laboratory was a great training experience for managers. It helped to develop the principles of shared mental models, more experimentation and communication lead the managers to learn and solve issue effectively.

Components of Effective Micro World

There are three components of effective micro world.
1- Formulation of the concepts
2- Reflection
3- Computer

Formulation of the Concepts

Enough time must be spent for discussion session in which the core issue and problems must be discussed in detail. So that causal maps can be developed. An understanding about those causal maps must be developed in the minds of participants. After introduction of Simulation Model participants have a clear vision about the relationships among variables and their value in the model.
Reflection
Many managers are least interested to apply the same simulation in real world. They don't learn much in Virtual World from experiments or they don't willing to perform such practices in positive way. Good simulations always provide an opportunity to perform trials with multiple strategies. The difference between outcome and expectations allows the managers to re perform their subsequent practices with strategies. Computer is not a learning tool. Experimentation and reflection are key elements of effective learning. Computer provides the information and simplifies the process. In virtual world with the help of computer experiments are performed which provide the solution of real world problems after scientific testing.

Discussion

Learning laboratories have made the learning process deeper and faster but simulation must be integrated in learning laboratories so that the managers can test the hypothesis and reflect accordingly. Another name of learning is Feedback Process. We receive the information and responses from world and alter our ways of thinking (mental models) and change our decisions on the basis of that altered mental models to

achieve our goals. Our decisions are not only based on information feedback from real world but also mental models. (What we perceive about real world in our minds).

Conclusion

For team learning, learning laboratories are becoming an essential tool for effective learning. Simulations help a lot to face the challenges of complex dynamic world and leads towards effective learning and training. It consumes less space, time and resources but results are dramatic. Simulation can only be effective and successful if it is strongly imbedded with learning laboratories. In complex systems barriers of learning have become a tough challenge for learning organizations. Recent studies have suggested tools like modeling, feedback presentation tools, structures, virtual world software and simulations which support the modeling phase of effective learning. As we use these tools frequently we will learn faster. In virtual world after modeling, certain assumptions are defined then hypotheses are tested. If the results show the significant impact then same practices (Experiments) are applied in real world problems. Thus fewer resources are on risk if companies learn through experimentations and virtual world simulations. Improvement programs like TQM must be strongly integrated with the corporate strategies so that they may support all the financial and non financial performance (Analog device inc. case study). Policy resistance can only be minimized if we have ability to expand our mental models and system thinking. The methodologies were used in these research work are case studies, interviews, surveys, and empirical studies.

Findings

The integration of Simulations, Learning Laboratories and experimentations has provided a new avenue to learning organizations. These techniques not only provide effective learning but also have made learning process faster and deeper. These modern approaches are now used by many educational institutions and corporations. First in experimentation the hypotheses is tested and then result are beneficial same action plan is implemented in real world. It is not lack of resources, information and technical knowhow that cause policy resistance but wrong perceptions of systems, incapability to learn in complex world are the basic reasons.

Recommendations

The shortcoming in the experimentation and virtual world simulations must be overcome by the managers so that when they implement the practices in the real world, they face minimum problems. The external factors that are uncontrollable by the managers must be kept into

mind while modeling and testing hypothesis in micro world in this way the success of learning laboratories can be secured.

Criticism

Jhon D Sterman has focused more on simulations and virtual world experimentations that is practiced in controlled environment. But in real world there are number of factors that are uncontrollable. To apply these practices in real environment is not possible due to presence of some external factors. The environment of learning laboratory is completely different from real world scenario. In this way where virtual world looks so beneficial for the learning organization at the same time there are some external factors which are beyond the control of the organizations to implement the same practices in real world. As concerned to policy resistance Jhon D Sterman focused on perceptions about systems and learning capability in complex systems. He overlooked the importance of resources, information and technical knowhow.

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