TRANSFERRING SYSTEMS THINKING AND CIRCUMSCRIBING PROBLEMS: A CASE STUDY

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ABSTRACT

This paper is a case study on the introduction of systems thinking tools into a research group within a large information services company. The central dynamic involved in this learning process was a continuous goal shift. We address the realities of trying to develop a shared dynamic problem definition, and show how would-be practitioners internalize the material in unexpected and often paradoxical ways.

The diffusion of systems thinking in an organization is a slow and challenging process. The issues raised in this paper relate to a real world situation, which required unusual flexibility in the choice and application of learning tools. In addition there was a continuous, client-driven shifting of direction of the project. We found that systems thinking can be applied simultaneously not only to the goals and the process within a project, but also to the process of defining the project itself.

We found that the systems thinking approach enabled us to continuously refine the problem definition without providing any resolution at all - which increased tension for all team members. And yet, the approach continued to promote team interest in systems thinking as a valid means to address problems.

THE PROBLEM

The diffusion of systems thinking in an organization is a slow and challenging process. We present a case of systems thinking and system dynamics transfer into an organization which was championed by one group in the organization as a way to influence the development of new change management consulting methodologies.

INTRODUCTION

This paper is a case study about the introduction of systems thinking tools into a research group within a large information services company. The central dynamic involved in this learning process was a continuous goal shift. In this paper we address the realities of trying to develop a shared dynamic problem definition in a real world situation. We also show how would-be practitioners (both consultant and client) internalize and apply system dynamics in unexpected and often paradoxical ways.

The diffusion of systems thinking in an organization is a slow and challenging process. The issues raised in this paper relate to a real world situation, which required unusual flexibility in the choice and application of learning tools. In addition there was a continuous, client-driven shifting of direction of the project. We found that systems thinking can be applied simultaneously not only to the goals and the process within a project, but also to the process of defining the project itself.

We were looking for a project which would allow us the opportunity to quantify soft variables. At the time, the problem appeared to be extremely challenging. It was. It still is. We found that soft variables should not be measured by hard variable standards. Instead, they can be used for theory exploration.

In the first part of the paper we describe our case "The Shifting Sands of Time": the situation, the players and the goals. In the second part of the paper we describe the learning which we derived from our experience.

THE SHIFTING SANDS OF TIME

This case came about through a graduate field project in system dynamics led by Professor John Sterman at the Massachusetts Institute of Technology. We were given an outline and a contact name at our organization. The first task of our project was to identify the participants in our case. Figure 1 lists the participants and contains a description of who they are and the relationships between them.

Consultants	The authors, MIT graduate students.
Research Group	Located in Massachusetts.
	A group who reviewed new technologies and assessed their applicability to the management group Technologies which were reviewed were selected in one of two ways (i) in response to solving a specific request from the management group or (ii) identified through exploration and association with local universities.
	The survival of this group is dependent upon continued funding from the management group.
Management Group	Located out of state.
	Small group who were looking to develop a new methodology for solving integrated management problems of their clients through the alignment of information systems, strategy and employees. The goal of this group is to maximize revenues.

Figure 1 : Players

In accordance with the many players in this case we decided to identify the goals of each - what we found was that there were as many goals (if not more) as there were players. Figure 2 describes the goals of the players (ex post facto). At the outset of the case we were not aware of the Management Group's goal.

Consultants	To assist the research group in providing insight into potential applications of system dynamics in the information services company.
Research Group	To assist the management group in developing a consulting methodology to address integrated management problems for their clients and identify other applications of system dynamics relevant to the management group of the information services company.
Management Group	To develop a consulting methodology. The group had exhibited interest in systemic approaches given that their methodology required an alignment of soft issues and strategic considerations - combining these into a single framework.

Figure 2 : The Goals of the Players in the Case

The research group proposed a learning-by-example project and prescribed the application of systems thinking to a real life engagement with a complex client of the management group. We were in agreement with the research group that applying system dynamics to a real problem would provide insight into how the tools could be of value to the management group - in this as well as in other projects.

As consultants we invested time to gain an understanding of the real life problem, the client's business, market and the problem definition and project scope

agreed to by the management group. At this stage we had a lot of difficulty in getting data as we were working on data which had been through a series of filters before it reached us.

Our ignorance of the real life project led us into design a system dynamics education. Our objective in doing so was to try to force the data and problem definitions we were getting from the research and management group into dynamic formats.

We spent the first phase of our education transferring the tools of causal loop diagramming only - this worked well. However, when we tried to apply causal loop mapping to the client's problem we were unsuccessful. It became apparent that the relationship between the client and the management group was not as strong as we had at first assumed. This led us, in future sessions to use dynamic stories closely linked to the participants' frame of reference to stimulate effective learning from causal diagramming.

We were under pressure to furnish Professor Sterman with progress reports which were intended to demonstrate that we were helping our clients and that our own understanding of the application of system dynamics was increasing. This requirement was a powerful incentive to use the tools provided to us through our introductory System Dynamics course to analyze our own pressing dynamic problem.

The causal loop we drew to analyze our situation can be found in Figure 3. Our learning from the consulting assignment as a dynamic hypothesis follows the diagram.
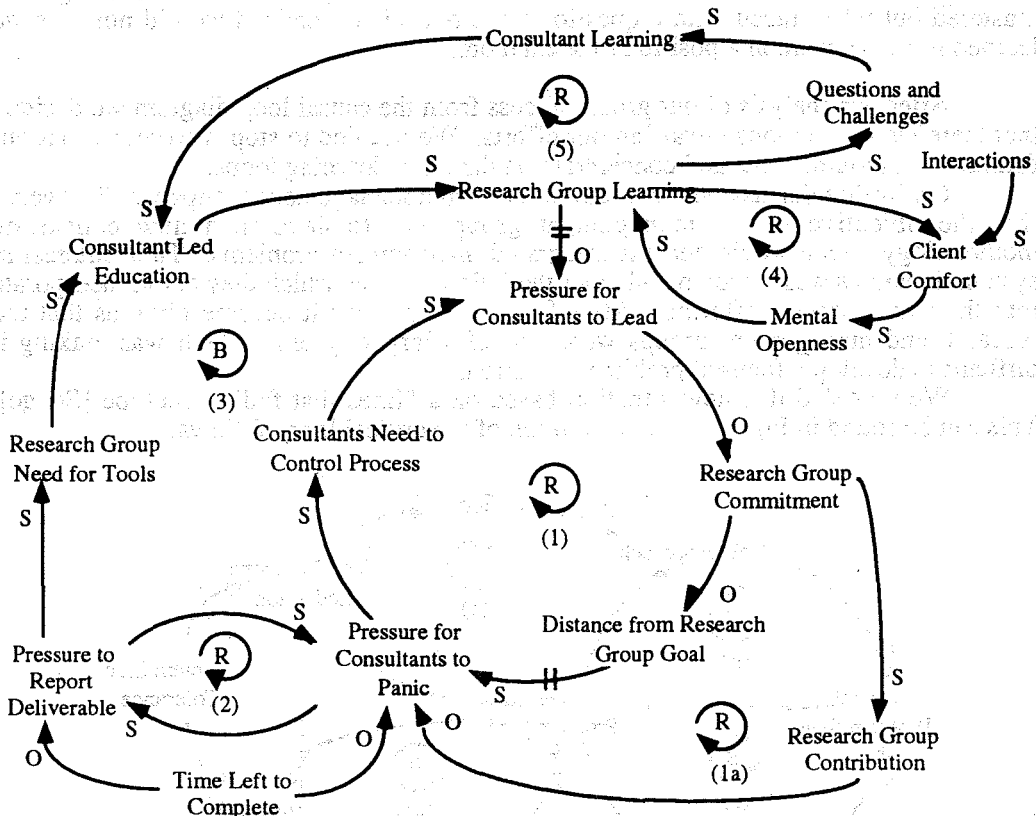

Figure 3 : Group Process Loop

Loop 1 and 1(a) - The Misdirected Loop : The more we led the process, the less our client was committed to the project. As we realized that the distance from the goal had increased, we faced an increased level of anxiety/panic **and felt an increased**

need to control the process. There is a time delay between the increase in the distance from our goal and our panic level. As the level of commitment from the research and management groups declined, we were getting less contribution from them. This further increased our level of panic.

Loop 2 - The Panic Loop : The increased pressure to define a report deliverable was fueled by our level of panic and the time left until the project delivery date.

Loop 3 - The Education Loop : The pressure to define a report deliverable relevant to our class led us to educate our client. This made us realize that the research and management groups needed tools in order to understand how systems dynamics could be helpful to them. The more education we provided, the more our client understood systems dynamics and its applications, the less we had to lead the process. This feedback had a significant delay.

Loop 4 - The Familiarity Loop : As the number of interactions between the research and management groups and the consultants increased, as well as the research and management groups' level of understanding of systems dynamics, the research and management groups became more comfortable with us. This had a positive effect on our client's mental openness, enhancing the learning.

Loop 5 - The Socratic Loop : As we provided the research and management groups with more education, their level of understanding increased. Consequently, the amount and level of questions they asked rose. This challenged our knowledge and enhanced our learning as we made an effort to understand points which we thought we mastered but when faced with a question from our client, realized we did not. As we learned more we were in a position to teach more.

After our analysis of our group process from the causal loop diagram we decided that there were two loops thwarting our efforts. We decided to stop worrying about our formal class requirements and concentrate on the client learning loops.

On further discussions with the research and management groups we discovered that the objective of the management group was to develop a new consulting methodology which would address integrated management problems. Their interest in system dynamics was driven by whether the field had tools which they could incorporate into their new service offering. After further discussions it became obvious that the research and management groups were part of a larger system, which was making it difficult to develop a focused problem definition.

We modeled this new situation based on a "fixes that fail" archetype [Senge]. This can be found in Figure 4. A description of the critical loops follows.
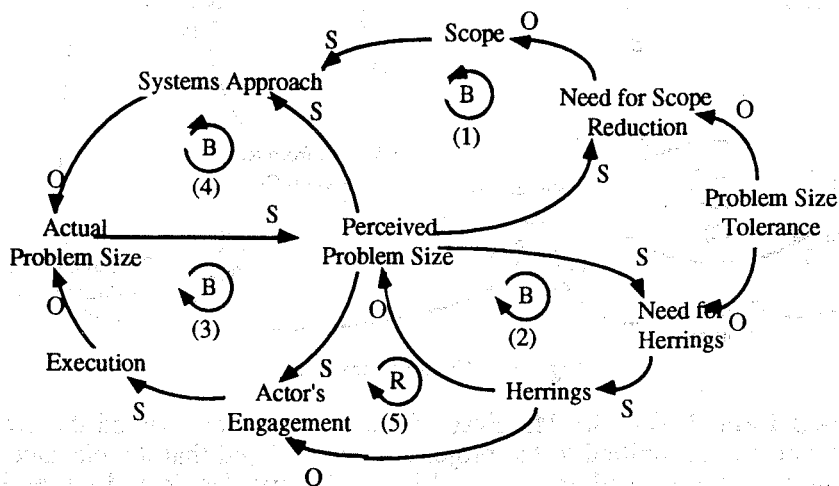
Figure 4 : Fixes that Fail : Problem Definition

    Loop One - Problem Definition : When problem size increases the need to reduce the scope increases which reduces the actual scope of the problem. When the scope of the problem increases, the need to use a systems approach to solve it also increases. A systems approach reduces the actual problem size as well as the perceived problem size. This neutralizes the need for scope reduction..

    Loop Two - Diversion Loop : As the perceived problem size increases the need to use diversions increases (referred to as herrings which we believe adds to self sealing behavior - no pun intended). The more herrings, the less the actors are engaged to execute and work to reduce the actual problem.

    Loop Three - Commit and Act Loop : As the perceived problem size increases, the actor's engagement also increases. This leads to action, execution which decreases the actual problem size. This will drive down the perceived problem size.

    Loop Four - Normative Loop : As the perceived problem size increases, the need to use a systems approach to attack the problem grows due to the increased complexity of the problem. The consequence is a reduction or a solution of the actual problem size which directly reduces the perceived problem size (which leads to a reduction in the need to further use systems approach).

    Loop Five - Diversion Results Loop : As the perceived problem size increases, the need for herrings increases. The increase in herrings reduces the active engagement of the actors - who execute less - driving up the actual problem size. What in effect happens is that the real or actual problem is not addressed by the executions driven by the diversions or herrings.

    This process yielded enough learning for the client to formally introduce systems thinking as a consulting tool within the organization. We were then invited to present the principles, tools, and conclusions from our work to the leader of the management group. What then became apparent to us was that we were part of a delicate negotiation. After the meeting with the leader we were able to use these tools to describe the dynamics of a short and localized dynamic. Figure 5 illustrates the dynamics of the negotiation during the meeting. A description of our learning from the meeting model follows.
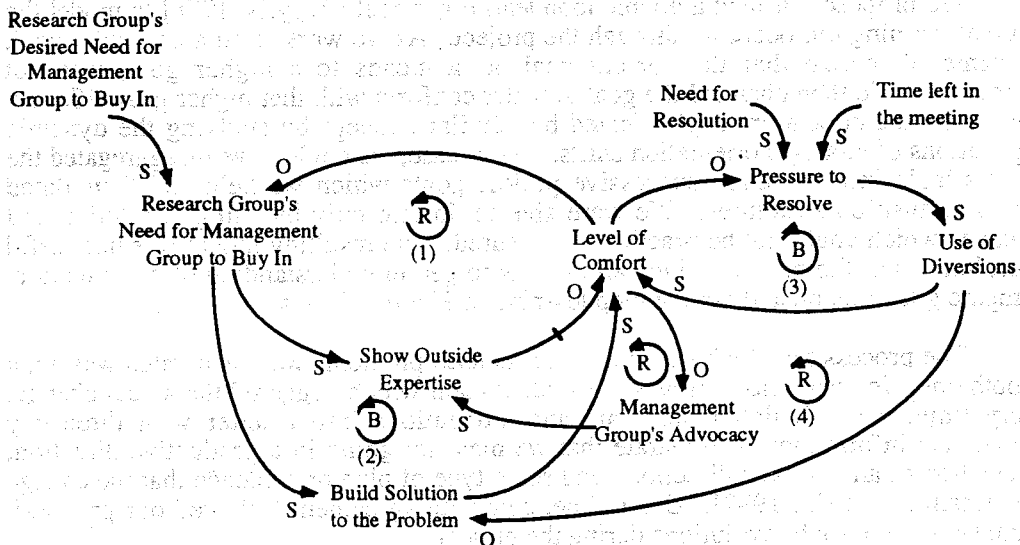

Figure 5 : Meeting Model

Loop 1 - Advocacy Loop : The management group has a desired level for finding tools to solve their problem (driven by the pressure which is mounting from their own management). The research group also has a desired level for the management group to buy-in to a solution - the more the management group changes its position and continues the search for a technology the more the research group finds it difficult to build a unified solution with them. The management group had a tendency to give more credibility to outside expertise. However, as the amount of demonstrated outside expertise increases, the management group's level of comfort paradoxically decreases, because of the realization that it takes time to learn new tools.

Loop 2 - Solution-building Loop : As the need for the management group's buy-in increases, they need to go through a process of building solutions to solve their problem. As the building of these solutions increase, the group's level of comfort increases as the problem situation is dissipated.

Loop 3 - Pressure Release Loop : As the level of comfort decreases, there is increasing pressure to resolve a problem. Tension and pressure builds up as the meeting progresses. As the pressure to resolve the problem rises, there is an increase in the propensity to use a diversion. While the diversion is a 'quick fix' or even a 'red herring' it, in the short term, increases the level of comfort. An increased use of diversions reduces the likelihood that solutions will be built over time to address the real problem.

Loop 4 - Advocacy Escalation Loop : When the level of comfort is high then the need for the management group to question (or the need for their advocacy) falls - the less they question, the less they drive the presentation of outside expertise.

ILLUSTRATING GOAL SHIFTING

One way of interpreting the steady drift of our project goal is to see it as a case of goal erosion [Senge, 1990]. Under the normal archetype, the goal is measurable and the erosion results from the fact that reaching the goal takes longer than the pressure to adjust the goal takes to grow. The goal variable is a unidimensional representation of a goal space, as opposed to the single-valued goal of a dieting instance of the archetype. Thus, we could think of a person who keeps changing musical instruments as the learning becomes too painful or time-consuming for any given instrument. However, the research and management teams did learn all through the process. The main goals were achieved: goal erosion was not an appropriate model.

We proposed instead a double loop learning model [Argyris, 1978] to model the fact that learning did occur all through the project. As we worked on a particular goal, we came to realize that the current goal, as a means to a higher goal, was not appropriate. We then changed the goal to better conform with that higher goal. [Sastry, 1992] has studied a more sophisticated but similar concept by studying the dynamic implications of strategic orientation shifts. In our case, we could have disaggregated the goal variable into the three successive project goals which we held and formulated specific transition structures. We were able to do that only by using attribution and variables which could not be practically measured. The resulting model was not useful to us, but it was the process which allowed us to get an understanding of our situation. Compare goal erosion and double loop learning in Figure 6 below.

The process by which new and more focused problems were generated was not a smooth one. In every case, it was the student team which triggered the actual change. Every time, we articulated our fears and attributions into a letter with three key paragraphs: information to illustrate that we may not going in a productive direction, proposition of an alternate direction, and some type of plan or evidence that the change was possible [Schein, 1987]. Every time, complete agreement followed our proposal. There were three such revolutions during the project.
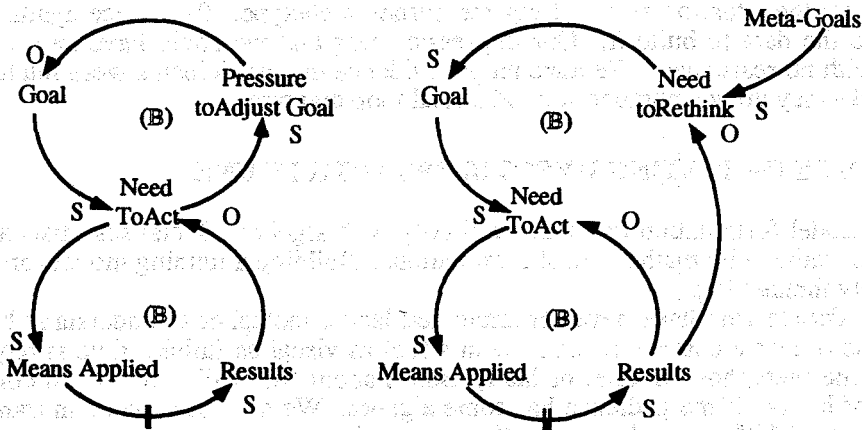
Figure 6 : Eroding Goals Archetype and Goal Shifting Structure

We managed the malaise which led to every one of them unilaterally. We would talk about our perceptions of the situation and about our discomfort. We only addressed the client when pressures reached high levels of threat. We did not test our hypothesis that the client would have agreed to any change. We did not explore the implication of such a hypothesis.

THE REALITIES OF DEVELOPING A SHARED PROBLEM DEFINITION

It was impossible for the clients to define a good problem when they did not even have classes of distinction for dynamic concepts. Their backgrounds of expertise in the social sciences and in particular with Chris Argyris' ideas did give them some intuition. They had little or no mathematical skills.

We thought that clients would not call upon us unless they knew what they wanted. As a consequence, we took their view of the world as a complete and true description of our task environment. Instead, we could have explored rapidly how they had built that view and understand to which degree they were familiar with systems concepts. A third of the time in the project could have been saved that way.

There is a tendency to look for the dynamic story in everything when operating in the system dynamics world. When it comes to a professional endeavor, however, the listening and responding to the client is more important than translating all their problems into dynamic representations.

From a professional point of view, transferring knowledge which cannot be translated into action may be ineffective. Yet, a lot of the knowledge required to do system dynamics does not lend itself to action. [Bakken, Gould, Kim, 1992] illustrate how it may be very difficult for people to apply the learning from a specific model to new domains with the same underlying structure. Practice may be what makes system dynamics knowledge operational. We did not have the time or the means to make a cost/benefit evaluation of our education.

Where does system dynamics stop and general consulting and advising begin?

The fact that we were not able to focus on a single problem is difficult to analyze without a complete picture of the organizational issues that our clients faced. Certainly, we drove the changes based on what we perceived to be the situation. We were tempted

to interpret the situation as a shifting-the-burden archetype. But, once again, we did not have the data to build it. Our impression was that we could have kept changing topics with no resistance. We have ample evidence that participants were intellectually involved - they drew a number of good causal loop diagrams.

THE PRICE OF TESTING HYPOTHESES WITH ITHINK

Model formulation requires familiarity with algebra. Social scientists are often not comfortable with mathematical formulations. Building a running model can become extremely threatening.

People who have never programmed lack a metaphor to understand how their programs run on a computer. Even with a tool as visual as Ithink, time is required to build some metaphor. Sooner or later, issues about "dt" will surface and consume a couple of hours, if the audience has some algebra. We did not succeed in transferring the concept of "dt" to people without that preparation.

Models built to test theories cannot gain much from accurate data. In fact, the need to quantify everything complicates the process of model development and brings forth a productivity issue. How much time are we ready to spend for a given amount of insight? Causal loop diagrams are by no means easy to master, but they are able to provide insight or shared models even when used improperly. Running models are much more demanding. We had to limit our help to describing how consultancies which use system dynamics use it.

CONCLUSION

Transferring systems thinking and causal loop diagrams triggered healthy learning loops. We found, however, that there were a series of pitfalls: relapses into short-term perspectives, underestimation of the time it takes to become proficient, day-to-day organizational realities, and limited quantitative skills.

In the short-term, the techniques we employed managed to transfer the basic tool-kit of systems thinking. We raised the level of interest and the commitment to continuing to develop systems thinking in the context of the company's consulting methodology. We found that the group had achieved an high level of understanding of issues that are very important to the dissemination and application of system dynamics.

In the long-term, however, it is not yet clear that the group has internalized the systems view - this has been evidenced by resorting to fixes that fail.

We found that the systems thinking approach enabled us to continuously refine the problem definition without providing any resolution at all - which increased tension for all team members. And yet, the approach continued to promote team interest in systems thinking as a valid means to address problems.

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