Building A Sustainable, In-house System Dynamics Capability

How an internal System Dynamics group can develop a distinctive service and become an enduring component of the company's operations

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Abstract

As consultants we have worked with our clients over many years to develop their in-house System Dynamics capabilities. Clearly, there are many advantages for our clients to continue the work with internal resources that we have often started.

Despite strong agreement by both consultants and clients on the benefits of developing an in house capability, these efforts generally last for only a few years. In only a small number of cases have they become self-sustained. Through review of our successes and failures we can draw some conclusions on what is necessary to create a sustainable in-house capability.

The four key forces that we have found influencing the long term sustainability of an in-house capability are: A) creating, maintaining and "advertising" the internal center of excellence; B) using specific value-added analyses in the regular business planning cycle or as part of the standard business processes; C) developing and maintaining an executive sponsor; and D) using external consultants to jump-start the process and periodically refresh the in-house capability.

Key Words
System Dynamics, in-house capability, case example, executive sponsorship, organizational dynamics

Introduction

This paper looks at the creation and evolution of centralized groups that use SD to provide strategic advice. The evolution of these groups is subject to complex dynamics, including: staffing changes, long learning curves, corporate perception of benefits realized from the work, struggle for resources, and competition with other internal analysts.

It is not uncommon that, after an excellent start, a decrease in executive and consulting support deteriorates the perception of the internal SD group and they start to lose visibility in the organization. Once this happens they are no longer included in the evaluation of key decisions by internal clients, instead division analysts take this role. The group then starts to lose talented people, and it becomes more difficult to find good talent in those uncertain circumstances. At this point the SD group either has an insignificant role in the organization, or is eliminated entirely.

However, our experience demonstrates it is possible to generate a high-quality, highly visible in-house SD group. Here we evaluate a few case studies while analyzing the supply and demand of a centralized SD capability, its enabling executive sponsorship, and the role of external consultants.

A. Building the Supply Side of an In-house SD Capability: creating, maintaining and "advertising" the internal center of excellence

Generating a center of excellence takes a lot of good work, but it is at least as important to project an image of excellence (see relevant dynamics in Figure 1). During the initial phase of deploying SD in house, it is relatively easy to develop positive perceptions from corporate commitment levels and the significant executive and consulting support. However, the typical reduction of executive and consulting support, after a highly visible initial phase of work, can generate significant deterioration of perception and send the group into a death spiral.
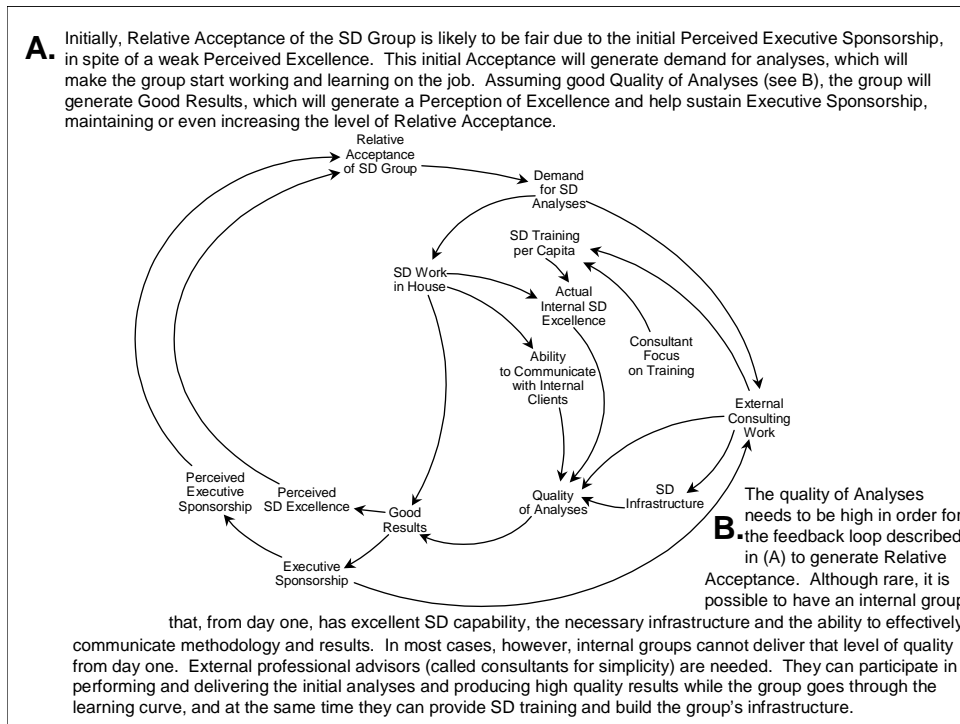

A. Initially, Relative Acceptance of the SD Group is likely to be fair due to the initial Perceived Executive Sponsorship, in spite of a weak Perceived Excellence. This initial Acceptance will generate demand for analyses, which will make the group start working and learning on the job. Assuming good Quality of Analyses (see B), the group will generate Good Results, which will generate a Perception of Excellence and help sustain Executive Sponsorship, maintaining or even increasing the level of Relative Acceptance.

B. The quality of Analyses needs to be high in order for the feedback loop described in (A) to generate Relative Acceptance. Although rare, it is possible to have an internal group that, from day one, has excellent SD capability, the necessary infrastructure and the ability to effectively communicate methodology and results. In most cases, however, internal groups cannot deliver that level of quality from day one. External professional advisors (called consultants for simplicity) are needed. They can participate in performing and delivering the initial analyses and producing high quality results while the group goes through the learning curve, and at the same time they can provide SD training and build the group's infrastructure.

Figure 1: Cause and Effect Relationships that Impact the Center of Excellence

It is important to have a clear capability development plan that establishes milestones and focuses the effort to quickly acquire the necessary skills for the group to start to generate good analyses that result in 'wins' for the sponsoring executives. Consultants are important to jump start the process by building the infrastructure (an example is shown in Figure 2), explaining basic concepts, and providing on the job training to develop technical and consulting skills.
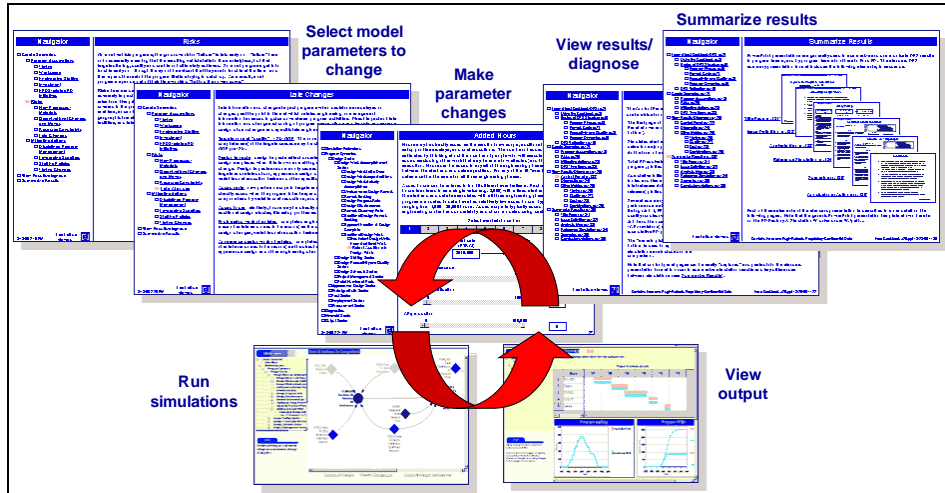

Figure 2: Example of Infrastructure (models, interfaces, help/instructions, frameworks) for an In-house Group

If this initial capability is effectively put in place through systematic training programs and technology transfer (see example in Figure 3), the image of center of excellence activates another self-reinforcing dynamic, that of acquiring talented staff. One example of this occurs at GE Jet Engine in their Office of the Chief Engineer (OCE). The OCE is staffed by the most capable engineers in the company. They are called in to projects for the most serious (and interesting) technical challenges. While other engineers learn something while working with the OCE (indeed, this is a primary purpose of the institution), OCE members learn much more. Engineers compete to be transferred into the OCE and only the best are accepted. OCE staff talent is developed faster in this group because they are working on the most challenging projects. When projects draw these talented OCE people into new challenges a virtuous cycle develops.
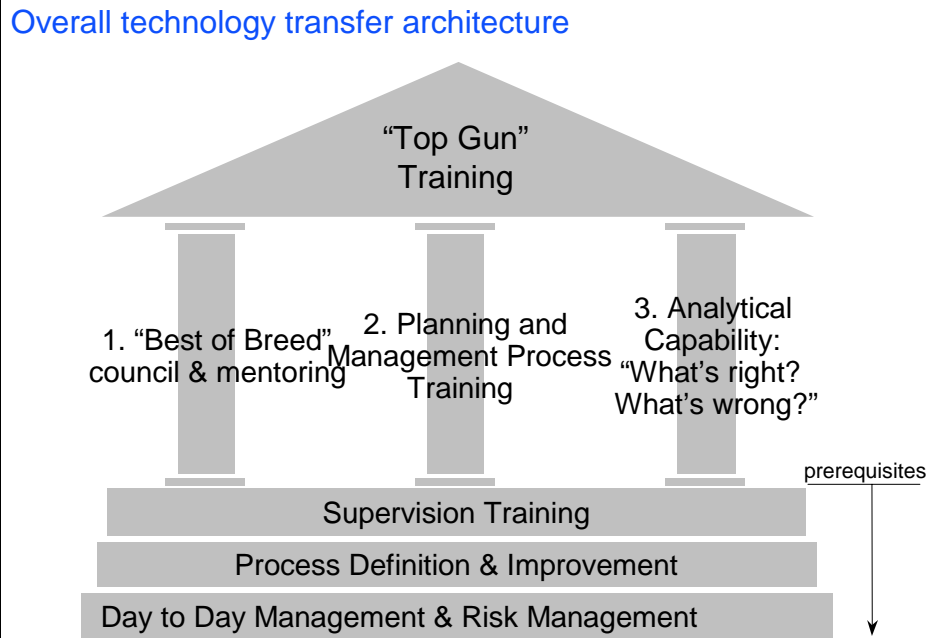
Figure 3: Example Architecture for a Center of Excellence

From the GE example, we can infer at least three ways competency can be lost: 1) through staff turnover; 2) by not attracting the best staff; and 3) by not focusing good people on challenging issues. We have seen examples of each of these in our work. Typically, a company will assign people to work with us to take the analytical capability in-house. It is risky to entrust this expertise to only one or two individuals because losing one of them can have a tremendous impact. However, it is not good to settle for "middle-of-the-road" staff because development potential is limited and they often cannot operate effectively without the supervision of external consultants. By contrast, at two of our specific clients, Airbus and Northrop Grumman, modeling was seized upon by highly competent individuals who made it a major part of their professional activity, for many years (Lyneis, 1998). Whoever works with the models must combine:

1. a technical capability for using, and diagnosing model behavior; and
2. a consulting capability for identifying critical business problems, seeing that they are solved, and taking the solutions back into the business.

These capabilities can either reside in one person, or in different members of the team (see talent dynamics in Figure 4). It is ideal, but not necessary for success, for the group to develop the capability to also calibrate models, add new model structure, and ultimately, create their own models.
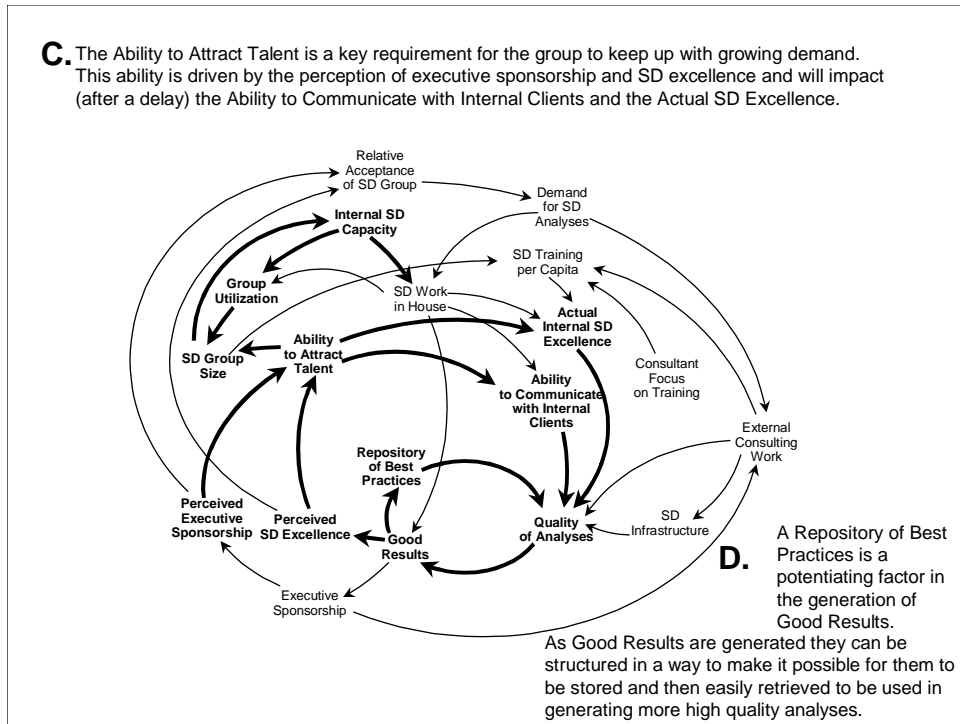
Figure 4: Talent Dynamics and Creating a Repository of Best Practices

At Hughes (now Raytheon) we achieved recognition for developing a best-practices repository (see impact of best-practices repository in Figure 4). Beyond the value of the immediate lessons from the cross-program simulation analyses, the focus of the work was to develop a system that would continue to support rigorous management improvement and lesson transfer (Els, 1997). At the project's inception, we envisioned a system that would help managers learn not only by analyzing past program performance, but also by testing strategies on current and upcoming programs. Figure 5 describes this continuous process of: 1) analyzing what has worked on past programs, 2) learning from this and disseminating the knowledge, 3) using these lessons on ongoing programs, and 4) finding new practices and approaches that will help future program performance.
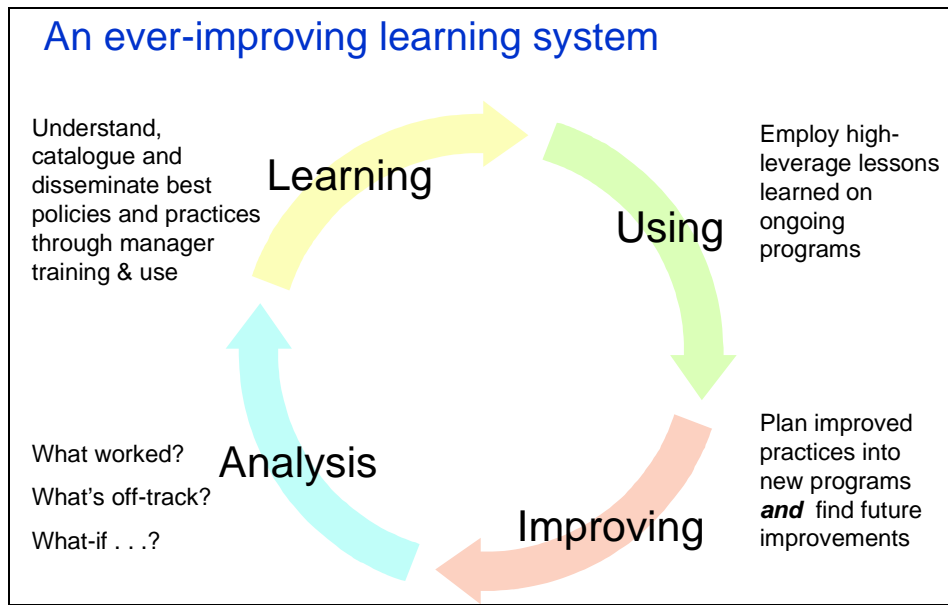
An ever-improving learning system

Understand, catalogue and disseminate best policies and practices through manager training & use

Learning

Using

Employ high-leverage lessons learned on ongoing programs

Plan improved practices into new programs *and* find future improvements

Improving

Analysis

What worked?

What's off-track?

What-if . . .?

Figure 5: The Key Component of Hughes' Program Management Learning System

Past programs were integrated into a single computer-based system accessible to all program managers. This system was linked to a data base of the "best practice" observations that could be searched by the users when considering what actions to take. Each manager could conduct a wide variety of "what if" analyses as new conditions emerged on a program. This interface drew upon one's own experience, the tested ideas from the other programs' managers, the "best practice" data base, and the extensive explanatory diagnostics from the simulation models.

In-house SD groups will frequently face internal competition for strategic analyses. The competition comes from other internal analysts who are associated with the specific operation or business unit (see other analysts dynamics in Figure 6). If the SD group is perceived as a center of excellence, other analysts will be eager to help the SD team and collectively offer better analysis capability. Other analysts can even join the central SD team, often improving the performance of the group, because these analysts have more business-specific knowledge. However, as there is always limited demand for analysis capability of any type, lacking the perception as a Center of Excellence quickly results in the team losing key pieces of work to the other analysts.
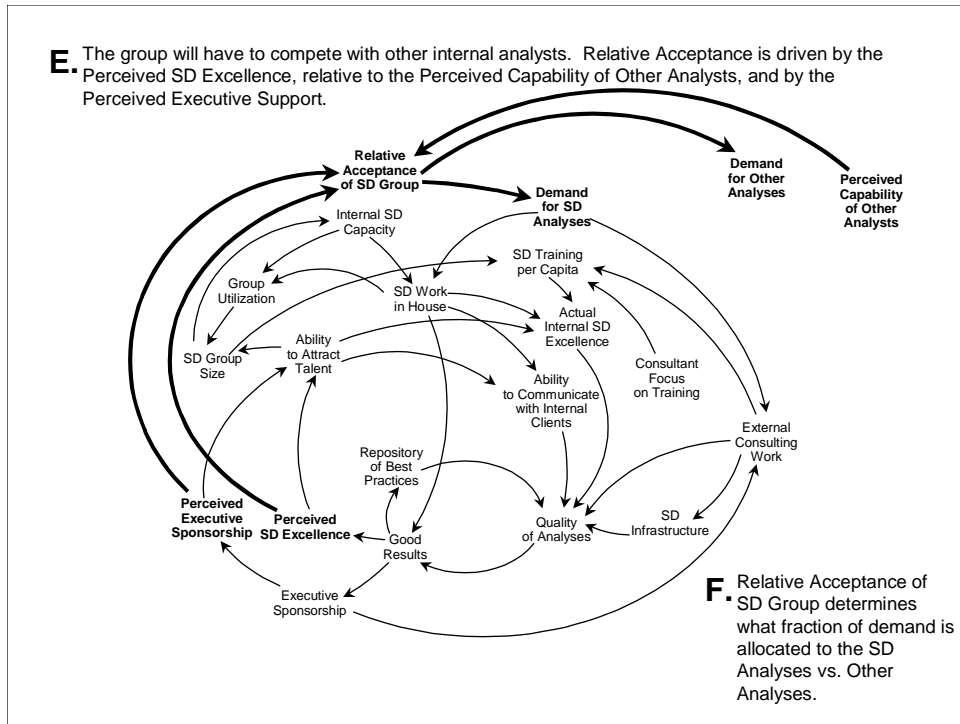
Figure 6: Interactions with Other Analysts

B. Creating Demand for SD by using specific value-added analyses as part of the standard business process

Typical internal SD groups suffer from a lack of demand for their services even while supply is ample. The major reason is organizational awareness acceptance, which can only be built in steps and with significant executive support (see Figure 7). At a major automotive manufacturer, System Dynamics started off with the issues of one vehicle development project and demonstrated the capability and its benefits to the project. Then the modelers worked with a few more projects, demonstrating consistent usefulness. Next they analyzed a portfolio of projects, even while single-project analysis became a virtually required part of the development process. Customer knowledge and acceptance grew with each step.
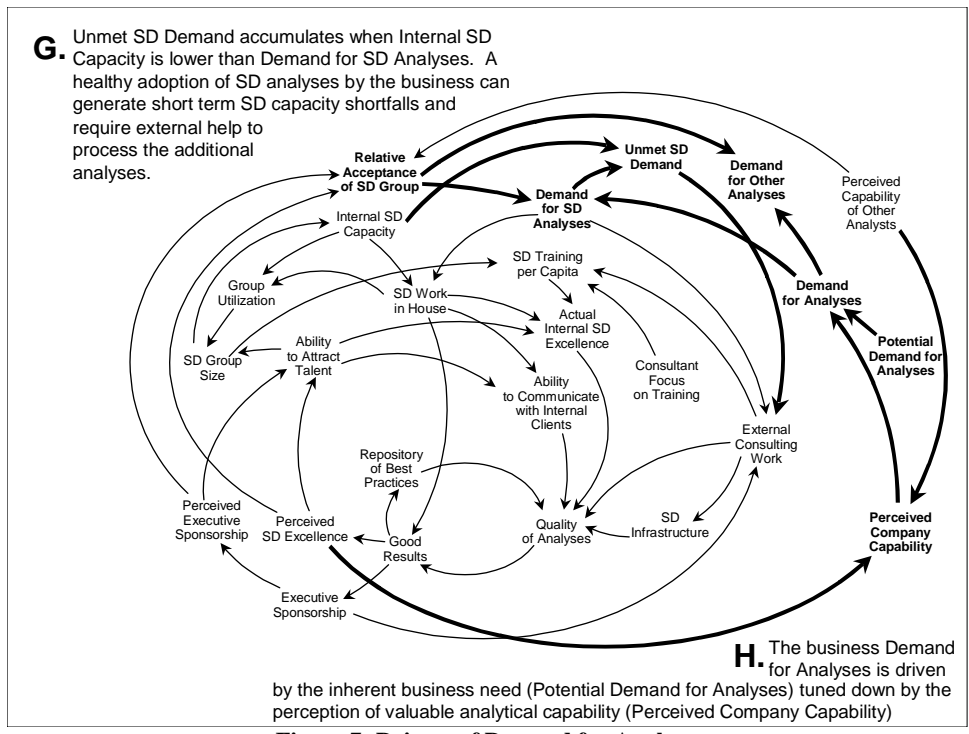
Figure 7: Drivers of Demand for Analyses

The "customers" for analysis are both down in the operations of the organization and up in the executive ranks. The analyses help solve the problems of individual stakeholders, which are usually also problems of the corporate management as well. For example, at Bath Iron Works, model analyses are now part of the corporate management process. Management meets to review the programs in the shipyard, which generates requests for model analyses. The results are then reported in the next management meeting and additional analysis demand is generated.

We can speculate that regular to model use during periodic management meetings at Bath Iron Works has much to do with its acceptance. There are no longer questions about what the models do, when they can or should be used, and at this point, what sorts of questions they are well suited to answer. Therefore, it is important to start with a reduced scope and a lot of focus. This creates stakeholders, familiar with the process and pleased by the results. This nascent reputation allows the purse strings to loosen for somewhat broader application, addressing the issues for a wider group of stakeholders. Throughout this process it is key to clearly communicate what the group does and what problems it can analyze. An additional way to develop demand, described in Figure 8, is for the group to be an integral part of the company operations (e.g. adding consistency to the yearly planning process, or providing feedback on each major project milestone).
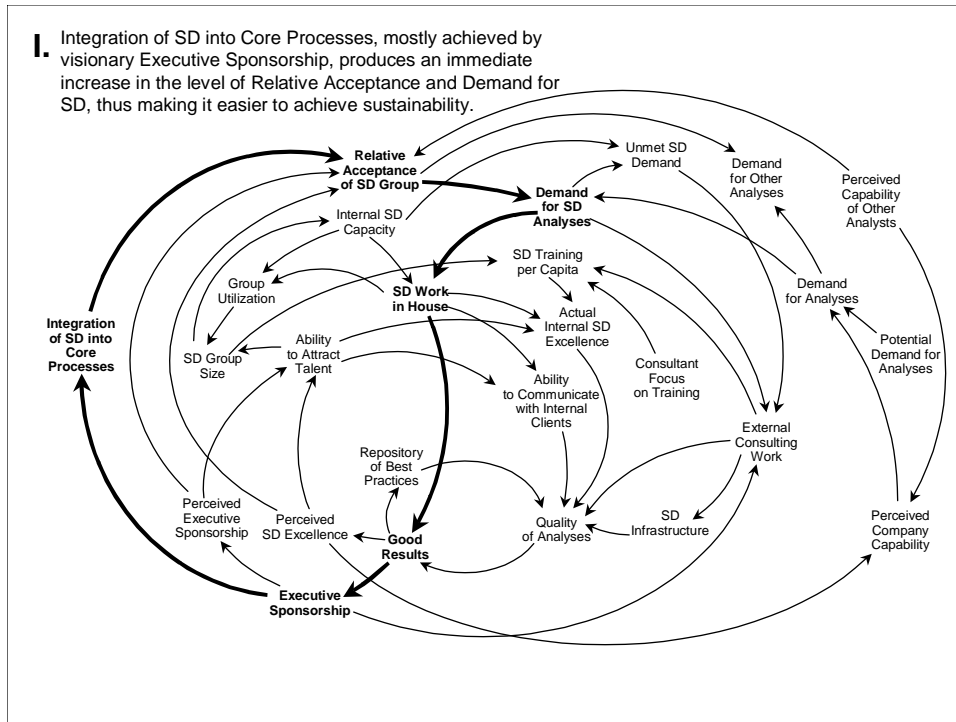
I. Integration of SD into Core Processes, mostly achieved by visionary Executive Sponsorship, produces an immediate increase in the level of Relative Acceptance and Demand for SD, thus making it easier to achieve sustainability.

Figure 8: Integration of SD into Core Business Processes

Another way to generate demand is to continually deliver value; continuously producing analyses and extensively communicating their results do this. This generates other beneficial effects like improving the SD capability (i.e., speeding up the learning curve), reinforcing executive support, and spreading the image of the group as a valuable resource and center of excellence.

C. Executive Sponsorship: developing and maintaining an executive sponsor

Initially, the executive sponsor is the driver for the success of the initiative (see Figure 9). They provide the budget for the SD group, hire the consultants, and promote the capability throughout the organization making it possible to recruit high quality individuals and to find opportunities and collaboration for initial analyses. The executive sponsor should also drive the integration of the SD capability into the business processes of the company. Without the continuous enthusiastic support of the sponsoring executive, the group is unlikely to survive.
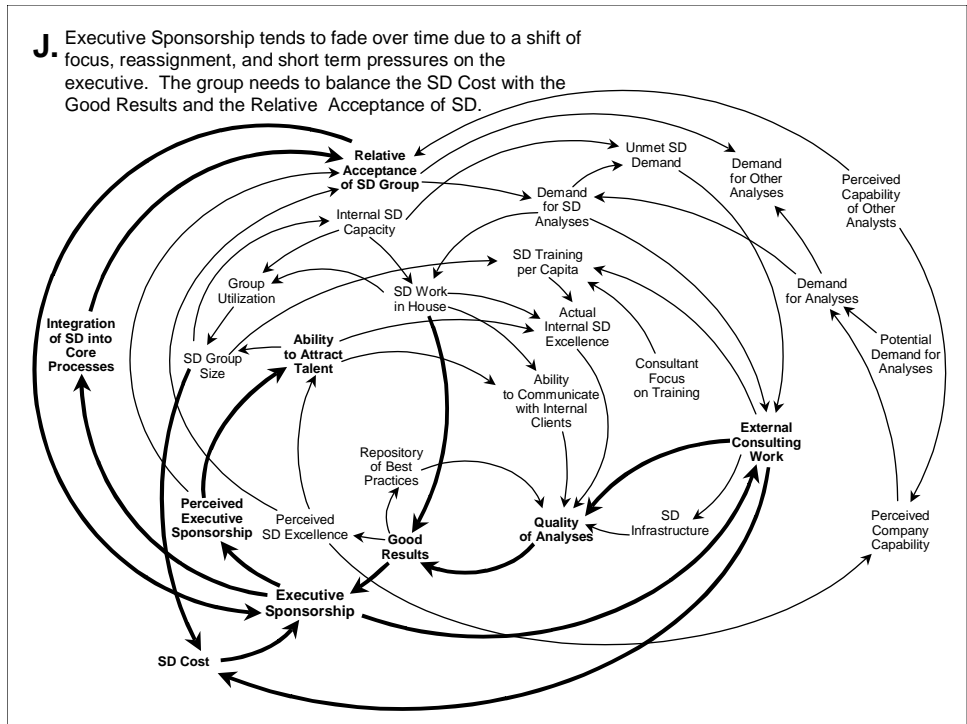
J. Executive Sponsorship tends to fade over time due to a shift of focus, reassignment, and short term pressures on the executive. The group needs to balance the SD Cost with the Good Results and the Relative Acceptance of SD.

Figure 9: Importance of Executive Sponsorship

After this initial phase, the internal group should not lose touch with the executive sponsor, in fact the group must sometimes guide the executive sponsor's participation and role. The added value of the group's services must clearly outweigh the group's costs while providing personal wins for the sponsor. This needs to happen before the sponsor's attention is driven away by new, more pressing issues, or before they step into a new role altogether.

D. Consulting services: using external consultants to jump-start the process and, when necessary, refresh the in-house capability

External consultants are key to jump-starting the in-house capability by providing necessary infrastructure and training. However, it is important to plan for the group to be self-sufficient after the initial development phase. Even if there is a commitment for long term use of external consulting services, there is always a risk that cost pressure will delay or cancel the request for consultants (see Figure 10).
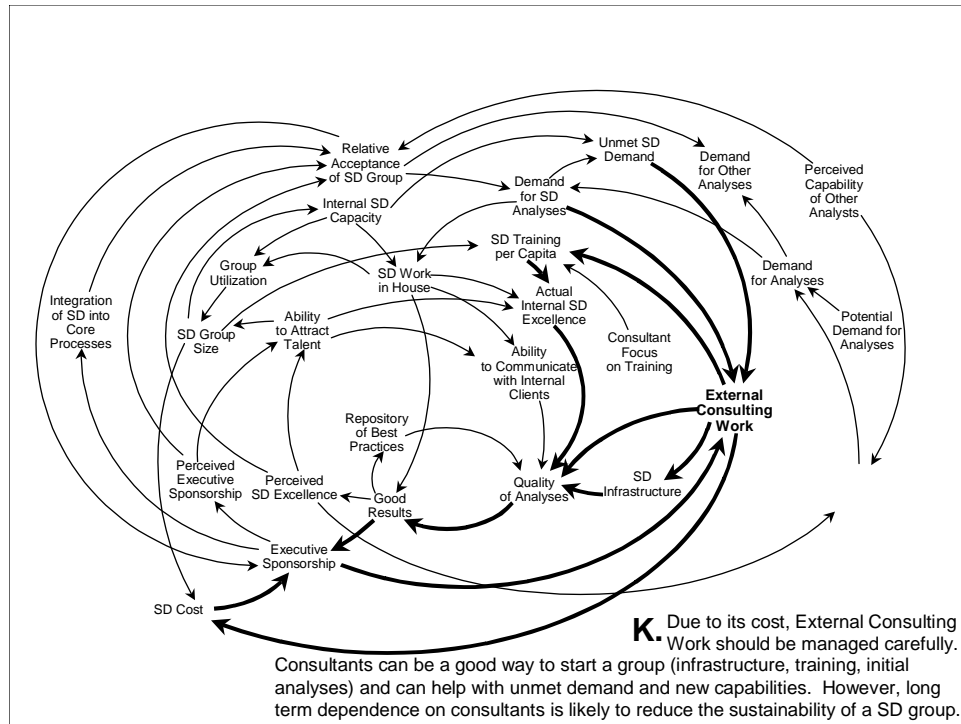
Figure 10: Role of External Consultants

In addition, it is often useful to keep consultants "on-call" and bring them in when help is needed with complex analyses, to process a large backlog of analysis requests, and to re-energize the group periodically through further training and reviewing of best practices.

Conclusions

Once all the individual dynamics at work are well understood, there remains one key question: *Which loop is dominant?* And, taking it one step further, *What can we do to accelerate virtuous cycles and prevent potential dead ends?*

At the highest level, the problem can be characterized as a race against time: Can a company embed SD into its core decision-making processes before losing executive sponsorship? In today's corporate world, executives rotate in and out of their jobs nearly every two years, and more often than not, the disruption caused by the transition will deal a mortal blow to any non-self-supporting initiative the executive was sponsoring.

In System Dynamics terms, several reinforcing feedback loops are competing for dominance: the slow reinforcing process of building a perception of excellence and building value delivered, supported by initial executive sponsorship is fighting against organizational inertia (or outright resistance) and also fighting against the perennial corporate pressures to dedicate precious resources to the most worthwhile endeavors (see Figure 11).
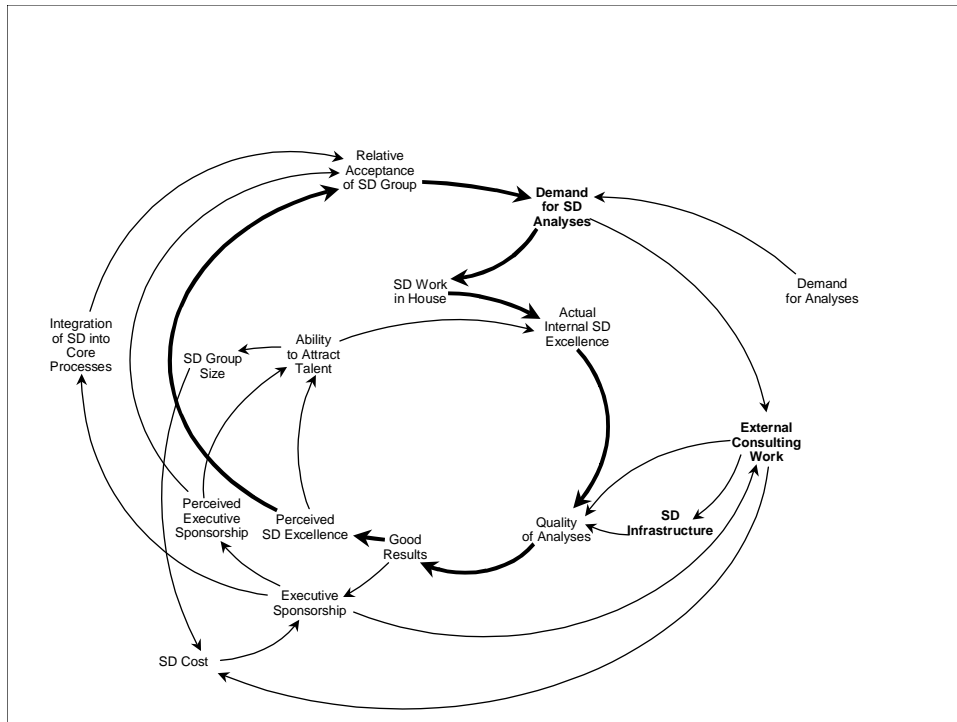
Figure 11: Interrelations

In the short term, the high, perceived cost of using external consultants to build a new internal capability is offset by the enormous potential of the capability and by the high value of the analyses being delivered. In the early stages, consultants "open the executives' eyes" to a new methodology, to new possibilities, and to new counter-intuitive answers. The "low-hanging fruit" is harvested, the most egregious policy errors are pointed out, and there is generally a perception that a lot of value is being discovered. The sponsoring executives are enthusiastic about the results, and they pressure the organization to make good use of the developing SD capability.

Because of the enormous structural inertia of corporations, initial acceptance of SD among middle and lower management is typically low. The new capability is seen as unproven (risky!), or even threatening. Thus, executive sponsorship is crucial in the early stages to overcome corporate inertia and generate demand for SD analyses, thus fostering the virtuous cycle of developing a strong internal SD capability.

Likewise, this perception of riskiness makes it difficult to attract the best talent, and only a perception of strong executive sponsorship can overcome this resistance.

After the initial push, the focus of the sponsoring executives often shifts from finding answers to fixing the problem. Their attention on doing further analyses sometimes dwindles while more and more effort is focused on using analysis insights to change the organization. In one sentence: the focus shifts from insight to implementation; from potential to money in the bank.

The likelihood of losing direct executive sponsorship is very high in this financial climate. The only guarantee for success now is to have achieved a significant acceptance of SD among management ranks. Producing a steady demand for analyses and ensuring that they are acted upon can facilitate this. Thus, the key lies in drastically accelerating the virtuous cycle of developing excellence and achieving acceptance, and we have one leverage point to do this: embedding SD into company processes. (Lyneis, 1999)

This has probably been the most neglected aspect of System Dynamics consulting, and yet it is the one critical for the long-term survival of System Dynamics as a valued analysis tool within client organizations. Too much group effort is typically spent on developing the *staff* capability, and not enough is spent on building the infrastructure that will ensure that the rest of the organization has quick and easy access to the group's work.

In conclusion, making System Dynamics a permanent in-house capability is difficult but can be improved through:
- Managing and fostering both the internal supply and demand for the capability
- Generating enough value to satisfy the internal clients, while providing personal wins for the sponsoring executive.
- Integrating the capability in the broader company processes
- Using external consultants to ensure the quality of the analyses (e.g., due to high demand or complexity), or to re-energize the group and reactivate the positive dynamics of attraction of talent and perception of excellence.

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Appendix A: Potential threats to a long term in-house team and their mitigation

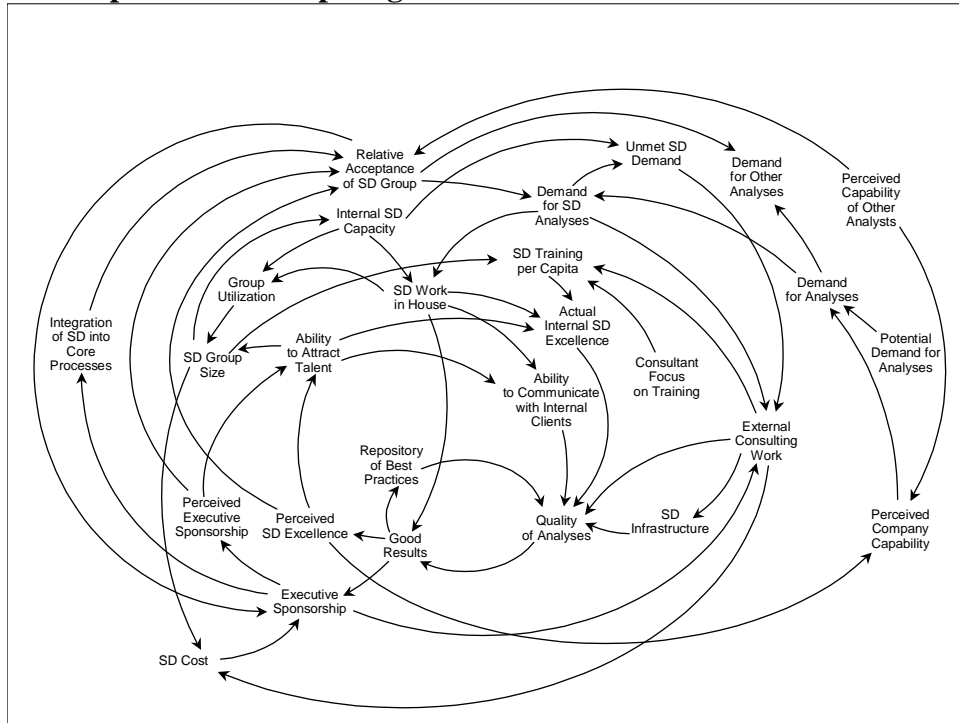| Threat	Mitigation
Effects of a long learning curve	Should be factored in for training/turnover management
Low competency System Dynamics individuals in team roles	Avoid by always making sure that being part of the team offers an opportunity for having significant visibility working on high profile activities and building valuable personal knowledge, relationships and awareness of top business issues
Rapid churn / turnover (star-like quality individuals move relatively quickly to new opportunities)	This should be planned for by identifying potential replacement internal consultants and developing a few technical users
Paralysis Unwillingness to present results until every model/scenario assumption is verified (i.e. never) due to increased responsibility in a new role which includes suggesting solutions to critical problems embedded in a significant amount of uncertainty	Address this problem directly through training and selection of individuals
Perceived as expendable initiative Easy-to-reduce cost / not necessary when management changes	If the use of a SD application has delivered clear value, helped prior participants with their career goals and was part of an important company process (not just driven by individuals), this risk should not be present

Appendix B: Complete causal loop diagram

Relative Acceptance of SD Group · Unmet SD Demand · Demand for Other Analyses · Perceived Capability of Other Analysts · Internal SD Capacity · Demand for SD Analyses · SD Training per Capita · Demand for Analyses · Group Utilization · SD Work in House · Actual Internal SD Excellence · Integration of SD into Core Processes · Ability to Attract Talent · Consultant Focus on Training · Potential Demand for Analyses · SD Group Size · Ability to Communicate with Internal Clients · External Consulting Work · Repository of Best Practices · Perceived Executive Sponsorship · Perceived SD Excellence · Good Results · Quality of Analyses · SD Infrastructure · Perceived Company Capability · Executive Sponsorship · SD Cost

Appendix C: Typical Timeline of Support and Technology Transfer

	Months 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
External Experts																		
Initial Assignment	■	■	■	■														
Second Assignment					■	■	■	■										
Multi-User System Dev.									■	■	■	■						
On-going Support								■		■		■		■		■		
Internal SD Group																		
Lead user training			■	■	■	■	■	■										
Group Expansion					■	■	■					■	■					
Production of Analyses								■		■		■	■	■	■	■	■	
Org. Training													■		■		■	
Funding	■	■	■	■	■	■	■	■	■	■	■	■	■	■	▨	▨	▨	▨