STRATEGY MODELING FOR TOP MANAGEMENT:
Going Beyond Modeling Orthodoxy at Bell Canada*

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1. Summary

In 1997, Bell Canada faced two of the most significant challenges in its 117 year history. Beginning 1998, Bell would lose the last of its regulated monopolies, facing competition everywhere. Simultaneously, the global "sea change" in telecom technology accelerated. But Bell's internal organization and experience revolved around functional "silos," with little infrastructure for high-level cross-functional strategizing. To prepare for these challenges, we implemented a large-scale system dynamics (SD) simulation model of Bell and its business environment.

The widely taught and researched paradigm for SD modeling is incrementally developing a model from scratch, using a mixed team of modelers and stakeholders, iterating until the model results are satisfactory, and then publishing the results. The modeling context at Bell differed sharply from the situation more commonly addressed by recent SD literature: The target was thoroughly-validated strategic results, not insights. For a comprehensive model, many dozens of informants were needed, not a single team. The target users were top executives leading an urgent business transformation, not mid-level managers with time to spend participating in a model development team. Some results were needed very soon after the start, and frequently thereafter.

So the standard academic approach to using SD modeling was almost certain to fail. We therefor used a different approach to be able to use SD on this very important set of issues. We constructed, validated, and used models with what might be called a “team of teams” that eventually involved some 160 people. To deal with schedule constraints, we started from a pre-existing framework model and maintained two and sometimes three model versions, allowing us to respond quickly to analysis requests.

The first year of modeling work can be considered a moderate success, having confirmed the viability of the overall approach and taken a first pass through an ambitious set of goals. We did integrate knowledge from previously-disconnected silos in strategically critical areas, where information was missing from the standard functionally-based models and reporting systems. We found a roughly 30% improvement in cashflow-based company valuation between the most-discussed strategic options and a set of strategies identified through simulation analysis.

Although the model now integrates the knowledge we eventually drew from the functional silos, we have just begun to give managers that more integrated view. The themes of management involvement and education are expected to become more prominent going forward.

2. Bell Canada’s Strategic Setting

Incorporated in 1880, Bell Canada is Canada’s largest telecommunication services provider, serving about 7 million customers in the provinces of Ontario and Quebec. In 1997 Bell had

approximately 42,000 employees and earned $8.5 Billion in gross revenues. Historically, the Company's service prices had been set by the Canadian Radio-Television and Telecommunications Commission (CRTC) such that Bell would earn a prescribed rate of return on common equity investment. Inherent in this system, which operated well under monopoly supply conditions, was a huge subsidy from the long distance business, designed to keep the price of basic residential telephone services among the lowest in the world.

The introduction of long distance competition in 1992 began to put enormous pressure on both Bell and its regulatory regime. Bell's already widespread implementation of digital switching (95% compared to 65% in the US) made Bell's entire customer base accessible to 1+ dialing to competitor's networks. This, combined with Bell's relatively high regulated prices made the long distance market very attractive to competitive entrants, including AT&T and Sprint Canada. As a result Bell suffered market share loss at a faster rate than any other country to date. During this period, the asymmetric regulatory processes governing Bell vs. its competitors led to more competitive battles being waged in CRTC courtrooms than in the marketplace itself.

What followed was a five year legal process which would lead to a complete change in Bell's regulatory regime and a new set of public policies governing telecom competition in Canada. The new rules would 1) open up basic local service markets to competition, 2) ultimately deregulate long distance services, and 3) replace earnings-based regulation with price caps, or rate ceilings that would govern the maximum local service prices Bell could charge. Under price caps, Bell would be free to earn whatever it could but its earnings would no longer be guaranteed in any respect. The details of the new regime were to be announced 1 May 1997 and implemented effective 1 January 1998. Internally, Bell named the new era "Total Competition."

As of late 1996 the potential significance of, and uncertainties surrounding, the outcomes of Total Competition were unprecedented in Bell's 117 year history. What was certain was that the impacts would be company-wide in scope and that speed in assessing probable consequences and formulating sound strategic responses would be essential.

Ultimately, however, even the significance of the regulatory environment would be overshadowed by more fundamental changes in Bell's business. Driven by rapid technological developments and the demands of emerging markets Bell would soon face the challenge of transforming its entire network and product set from a voice-centric, circuit switched design to a data-centric, (Internet-like) packet switched, interactive multimedia capability for all customers. Planning and managing this transition would demand a level of sophistication and systemic thinking unprecedented in the industry.

Only one comprehensive model of Bell's business had existed previously, of which the second author (Walker) had been the last internal owner. It was a huge spreadsheet based model used during the Long Distance Competition regulatory proceedings of 1991. But the model had become unmaintainable, virtually dying under its own weight. (While not commonly cited in the literature as a benefit of the SD paradigm we note that the model we are about to describe is at least an order of magnitude smaller than its spreadsheet predecessors and, given the appropriate level of skill, is both maintainable and extensible at a reasonable resource cost.)

All other existing analysis tools within Bell were generally similar in design, and each focused solely on the needs of functional operating groups or Departments. These models, and hence planning, evolved in a stable, rate-of-return based, largely monopoly environment. They generally had a strong tradition of attention to detail and expected precision. Although critical for operating

the company, such models were not the tools to conduct top-down, integrated analyses of Bell's strategy for entering the new era.

In September 1996, Walker, recognizing the dynamic nature of the issue set facing the Bell, began to work with a team at Pugh-Roberts Associates to propose building a comprehensive System Dynamics (SD) model of Bell's new business environment. From the beginning, the focus (and the strongest selling point) of the effort was integrating, in one strategy-level analysis, the entire spectrum of markets, competitors, regulations, operations, and finances. No other modeling effort came close to this capability, and this capability was what Bell needed to protect itself during the turbulent times ahead. Work on the model began in January 1997, only four months from "Decision Day."

3. Modeling Total Competition

To provide direction and support for the modeling effort a Guidance Team was formed, consisting of Vice Presidential (Department Head) level representatives from across Bell. This team helped to focus initial efforts around four central questions…

- In the face of Total Competition, which customers will desert us, how fast, to whom and why? How will this affect financial performance and shareholder value?
- Under Total Competition, what factors & policies within Bell's control/influence will most favorably affect performance?
- What actions should Bell initiate right now?
- What outcomes should Bell seek from the CRTC during 1997?

Monthly meetings provided a forum for progress reports, work plans, and arranging for controversial or ambiguous issues to be addressed (elsewhere).

Dedicated Bell support for the modeling effort consisted only of the second author and one support manager. As a consequence all of the initial modeling efforts were delegated to the Pugh-Roberts team. Although the Guidance Team performed a valuable oversight role, it was the wrong forum for information-gathering and validation of model structure, behavior, and results. We used a "team of teams" for the latter tasks, consisting of many smaller *ad hoc* teams, ultimately reaching over 160 people who provided input data, subject matter knowledge and participated in various model review sessions around their particular area of expertise.

The overall design was for a model to start simulations in 1988. This timing would capture the earliest beginnings of long distance competition (resale and sharing) and move forward through the expected transition of 1998 to at least 2008. This would provide the opportunity for nine years of historical re-creation and a long enough future period to capture the full directional impacts of the impending industry changes. As well, the model would represent multiple products, market segments and competitors as illustrated in Figure 1.

By design, the model was to be limited to the "telephony business" as these products were the ones principally at issue in the impending changes. Data, image, and multimedia services, telephone sets, directories and other specialized offerings were excluded for the first set of analyses.

While scope was intentionally limited in terms of the modeled "lines of business," it was also clear that impacts from services and competitors outside the model's boundary could be important. This would happen, for example, through anticipated marketing strategies to package or "bundle" services such as wireless, internet access and broadcast television (via cable, satellite, or other

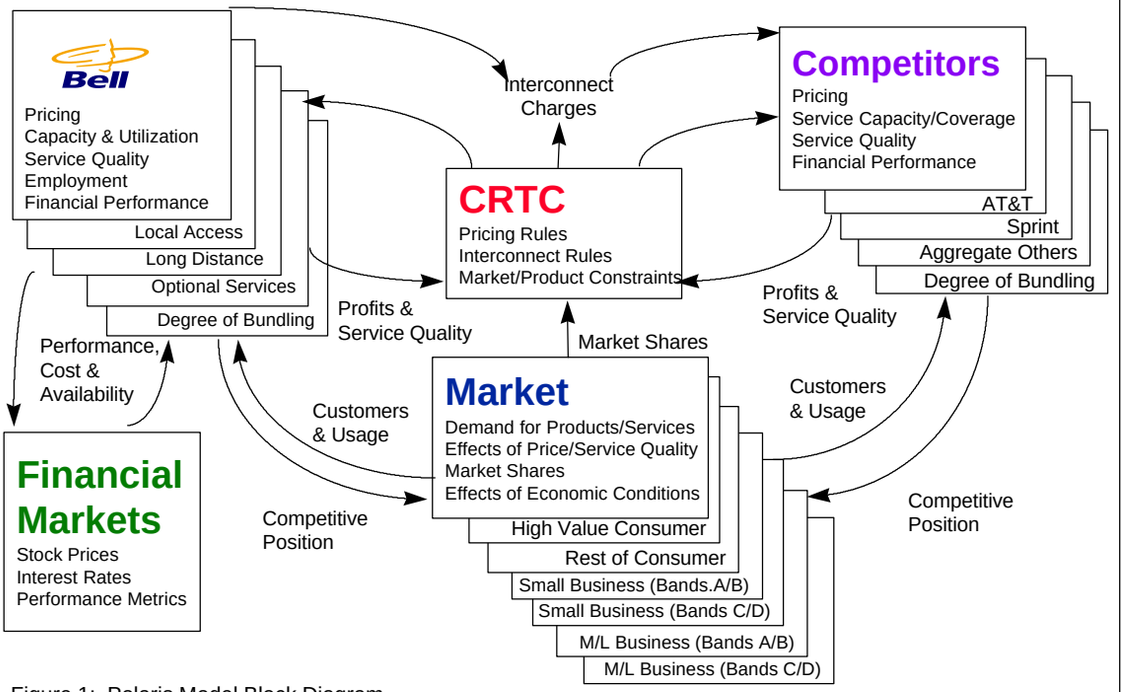

Figure 1: Polaris Model Block Diagram

means) with traditional telephony services. To accommodate this we would build in the market-influencing variables in lieu of the full business business dynamics of such services.

It was also clear that the expectations of internal stakeholders and decision makers would include unusually detailed and robust treatment of financial performance, both through traditional accounting-style statements and the more all-encompassing metrics such as cash flow and company valuation. As a result, the model would need both a full double-entry accounting system and an advanced cash flow valuation capability.

The description above should give a feeling for the scope and nature of the analysis task before us. As indicated in the summary, the modeling effort diverged substantially from the commonly-espoused "team learning" style. The remainder of this paper describes the reasons for this divergence, what we did instead, and what we learned in the process.

4. The "Team Modeling" Paradigm Breaks Down

Close collaboration is the commonly-held ideal for building and using System Dynamics models. The client is the user, and sees how their own data and mental models fold into the conclusions, so that the model is continuously validated. Jay Forrester may have added group modeling to the SD paradigm in 1968 by evolving his *Urban Dynamics* model through periodic meetings with a group of urban executives and stakeholders, including a former mayor of Boston.[1] Since then the process has been formalized and studied by researchers such as Vennix,[2] Andersen and Richardson,[3] and others. Team learning through model-based "Microworlds" has gained an enormous public recognition through Peter Senge's *The Fifth Discipline*.

But the modeling context at Bell differed sharply from the "team modeling" ideal:

- The ultimate clients were Senior Executives, including the COO—distant from the level of managers able and willing to devote many days to participative modeling. We certainly would have liked the top executives to have been SD enthusiasts from the start, but in most cases (including ours) that won't be true.

- The primary goals were obtaining strategic direction much more so than personal insight or growth. Although we are discussing use of the model in "wargaming" mode to help train middle management in the new competitive realities, the initial goal was preparing a counterattack in case of unexpectedly negative regulatory outcome.

- From the beginning, the issues were known to have extremely broad scope, not only cutting across functional silos of network operations, technology planning, finance, and marketing and sales, but also assessing competitors' capabilities and intentions, impact of new technologies and competitors in other markets, and public policy. Indeed, policy debate suffered from the classic "blind men and the elephant" syndrome, where the issues were so far apart that the discussion never really was able to tie them together. So the ideal of harmonizing the mental models of the entire executive team was a task at least an order of magnitude too large for us to tackle. Both executive time and calendar time were too short.

In brief, the widely-taught ideal of a single team of executive users interactively creating and applying a model seemed doomed to failure. Fortunately, other disciplines have evolved an alternative approach, which the next section describes.

5. Integrating the Stakeholders: A "Team of Teams"

Practitioners in the fields of strategy formation[4] and Total Quality Management[5] (and undoubtedly many others) have long had the problem of involving large numbers of people in serious intellectual tasks. The common solution can be called a "team of teams." Following this approach, we decomposed the problem into a series of group meetings with different participants. The participants varied from the COO down to mid-level subject matter experts, and from all the major functional "silos." We learned several lessons from this exercise.

Integration is Sorely Needed

One of the truly unique characteristics of a telecom company is an almost total degree of physical integration. The Network is a massively interconnected web of hardware and software that defies most forms of segmentation. It serves all customers, on demand, all of the time. However, from an operating perspective, companies the size of Bell tend to be organized in a highly fragmented way, generally along lines of technical or functional expertise. Over time this seems to produce a culture that creates its own domains of "turf", despite the clear interdependence of the plans and actions of the various groups. We have come to speak of "Silos of Expertise."

The danger, of course, for both managers and modelers, is that things can get badly out of sync, especially under conditions of rapid change and increasing uncertainty, both of which Bell faces. We have come to realize that the single greatest value our effort delivers is the maintenance of an integrated view, achieved largely at the expense of limiting operational detail. We discovered two types of disconnects or dis-integration. First, most silos (such as finance, business development/strategy, marketing, and technology planning) could not glean the strategically important nuggets of information from the other silos—that information was either buried or not

articulated. Second, no silo (except finance) could reliably translate strategic proposals and information into financial terms that were comparable across silos and proposals.

Distributed validation is delegated down the hierarchy

Given the diversity of participants, we had our collective noses rubbed in a basic fact of human nature: *People get comfortable with model results and the modelers by validating in the way that they usually validate things, not in the way that we (as System Dynamics modelers) think they should.* In this context we speak of validation in the broadest possible terms: Getting comfortable with the entire process and chain of reasoning that stretches from initial inquiries to final recommendations. So here, "validation" encompasses comfort with model structure, behavior, response to policies, and analysis and sensitivity testing of recommendations.

On a positive note, we learned that validation involving a very large number of people proceeds within the corporation like most tasks involving a very large number of people: The top level adds as much value as they can quickly in person, and delegates the rest to lower levels in the corporate hierarchy. Specifically, we found ourselves validating for top level executives (e.g., the COO) by implicitly providing answers for these questions:

1. Does it match what I know (e.g., top-level financial results and projections)
2. Do the modelers behave like they know what they're talking about?
3. Does it make the same "top level" assumptions within the range of plausibility (e.g., rate of demand growth, pricing policies, character of competitors, etc.)
4. Have experts within the company looked at the work and agreed that their part is valid?

This is almost the reverse of the way that a System Dynamics modeler would go about validating. Virtually all of the earlier validations that lead up to replicating known data are absent: Little if any understanding of cause-and-effect relationships. No extreme condition testing, no exploration of behavior modes, no in-depth analysis of why the policy results come to be. Such validation criteria aren't on the executive radar screen.

Finance representatives followed roughly the same pattern of validate-and-delegate. In fact, for one particular analysis, we were preparing to be audited by Bell's external auditors, who likewise used validate-and-delegate. Historical behavior of financial results needed to track known actuals closely. Other validation tended to be checking that standard financial ratios (debt/equity, depreciation reserve, and operating ratios like unit costs) showed plausible movement into the future. Delegation of validation was either to other modeling and projections that had been audited, or to subject matter experts qualified to "sign off" on the future behavior and the underlying assumptions.

Subject matter experts were the ultimate delegatees, being counted on to supply or review assumptions about specific topics such as technology planning, competitor capabilities and intentions, consumer response, regulatory matters, and even employee morale. With respect to validation, subject matter experts behaved most like System Dynamics modelers (indeed some were modelers, although with Excel-based models). They participated in checking a rich body of verbal knowledge against quantifiable relationships. Like the executives, they checked assumptions at a level of detail with which they were comfortable. We deliberately stayed one or two levels of abstraction above actual model equations. In some cases, we showed causal diagrams of, for example, our understanding of how price cap regulation would work. Likewise (to another group), we described our understanding of how product attractiveness changed market share over time, and

what drives product attractiveness. However, there was no great demand to see details of the behavior, or even to see how the causal relationships linked into feedback loops.

The paradigm of validate-and-delegate probably seems obvious in retrospect. Indeed, we generally managed to deliver to each of these groups what they needed to validate the model. But a modeler's human nature is forever drawing him or her back to projection—the viewpoint that "everyone is like me." So regardless of our experience level, we all need reminding from time to time that people are going to validate pretty much as they always have, and SD modelers had better give them what they need to do so.

Tuning to Data Validates the Model and the Modelers

Traditional system dynamics practice emphasizes validation through qualitative duplication of behavior modes, as opposed to closely duplicating the timing and magnitude of specific movements in real data.[6] Regardless of the roots of this particular belief, it often transmutes in practice to a disdain for working with real data.

To the contrary, we have found working with real data indispensable. Goodness of fit to data is the dominant validation critereon of virtually all managers. Consider: Bell, like many other organizations, has urgent strategy issues yet has no provocative high-level reference modes. No oscillations, no puzzling cluster of apparently contradictory behaviors. Nothing at a high level that would compel an executive to get comfortable with a model by virtue of generating the same unique behavior mode. So a more detailed approach to behavior validation is needed, using data.

Perhaps more importantly, working with data describing behavior at widely scattered points in the system means that virtually no major event in the historical period will be unnoticed and not understood by the modeling team. In turn, this means that the modeling team is able to talk about not only the important trends in the company and industry, but the important events and their repercussions. The modelers are able to speak with executives and subject matter experts and know what they're talking about. This validation through trust in the modeler—just like trust of any employee—is an important ingredient in achieving acceptance of the results.

"Silo" Stakeholders Pull toward Dynamically Minor Issues

There is at least one pitfall to "distributed validation" that we explored in depth. We very much wanted a wide base of support within the company, given the scope of the model and the issues. In briefing various operating groups on the new analysis capabilities we envisioned, we continually asked what the important issues they saw were. We started doing fast-turnaround analyses for various groups, by making parameter changes in the model to approximate some of the strategies (implying policy changes) being considered.

In retrospect, a "demand pull" strategy was an inefficient way of discovering the policies that significantly improve overall corporate performance, even though we seem to have generated much goodwill. We usually just reconfirmed the traditional wisdom of System Dynamics that most policies have little effect.[7]

Especially in a regulated monopoly, there is a strong tradition of focus on single-silo, operational issues—this is what people considered most important. Yet the model generally found few potential gains in purely "operational" changes. Moreover, of the strategies currently being discussed, one is widely recommended by industry experts and the business press, and it has the single most negative impact we found. On the other side of the same coin, we did identify strategies that have a major impact on the value of the firm, over 30 percent of cashflow-based

company value. Of those strategies, only one has a strong executive champion behind them at present. If X, Y and Z are the strategies that matter, there's no "Vice President of X or Y."

6. The "Waterfall" Paradigm Breaks Down

In the academic System Dynamics literature, modeling what software developers would call a "waterfall" paradigm: begin with a problem statement, then build a model, then do policy analyses. Iterate each stage as necessary, and report out (or publish) only at the end. The modeling stage starts off with a simple model, and iterates by looking at the behavior, and discussing it to reveal the shortcomings in the mental models of which the simulation model is a reflection. Thus, modeling causes the participants, managers and modelers alike, to internalize a series of insights about the issues being analyzed.

A drawback to this "waterfall" approach is that bringing the model up to snuff is a drawn-out process, limited by availability of management participants. The model is judged valid for drawing conclusions only at the end of the study. Consequently, this participative, ground-up modeling was incompatible with the scope and schedule with which we were faced.

In the Bell work, as in most high-stakes, commercial modeling efforts, the timeline is neither lengthy or simple. There are multiple strategy questions, and defining which problems are important is part of the exercise. Deadlines for some results get set from on high that are not possible to change: The regulators will announce the new regime May 1. The Board of Directors has demanded a first statement of strategic direction by such and such a time. Oops, the Executive Committee wants it two weeks earlier than that for review.

On a more tactical level, the COO has made time on his calendar—What can we show him that's new? Executives often have had expectations set by more traditional consulting operations that heavily emphasize fact-finding and conceptual re-framing. Such consulting operations, unlike SD modelers, do not spend calendar time developing or changing the analytical (simulation) engine. So the more common and expected consulting practice is to show new results frequently, often weekly.

Unfortunately, an SD model may be in a state of flux for several weeks while making major architectural changes. For example, we made significant changes to explicitly represent wholesaling unbundled services. While making the changes, the model runs were worse-fitting than older runs.

In brief, then, the demand for model results has two conflicts with the simple "waterfall" modeling process: some results were needed quite quickly, and a diversity of results were needed frequently thereafter. So we abandoned the classroom model-building process.

Fast Start from an "Off-the-Shelf" Framework

The solution to a compressed schedule was to start, not from scratch, but from a pre-existing generic framework for modeling a telecom company. This framework, called SMS Telecom, is fundamentally a generic integration of previous modeling work. It had formulations for everything described above in some form. So for example, the mechanisms were in place for price regulations for both the old regime of rate-of-return pricing, and price caps. So we only needed to refine the existing formulations to represent the range of likely regulatory decisions.

One very desirable feature of starting from a generic framework is that information requirements were known from the outset, so that model calibration could start within weeks, and roughly realistic simulations could start within a couple of months. Thereafter, the refinements reflected the unique features of the Canadian market, rather than refining model formulations.

Contrary to traditional wisdom that "you can't model the whole system" we have already done so, at least for the details that "most people consider most important"[8] In sharp contrast to the previously abandoned attempts to model the business on an integrated basis, the SD model is surprisingly economical. Despite weighing in at roughly 40,000 effective equations the model code occupies about one-third of a single floppy disk, an order of magnitude smaller than earlier efforts. Despite the relative compactness, the framework is sufficiently general that most strategy alternatives can be pre-tested with fairly simple parameter changes, often in "real time." If the results seem encouraging, more detailed and elaborate modeling can be pursued.

Multiple Models for Frequent Delivery of Results

To ensure continuous availability for "command performances" (and fast-turnaround analyses), we maintained two separate model development tracks. One track made incremental improvements (and often minor recalibrations) and was almost continuously available. The other track was where the major architectural work was done. Periodically, we would duplicate a batch of incremental changes in the re-architected model and recalibrate it to form a new, unified point of departure for a new pair of parallel development tracks.

In addition, at one point a deadline moved up, and the older "backup" model couldn't be used—it didn't have the structure in place to estimate the capital investment required to upgrade capacity to utilize new technologies. In this particular case, we decided to create a third stream of backup--a "mini-model" whose output we could use as input to the full "backup" model to get something close to what we needed. Of course, the simple model (of only capacity levels) assumed no feedback from the speed of upgrade back to the ability to make capital expenditures. But in this particular situation we judged such feedback should not have a first-order impact on dynamics. Later full simulations justified this assumption. Making the assumption was a risk, but riskier still was having no answers at all by the time answers were needed.

Was having three models going at once extra work? Of course, at least directly. But it's not clear that total effort was increased: The "mini-model" was useful in debugging the full, re-architected model, by creating a numerical point of comparison that facilitated detection of a subtle error in the capacity pricing formulations.

Having broken with orthodox modeling practices in several ways, we should add that the team model development and waterfall paradigms still seem to be good pedagogy. But by analogy to baseball, everyone is taught to catch the ball with two hands. Major league players will do this when possible, but will catch one-handed or bare-handed if the alternative is not making the catch.

7. Where We're Going

The ultimate goal of our work (now named "The Polaris Initiative" after the use of the North Star for directional guidance) is to embed the disciplines of systemic thinking across management ranks so that the benefits of feedback-informed decision making can make a tangible and sustained contribution to Bell's overall performance. As is the case for simple management teams that develop models, achieving this goal requires that the company's executive management share the same (correct) mental model of the dynamics of their businesses, and how their individual functions play out within those dynamics.

In many respects, the first year of work represents a first pass in many dimensions, and the ensuing work requires more of the same, but at an expanded depth of analysis and participation.

Achieved during the first year	To do in the next pass
Verified that the "distributed team" validation process will work	Continue the refinement and validation process to an initial completion, where stakeholders have the opportunity to see the full trail from assumptions to strategy recommendations
Gained goodwill and acceptance of the idea of integrated strategy analysis	Getting Polaris into the hands of management, with extensive communication, documentation, and wargaming capability. Defuse perceptions of the model as a "black box."
First-round strategy analysis on what's important and not	Systematic search for leverage points, as in Pugh-Roberts' MasterCard analysis.[9]
Backup role in Regulatory analyses, and called on for strategy analysis on an *ad hoc* basis	Role as an "informed second opinion" in strategy development and performance improvement initiatives. Create demand for focused single-team studies closer to the SD ideal for collaborative team-based modeling.

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1 Forrester, Jay W., *Urban Dynamics* (Portland, Oregon: Productivity Press, 1969, Preface)

[2] Vennix, Jac A.M., *Group Model Building: Facilitating Team Learning Using System Dynamics*, (Chichester: John Wiley & Sons, 1996)

[3]For a good sampling of the current state of practice in the System Dynamics field, see Vennix, Jac A. M., David F. Andersen, and George P. Richardson, "Special Issue on Group Modeling," *System Dynamics Review* 13(2), Summer, 1997

[4] Ackoff, Russel, *Creating the Corporate Future*, (New York: John Wiley, 1981)

[5] Shiba, Shoji, Alan Graham, and David Walden, *A New American TQM: Four Practical Revolutions in Management* (Portland, OR: Productivity Press, 1993, pp. 384-7). See also Kanter, Rosabeth Moss, *The Change Masters* (New York: Simon & Schuster, 1983), and Bushe, Gervase R. and A. B. Shani, *Parallel Learning Structures* (Reading, Mass.: Addison-Wesley, 1991).

[6] Forrester, Jay W., *Industrial Dynamics* (Portland, Oregon: Productivity Press, 1961, pp. 119-121)

[7] For example, *Urban Dynamics, Op Cit.*, pg. 110: "With a high degree of confidence we can say that the intuitive solutions to the problems of complex social systems will be wrong most of the time."

[8] Forrester, Jay W., "System Dynamics in the elevator"(SD1152). Posting to the SD mailing list 10/22/97.

[9] Rather than simply evaluate extant suggestions for strategic direction, one can first search the model for high leverage points, and with knowledge of which small number of points in the system have high leverage, actively seek strategies that influence those leverage points. For example, another Pugh-Roberts team used this type of analysis for the MasterCard association of credit card-issuing banks. The analysis lead to MasterCard's pioneering use of co-branded credit cards (for example, a GM credit card issued by a bank). MasterCard reversed a long decline in market share, increasing over 25% in three years following that innovation, due almost completely to co-branding, which in turn was brought into serious consideration only through model-based systematic leverage point search.