Walking the thin line
Reflections of a professional modeler

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Written for the *liber amicorum* of Jac Vennix

Introduction: the story of the hidden hexagon

Some time in the mid-nineteen nineties, Jac Vennix told me, shocked and fuming, his recent experience with a mutual acquaintance, a consultant active in the field of organizational learning: …*and you know what he did during the hexagon brainstorming [a once very popular version of the Nominal Group Technique method of brainstorming] session with the group? He had kept in his back pocket a carefully prepared hexagon. When it became time to do the clustering of the brainstorm items, he put this self-fabricated hexagon in the center and grouped the other items around his own theme. Can you imagine!*
Indeed, sneaking in your own opinion in a setting where you are claiming that you are just facilitating the expressions of other people's opinions would count as unethical behavior for most people. On the other hand, also without hiding your own hexagon up your sleeve, it is impossible for a facilitator *not* to impose his or her own preconceptions on the group process, consciously or unconsciously. I assume that Jac's outrage was not caused so much by the clear effort of this consultant to steer the group in a certain direction, but rather by his attempt to do so disguised as a sincere group facilitator, rather than a closet expert consultant.
It is common knowledge that there are, broadly speaking, two opposing camps in the world of business consulting: the process consultants and the expert consultants. The process consultants claim that the mode of operations of the expert consultants is ineffective, because it takes away ownership from both the problem analysis and the proposed solutions, and without ownership there will be little commitment to change, and without commitment, there will be no implementation (Akkermans and Vennix 1997). The expert consultants, on the other hand, will claim that the process consultants are ineffective because the very reason that clients ask for help is they are aware that they lack certain skills and expertise, and want the consultant to be the expert providing those. The process consultants resemble coaches that make you perform better, the expert consultants role model is that of the surgeon who operates on you to make you better. Few surgeons are great coaches, few coaches are skilled surgeons.
However, is there really such a big and fundamental difference in modeling as between coaches and surgeons? And, if there is, does it matter? Back during my Ph.D. student years under Jac, back in the time of Jac's Group Model-Building, it mattered a great deal, also in the system dynamics community. There was something of a controversy between the system dynamics modelers operating more as expert consultants and those that operated more as process consultants, or at least group facilitators. Over the last quarter century, I have met many people from both camps, and have worked as a professional modeler in a wide variety of real-world modeling settings, with very different characteristics. I have worked in projects mostly in expert mode and mostly in process mode, and these modeling engagements have both been successful and unsuccessful. So, what's my personal assessment, twenty-five years later? This paper contains some personal reflections on this question, based on an eclectic set of eleven cases and an equal number of lessons from those. To frame these anecdotal reflections, the next section contains a generic framework to look at system dynamics modeling assignments and consulting roles.

The changing role of the modeler in the modeling process

System dynamics modeling studies come in many varieties. This paper reflects on a particular kind of study, which is a commercial consulting engagement for a specific client, where the external modeler is the lead responsible for the quality of the system dynamics model and also the facilitator of the group model-building sessions, thereby combining the so-called *model coach* and *process coach* roles (Richardson et al. 1992, Akkermans 1995a). These engagements all share (a) a generic modeling process, (b) a generic project stakeholder composition and (c) a generic distribution of expertise / leadership per stakeholder group per modeling process stage.

a. A generic modeling engagement process

Before we move to specific experiences from specific modeling engagements, it may be helpful to provide a more generic organizing framework for professional modeling engagements. In many aspects, using system dynamics modeling to help a group to tackle a complex issue resembles a product or software development process.

First there is the *scoping* of the issue; then there is a two-stage design process, moving from basic and *conceptual design* to more detailed and *technical design*. In system dynamics modeling, there tends to be a separate stage after the model is technically at such a level of detail and maturity that the reference behavior of the issue under investigation is adequately reproduced. This is the stage of *policy analysis*. When the modeling effort has reached a systemic understanding of a thorny issue, it becomes highly desirable that options to improve performance are systematically analyzed. The next stage is *Communication*, in this case communication with the broader group of affected parties. And the proof of the pudding remains in *Implementation*.

b. Typical stakeholders in the modeling process

Generically speaking, there are at least four stakeholders that together form the natural project composition for modeling engagements. The core project team is composed of (1) the modeler (or modelers), who is typically (2) supported by staff from the client organization(s). The (3) line managers of the organizations dealing with the issue are not the core team, but it is their in-depth knowledge of parts of the issue coming from dealing regularly with its symptoms are also essential for project success. These managers are also often crucial for successful implementations of the recommendations. Last but not least there is (4) the project sponsor, often someone from higher management.

c. Varying roles of stakeholders across process stages

Figure 1 shows these stages and stakeholders. What is also shown here is a personal assessment of the distribution of expertise, and hence also of leadership, per stage. The curved line can be read as the shift between the facilitator and the expert role as the engagement enfolds that seems appropriate to me.
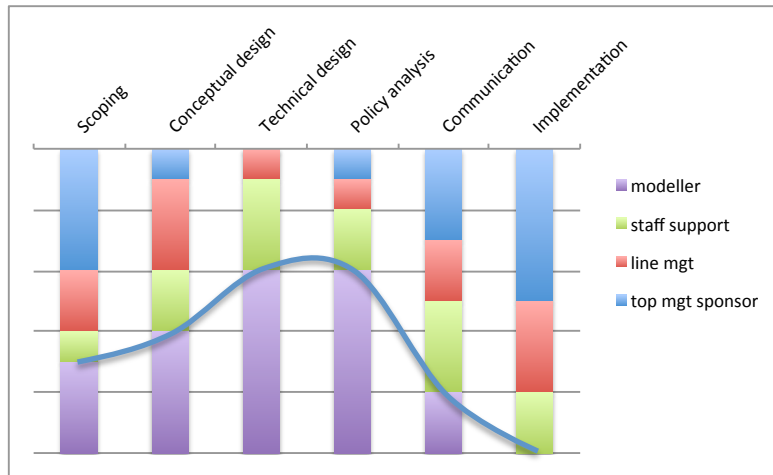
Figure 1: Distribution of expertise and lead in the modeling engagement process

In the *scoping phase*, the top management sponsor's opinions are leading. The sponsor knows what the issue at stake is, defines it and allocates resources to address the issue. The modeler has a significant influence in this stage, because he/she knows what the "sweet spot" of system dynamics modeling, is, e.g. the right level of abstraction (the "policy level", as Forrester (1961) put it, or the right system boundary (e.g., including customers and suppliers).

In the *conceptual design phase*, the modeler's role becomes even more dominant. At first this might seem odd, since the modeler is clearly the stakeholder with the lowest level of domain knowledge. However, how to translate a real-world, messy problem into a high-level diagram, preferably a stocks and flow diagram to facilitate subsequent quantification, requires special skill and training. In this stage, this skill level is essential to create a shared mental map of the issue through one or more group model-building sessions (Vennix 1996, Akkermans and Vennix 1997).

The dominance of the modeler role in the *technical design phase* is obvious. Making a robust system dynamics simulation model of a real-world setting is a specialized skill. Another important role in this stage is played by the internal staff, who are essential in providing specific parameter values, values that are typically not provided during the conceptual modeling phase. Top management does not play a role in this stage.

Top management has some influence in deciding what scenarios are to be investigated in the *policy analysis* stage, but primarily this is the domain of the modeler and the support staff, who by now know quite well where the "interesting" parts of the model and its behavior can be found, and so also what scenarios are most interesting to carve out. Top management resumes its central stage position during *communication* and especially *implementation*. Here the modeler gradually withdraws. By now, ownership of the model and its findings, welcome or not, should have been built up internally, ideally with all three internal stakeholders since top management and line management and staff will need each other to translate the modeling project effort into the regular business processes.

Please note that the description just given is a stereotype, that every organization and every modeling effort is different. Nevertheless, this simplified picture does represent the modeling engagements described in the remainder of this text rather well.

A quarter century of modeling engagement experiences

This section looks back on a quarter century of modeling engagements, drawn rather eclectically from a much broader range of experiences of "modeling with managers" (Akkermans 1995). The first case goes back to 1991, the implementation of case eleven is still ongoing in 2016. From these cases specific lessons relevant to the choice of consulting style and its impact on engagement success are drawn.

Case 1: A lucky start (1991)

In the summer of 1991, while continuing to work part-time on my Ph.D. at TU Eindhoven, I joined a company that specialized in developing decision support systems for managers. My first assignment there was a lucky start. A company that distributed international newspapers in the Netherlands had just moved to a new central distribution location but it could not get its newspapers to the hundreds of sales outlets throughout the company in time. Perhaps a simulation model could help? This turned out to be a fortuitous choice of method.

The team I worked with consisted of the logistics managers and some of his supporting staff. We managed to come up with a whole series of practical recommendations, based on a variety of analyses, which all came together in a relatively simple, system dynamics simulation model of the distribution supply chain. Communication of these insights to the project sponsor, who kept a low profile during the project, and the company owner, who also was, as a self-made man, an expert op operations issues, was successful. Implementation went ahead the year afterwards, resulting in the saving of several millions of back then guilders, according to the project member.

So, a clear business success and for me personally an entry card into the business consulting world and also into academia, as the case study that I wrote on the basis of this project was presented at the 1992 Utrecht conference of the System Dynamics conference, organized by Jac Vennix's group there. Subsequently, this paper got accepted in an operations management journal without any problems as well (Akkermans 1993).

Lesson 1: Use, together with the team, any technique to gain insights, and use, as a modeler, the model to integrate these

My main lesson from this case is that the SD modeling effort is only a part of the entire problem-solving process. Together with the team, we also used Pareto analysis and even time-and-method studies of various materials handling techniques. Data collection also included direct observation during the night at the distribution center. A modeler-centric view of the world would say that such analyses are there to feed the model with empirical data. A client-centric view might suggest that the models main role is to *integrate* a number of separate findings into one integrated whole. Throughout the entire analytical process, we obtained insights. The simulation model made it possible to put everything together. The SD modeling effort was performed in expert mode; problem structuring and specific analyses were done as a team effort, with modeler, staff and line management working side by side.

Case 2: Learning the ropes (1992)

The second case took place one year later and was a completely different setting. Now, Jac Vennix was the group facilitator and I operated as model coach, back-then student assistant Etienne Rouwette as the recorder of the sessions (Akkermans et al. 1993, Vennix et al. 1996). Also very different from Case 1, this case dealt with a very "soft" issue and no attempts were made to quantify the model; there were just the group model-building sessions.

The topic we addressed was the apparent lack of collaboration between a number of business units from one IT services company, and root causes for that lack, as well as longer-term consequences of that lack of collaboration. Our group model-building sessions with the managers of the company, where I learned the ropes from observing Jac's facilitation of the

group, were quite successful in explaining where the lack of collaboration came from and what detrimental consequences this would have longer term, also for the managers involved. What we were not successful in was in finding clear solutions for this problem, quite unlike the situation in the previous case.

Lesson 2: There is no harm in you as the modeler not finding clear solutions, if line management understands the root causes of the problems

This leads to the main finding from this case. From my engineering background, I felt the need to come up with clear "answers" for "decisions". We didn't. However, what did change considerably as a result from this intervention is that the behavior of the managers themselves changed completely. Collectively, they came from one specific region of the country, where BU competition had been strong prior to the project. After this project, this region started to collaborate quite well and successfully, because the directors themselves were convinced of the shortsightedness of their competitive actions. So, if the line managers themselves become really convinced that they are part of the problem, this may lead a long way into the solution of the problem.

Case 3: The soft issues are the hard ones (1994)

Two year later I led a consulting assignment with a big retail bank that was concerned about the adverse long-term effect on customer revenue from closing smaller branch offices, which would reduce operational costs in the short run. Here, a large group of managers and internal staff were led through a series of group model-building sessions. Carefully, the group, which contained a lot of expertise on a very broad, complex and "soft" issue, converged on a very much simplified version of the problem, which nevertheless contained all the essential parts to support decision-making. Obviously, I was not an expert in retail banking, and we stayed in a clear process-facilitation role. Nevertheless, in the conceptual modeling a drive to arrive at a clear conceptual representation that would lend itself to quantification did help in arriving at the core of the issue (Akkermans 1995b).

Lesson 3: Without expert domain knowledge, a modeler's drive to arrive at conceptual clarity can be effective in zooming in on the core issues without taking ownership away from the domain experts

This is then also the main lesson from this assignment. You don't have to be the expert to guide a group into what an expert will recognize as the core of the issue.

Case 4: Understanding the moving parts (1995)

Shortly before my Ph.D. at TU Eindhoven in 1995, with Jac Vennix as one of my three advisors, I was headhunted by a major consultancy to come and work for them as an expert system dynamics modeler. My first major assignment brought me to Chicago, where I worked alongside the late Nat Mass, who was my system dynamics mentor during this time. Our client was a telecom company undergoing major fluctuations in its service supply chain.

What struck me in the current context was that the project sponsor appeared genuinely interested in "understanding how the moving parts work together" for the business process she was responsible for. This also helped that Nat and myself were not too worried in presenting a working simulation model, which I had developed with guidance from Nat on the basis of two group model-building sessions led by Nat, which contained quite some provocative behaviors and insights. Where I personally thought that the behavior that the model displayed was really too "wild", including a virtual "meltdown" of some of its facilities, our group of line managers actually thought that this was precisely the behavior they had seen in the past (Akkermans and Vos 2003).

This is then also the key insight from this particular case. We were never the domain experts, and the model exposed quite some flaws in process design, but since the primary focus was set on understanding what happened rather than on blaming people for what happened, this engagement was a success and also led to a change in business practices afterwards.

Case 5: In the pits (1995)

Shortly afterwards I went through an engagement that was quite unsuccessful but perhaps with the same root cause at work. Here the client was a big electronics company that faced problems during production ramp-ups. Nat had convinced the sponsor that it would be good to check some of the policies that he had in mind with a simulation model. There were no group model-building sessions, no interviews with company management, just sessions with fellow consultants with experience within this company. Moreover, the messages that we delivered were quite unwelcome for the sponsor. These included the ineffectiveness of using quality gates between production stages (see also Akkermans and van Oorschot 2016) and the potential benefits of feeding back quickly findings from root cause analysis of flaws with discarded machines that were allocated in "the pit" to upstream production. The sponsor had different ideas about these items, and when a typo somewhere halfway the report was spotted, this was reason enough to discard the entire modeling effort. So, Lesson 5 reads somewhat as the opposite of Lesson 4:

Lesson 5: Low involvement + unwelcome message = abrupt end of modeling engagement

Case 6: Three is not a crowd (2000)

Some years later was the first modeling engagement with clients coming from different organizations, from a three-echelon supply chain in high-tech electronics. (Akkermans et al. 2004). The purpose of this model was to aid in some supply chain design issues that this network of companies was facing. This supply chain was experiencing a great deal of volatility, and the management intuition was that it would be beneficial to engage all parties in a joint supply chain planning process. I facilitated multiple supply chain mapping exercises with all the parties involved, not from an explicit system dynamics perspective but certainly from a systemic and integral perspective.

Then one of the key sponsors asked if a simulation model could confirm or falsify the assumption that information sharing would lead to less volatility. Basically by combining and then modifying existing building blocks from John Sterman's *Business Dynamics* (2000), I could construct a simulation model within a few weeks that indeed clearly confirmed this managerial intuition at a moment when clear answers about who to involve and with what intensity was a crucial supply chain design issue. Amongst other, the model analysis suggested that an active involvement of the middle part of the supply chain would be highly beneficial; indeed three would *not* be a crowd (Akkermans et al. 2011).

Lesson 6: A high-level model can inform the sharp client quickly

The main takeaway from this case in the current context is that even a high-level model that addresses the right questions in a timely way can inform a sharp client quickly and can be of high use. So, again the conceptual modeling was a collaborative effort and the technical modeling happened in expert mode, but the sustained and intrinsic interest of top management in the progress and outcomes made implementation successful.

Case 7: Worse before better (2002)

In 2002, a branch of an insurance conglomerate focusing on providing legal aid to consumer clients wanted help in developing and validating a Balanced Scorecard (Akkermans and van Oorschot 2005). This engagement I conducted together with Kim van Oorschot, who acted as the model coach here while I played the process coach role (and perhaps did a little QA in the modeling process, while Kim was still a budding SD modeler at that time). Here again we were blessed with a strong and sharp sponsor, who saw the need to think "out of the box" with his management team of long-time industry insiders.

Again, conceptual modeling was side-by-side with the domain experts from line management and technical modeling was mainly an affair of us modelers with the support staff from the client organization. One of the more difficult messages from the policy analysis phase was that our projections for the future suggested this would be a "worse-before-better" case. So, despite the good work of the management team in developing a validated and balanced management scorecard, performance would still first deteriorate in the year ahead before it would gradually improve. And again, the fact that we had a strong sponsor who was intrinsically interested in understanding the content and the dynamic complexity of the issue at stake, we could get this message across and expectations were set accordingly with management and employees.

A few years later our sponsor came to give a guest lecture at the university and, indeed, reality had played out as projected during the study and several of the recommendations given had been taken to hear and had led to good results.

Lesson 7: Good (management) involvement + unwelcome message = Good expectation management and implementation

So, the lesson here was that if you are as a modeler the bringer of bad news, it helps a great deal if your sponsor is not interested in hearing good news, but really just (your best attempt at) the truth, good or bad.

Case 8: Learning the hard way (2007)

A high-profile example of a situation where management did not want to hear the truth, but just the good news, happened a few years later when a telecom company introduced a new service but shoot itself in the foot by ramping up far too optimistically, not unlike the two cases discussed earlier on from 1995. After a public outcry had forced top management to stop advertising the new service altogether, a large system dynamics modeling effort was set up to do a root cause analysis of the problems and come up with good solutions. The root cause analysis during the conceptual model building was extensive, involving over 100 management and staff in four separate large group model-building sessions. Technical design and policy analysis once again went in expert mode with modelers and support team and led to a fairly large and sophisticated simulation model (Akkermans and van Oppen 2007).

Some of the top management sponsors of the modeling effort were really interested in the findings. Not all of them were. However, all the recommendations from the policy analysis pointed in the same direction, not so differently from the telecom study I did in 1995: quality of the orders and their processing would have to be improved, if not all other measures would fail. That sounded simple, safe and sound enough. And agreements were made to fix these quality issues now that the order load was minimal. And yet, some time later, when the order intake was ramped up again, it became clear that most of the quality issues had not been solved in a fundamental way. The existing culture simply was one where selling was appreciated; fixing technical issues or, even worse, preventing issues from happening, was not.

Lesson 8: A model with a simple message running counter to the existing culture will be appreciated but not implemented

This brings me to the lesson from this case: even if you lead a score of managers through a group model-building process, even if the subsequent technical modeling is extensive and sound, even if the resulting message from all this is simple, all this may not lead to successful implementation if this message runs against the existing culture and existing managerial incentives.

Case 9: Tipping points (2013)

A later case with the same telecom company, but in a different area, was very different in almost every respect. This was not a consulting assignment but a research effort together with my Ph.D. Yan Wang. There was only a small group of a handful of managers involved in the group model-building sessions. The model we made was also small. Here, there was only one sponsor and she was once more intrinsically interested in what we were trying to find out. The model predicted, to our surprise, a tipping point behavior of gradual and slow deterioration of performance, leading to a complete and sudden collapse. This was potentially threatening enough for management, but also the most promising policy we could come up with would require crossing organizational borders and therefore also managerial territories.

What was especially nice in this case was that, not only did management buy into our prediction of tipping point behavior; they also liked our far-reaching policy suggestion. Indeed, they told us: *that's nice, we actually have been doing that for the last few months and, indeed, it seems to work.*

Lesson 9: Surprise model behavior is nice, surprise real-world behavior is much better

Case 10: Serendipity management (2014)

This recent case was with an airline that was introducing a new type of aircraft, for which its workforce of pilots would have to be trained. Pilots are busy people, simulators and trainers for them are rare and expensive, formal requirements for changes in qualification are high and strict, and having excesses or shortages of either planes or pilots or both are extremely expensive. Conceptual and technical modeling was mostly done in expert mode, together with a small team of support staff. The resulting model was also fairly complex and "tightly coupled", just as the real pilot workforce aging chain was. During the policy analysis phase, top management sponsors and line management became very active and interested, also in the deeper structure and dynamics of the model we had made.

One year later, there was a related issue for which I was invited to come and use the same model for different policy analyses with the sponsors. That worked quite nicely, and again some time later the sponsor indicated that by his estimate they had already saved many millions on the basis of the insights gained by the model. That is always nice to hear, but the thing that I found especially relevant to share here, is that these insights were applied in an issue that we originally had not been seen as at the core of the problem. Rather, this was a related topic that, armed with the generic insight gained by management, could be tackled much more effectively as well.

Lesson 10: Smart clients pick up more from the modeling process than the answers to their immediate questions

Case 11: Dawn of a new era? (2015)

Transferring the insights from this last case into a regular business process is at the time of writing still ongoing, but going well indeed. This was a modeling assignment for a utility responsible for the rollout of so-called smart meters for electricity and gas usage in households. I call this the possible dawn of a new era, because my impression was that in this case, and indeed in other cases I am working on nowadays, the internal support staff is much better qualified to take over technical aspects of modeling and data analysis. Moreover, there is simply also much more relevant data available, also in time series format, also from a variety of sources.

One side effect of this is that, as a modeler, I find that every equation I put in is screened and potentially challenged, leading to quite some extra work in technical design, but also leading to a better model and more trust with the client organization in the technical soundness of the model. Another side effect is that, in such a setting, the existing staff is quite able to take the model just made and transform its structure and insights into a regular operations process, in this case a sales and operations planning process. This leads to my last lesson:

Lesson 11: When the staff support team goes the extra mile, the modeler will have to work harder but implementation of findings will be much better

Conclusion

Over twenty years ago, the question to what extend a system dynamics modeler was allowed to "lead the witness" seemed a very important one to me, not just from an ethical perspective but and also from a business implementation perspective. Now, dozens of modeling engagements later, I think the question remains nice but is really not so important. From a methodological setting, it remains impossible to observe and map a setting with real people without having an influence on them, and without having your own preconceptions playing a part in this. And during a modeling engagement, there is a natural flow as shown in Figure 1 from steering a little to steering a lot and then back to a little again. Also, in today's businesses, a new generation of data-savvy and systems-minded business analysts may be climbing the ranks, making the modeler's role a more modest one as well.

Last but not least, in the end it is much more important how intrinsically motivated and interested the project sponsors are than how many hexagons or other consulting tricks the modeler has on his sleeve. These sponsors, their managers and their staff, they are the real heroes of the modeling effort. Try to help them with all the skills and modesty you have available, is I think the best advice I can give to fellow system dynamics practitioners, after twenty-five years of trying to become a better modeler. And that remains a rather thin line to walk…

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